CITY OF SANTA ANA

COMMUNITY WORKFORCE AGREEMENT COMPLIANCE REQUIRED

CONTRACT DOCUMENTS
FOR
PROJECT NO. 23-2601

SANTA ANA ZOO EDUCATION HUB
BUILDING A - PHASE 1

PREPARED UNDER THE SUPERVISION OF:

Ali Jeevanjee — **Date** 4/1/25

20 CIVIC CENTER PLAZA
CITY HALL - ROSS ANNEX
SANTA ANA, CA 92701

SANTA ANA
PWA
PUBLIC WORKS AGENCY

Prospective bidders may obtain Bid Documents, Project Specifications and Plans via PlanetBids:
https://www.planetbids.com/portal/portal.cfm?CompanyID=20137

CITY OF SANTA ANA

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CITY OF SANTA ANA
INSTRUCTIONS TO BIDDERS
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

NOTICE INVITING BIDS

NOTICE IS HEREBY GIVEN that the City of Santa Ana will receive Bids **electronically via PlanetBids** on or before 2:00 pm, June 11th, 2025. No late bids will be accepted. No other method of bid submittal will be accepted for:

PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

All Plans and Specifications are available on PlanetBids.

For further information on how to register as a vendor refer to:

https://www.santa-ana.org/vendor-registration/

Do not call Purchasing Division regarding Public Works Agency projects.

Scope of Work: This project consists of constructing a new one-story type V-B building, new landscaping, sewer, water, electrical, plumbing, and fixed furnishings. Also includes grading, excavation, and demolition of existing brick walkways, paths, chain link fence, concrete slabs, underground telephone line, and planters.

Pre-Bid Job Meeting: There will be a Pre-Bid Job Meeting at 1801 E Chestnut Ave on Wednesday, May 14, 2025 at 1:30 p.m.

Contractor's License Requirements: From the time of City Council contract award until work completion, the Contractor shall possess a valid California Class "B" Contractor's license. All sub-contractors shall be properly licensed for their respective trades.

Public Works Construction Permit: The Contractor will be required to obtain a Public Works Construction Permit (refer to Section 2-2a, Construction Permit, of these Special Provisions). The required deposit for this permit shall be as described in the Bid Proposal.

Bid Proposal Guaranty:

- A *scanned copy* of the Bid Proposal Guaranty shall be uploaded to PlanetBids along with project bid. Bid Proposal Guaranty shall be in the form of a cashier's or certified check payable to the City of Santa Ana, or Bid Bond issued by a corporate surety, in an amount not less than ten percent (10%) of the bid aggregate, as a guarantee that the Bidder will enter into the proposed contract if the same is awarded. The signature of the bidder on the bid bond must be notarized.

- In addition to electronic Bid submittals, Bidders shall deliver an *original* hard copy of the Bid Proposal Guaranty. For further instructions regarding *original* Bid Proposal Guaranty submittal, refer to PlanetBids. **Hard copies of bid/proposal documents must now be submitted in the PWA drop-box located on the 1st floor, no one will be allowed to enter 3rd or 4th floors to submit documents.**

Failure to provide required documents with Bid may cause the bid to be deemed non-responsive.

COMMUNITY WORKFORCE AGREEMENT

For projects with bids greater than $750,000 for prime multi-trade construction contracts (including all subcontractors) or over $100,000 for specialty contracts (contracts either limited to a single trade or craft or limited to a singular scope of work), the CONTRACTOR shall adhere to the CITY'S Community Workforce Agreement (CWA). This project is considered a prime multi-trade construction contract. The CWA is a pre-hire collective bargaining agreement, which establishes the labor relations policies and procedures for CONTRACTOR to follow in the crafts persons employed to complete the WORK OF IMPROVEMENT as more fully described in the CWA. The CWA is incorporated by reference in the Construction Contract. A copy of the CWA may be found in Appendix H.

CALIFORNIA LABOR CODE

This project is subject to compliance monitoring and enforcement by the State of California Department of Industrial Relations, per Section 1771.4.a.1. BIDDERS are required to inform themselves fully of the conditions relating to construction and labor under which the work will be performed. Any contract entered into pursuant to this notice will incorporate the provisions of the California State Labor Code.

In accordance with the California State Labor Code, prevailing wage rates apply. Copies of the prevailing rate of per diem wages are on file with the Public Works Agency and shall be made available to any interested party on request.

A Contractor and any subcontractor must be registered with the Department of Industrial Relations prior to submitting a bid or otherwise have the ability to be registered prior to contract award per Section 10164 or 20103.5 of the California Business and Professions Code. "*A contractor and any subcontractor shall not be qualified to bid on, be listed in a bid proposal, subject to the requirements of Section 4104 of the California Public Contract Code, or engage in the performance of any contract for public work, as defined in this chapter, unless currently registered and qualified to perform public work pursuant to Section 1725.5. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the California Business and Professions Code or by Section 10164 or 20103.5 of the California Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.* Information about registration can be found on the Department of Industrial Relations website at

http://www.dir.ca.gov/public-works/publicworks.html

A bid will not be considered nor any contract or subcontract entered into without proof of the contractor and subcontractor's current registration to perform public work as defined in the Section of the California Public Contract Code stated above.

The California Air Resources Board (CARB) implemented amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulations (Regulation) which are effective on January 1, 2024 and apply broadly to all self-propelled off road diesel vehicles 25 horsepower or greater and other forms of equipment used in California. A copy of the Regulation is available at: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/off-roaddiesel/appa-1.pdf. Bidders are required to comply with all CARB and Regulation requirements, including, without limitation, all applicable sections of the Regulation, as codified in Title 13 of the California Code of Regulations section 2449 et seq. throughout the duration of the Project. Bidders must provide, with their Bid, copies of Bidder's and all listed subcontractors' most recent, valid Certificate of Reported Compliance (CRC) issued by CARB. Failure to provide valid CRCs as required herein may render the Bid non-responsive.

APPROVAL:

By:_____ Date: 5/1/2025

Nabil Saba, P.E.
Executive Director, Public Works Agency

The California Air Resources Board (CARB) implemented amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulations (Regulation) which are effective on January 1, 2024 and apply broadly to all self-propelled off road diesel vehicles 25 horsepower or greater and other forms of equipment used in California. A copy of the Regulation is available at: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/off-roaddiesel/appa-1.pdf. Bidders are required to comply with all CARB and Regulation requirements, including, without limitation, all applicable sections of the Regulation, as codified in Title 13 of the California Code of Regulations section 2449 et seq. throughout the duration of the Project. Bidders must provide, with their Bid, copies of Bidder's and all listed subcontractors' most recent, valid Certificate of Reported Compliance (CRC) issued by CARB. Failure to provide valid CRCs as required herein may render the Bid non-responsive.

APPROVAL:

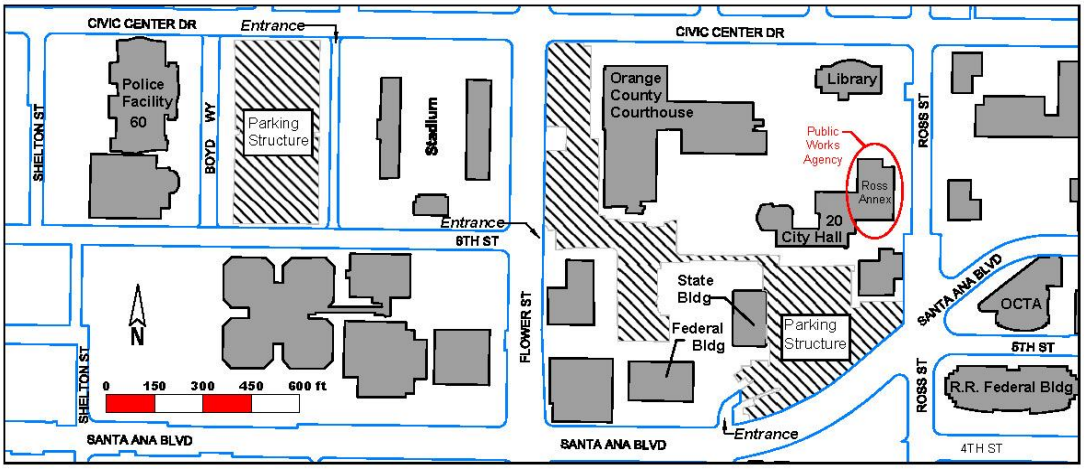
By: _____ Date: 5/1/2025

Nabil Saba, P.E.
Executive Director, Public Works Agency

MAP OF CITY HALL

Civic Center Plaza

Public Works Agency
Ross Annex
20 Civic Center Plaza
Santa Ana, CA 92701



Directions

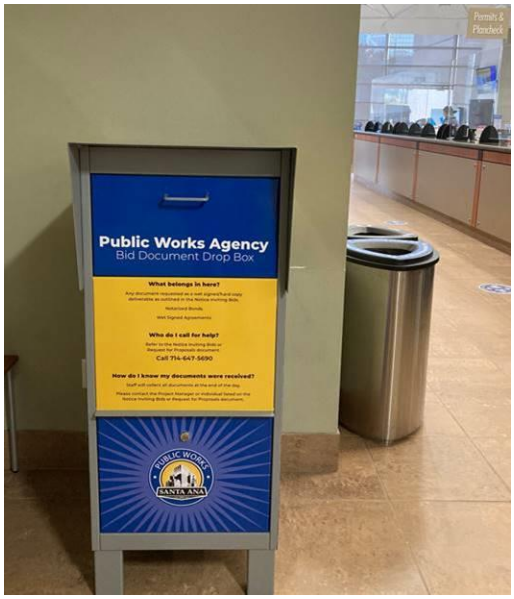
From 5 Fwy South
Exit Broadway, go South on Broadway, turn Right on Santa Ana Blvd.

From 5 Fwy North
Exit Grand Ave, turn Left on Grand Ave, turn Right on Santa Ana Blvd.

From 22 Fwy East
To I-5 South, exit Broadway go South on Broadway, turn Right on Santa Ana Blvd.

From 22 Fwy West
Exit Main St., turn Left on La Veta, turn Left on Main St., turn Right on Santa Ana Blvd.

The bid document drop box is located opposite the Public Works Development Services Counter in the Ross Annex.



INSTRUCTIONS TO BIDDERS FOR PROPOSAL SUBMISSION

INTENT OF PROPOSAL

The purpose of this Proposal is to identify a Prime Contractor to enter into a contract with the City of Santa Ana, referred to as AGENCY, to complete the Work shown on the Contract Documents.

PROPOSAL

The Proposal shall be submitted in accordance with the Notice Inviting Bids and shall be accompanied by the following documents:

1. *Bid Proposal*
2. *Bidder's Statement*
3. *Contractor's Licensing and Registration Statement*
4. *Prevailing Wage Compliance and Monitoring Statement*
5. *Ownership Affidavit*
6. *Bid Bond*
7. *List of Sub-Contractors*
8. *References*
9. *Additional References*
10. *Non-Collusion Affidavit*
11. *Non-Discrimination Certificate*
12. *Statement Regarding Apprenticeship Requirements*
13. *Statement Regarding "Anti-Kickback" Requirements*
14. *Fleet Compliance Certification*
15. *Public Contract Code Section 10162 Questionnaire*
16. *Statement Regarding Community Workforce Agreement (CWA) Requirements*

The Proposal may be considered non-responsive if any of these documents or forms is not included. The bid package shall be submitted as instructed in the Notice Inviting Bids. **It is the BIDDER'S responsibility to ensure submittal of their Proposal on PlanetBids.**

CALIFORNIA STATE LABOR CODE

As outlined in the Notice Inviting Bids, this project is subject to compliance monitoring and enforcement by the State of California Department of Industrial Relations, per Section 1771.4.a.1. BIDDERS are required to inform themselves fully of the conditions relating to construction and labor under which the work will be performed. Any contract entered into pursuant to this notice will incorporate the provisions of the California State Labor Code. Per Section 1771.4.a.2, Contractors are required to post job site notices, as prescribed by regulation.

EXAMINATION OF CONTRACT DOCUMENTS AND PROJECT SITE

BIDDERS shall satisfy themselves by personal examination of the work site, Contract Documents including the Plans and Specifications (and by any other means as they believe necessary) as to the actual physical conditions, requirements, and difficulties under which work must be performed.

DISCREPANCIES AND MISUNDERSTANDINGS

No BIDDER shall at any time after submission of a proposal make any claim or assertion that there was any misunderstanding or lack of information regarding the nature or amount of work necessary for the satisfactory completion of the job. Any errors, omissions, or discrepancies found in the Contract Documents including the Plans and Specifications shall be called to the attention of the AGENCY as a Request for Clarification and addressed prior to the submission of bid proposals.

REQUESTS FOR INTERPRETATION OF CONTRACT DOCUMENTS

Requests for interpretation must be submitted online through the PlanetBids Q&A section. Any interpretation or correction of the documents will be made only by an Addendum.

ADDENDA

All addenda issued during the open bid advertisement period will be posted on PlanetBids and shall become part of the Contract Documents. Before submitting a Proposal, each BIDDER is responsible to acknowledge the issuance of addenda via PlanetBids.

WITHDRAWAL OF PROPOSAL

A Proposal may be withdrawn by submitting a written request signed by the BIDDER. Such requests must be delivered to the AGENCY'S Public Works Agency Executive Director prior to the bid-opening hour stipulated in the Notice Inviting Bids.

BID PROTEST

Bid protests must be submitted in writing to the Executive Director of the Public Works Agency, City of Santa Ana, 20 Civic Center Plaza M-21, Santa Ana, CA 92701 before 4:00 p.m. of the 5th business day following bid opening ("Bid Protest Deadline"). A business day means a day on which the City is open for normal business and excludes weekends and holidays. Bid protests sent via U.S. mail or overnight carrier must be received by the AGENCY by the date and time limits described above in order to be deemed timely. Hand delivered protests must be provided during regular business hours to the receptionist in the City Hall Annex/Public Works Counter on the first

floor of the City Hall Annex. Subsequent responses from the protesting and protested bidder can be submitted by email. Bid protests must comply with the following:

a. **Bid Protest Fee.** Any potential protest shall be required to submit the Bid Protest Fee Payment Form (Appendix G) and include the payment of a nonrefundable fee by the protesting bidder at the time of submittal. The fee will cover the administrative costs of processing the bid protest consistent with the Santa Ana Municipal Code relating to administrative appeals (SAMC Section 3-3.) This fee shall be in the amount of $2,026.

b. **General.** Only a bidder who has submitted a bid proposal is eligible to submit a bid protest against another bidder. Subcontractors are not eligible to submit bid protests. A bidder may not rely on the bid protest submitted by another bidder, but must timely pursue its own protest.

c. **Contents of Protest.** The bid protest must contain a complete statement of the basis for the protest and all supporting documentation. Material submitted by the protesting bidder after the Bid Protest Deadline will not be considered. The protest must refer to the specific portion of the Contract Documents upon which the protest is based. The protest must include the name, address, e-mail address, and telephone number of the person representing the protesting bidder if different from the protesting bidder.

d. **Copy to Protested Bidder.** By or before the Bid Protest Deadline, the party submitting the bid protest shall concurrently transmit a copy of the bid protest document to the protested bidder and any other bidder who has a reasonable prospect of receiving an award depending on the outcome of the protest.

e. **Response to Protest.** The protested bidder may submit a written Response to the Bid Protest within two business days after the Bid Protest Deadline or after actual receipt of the bid protest, whichever is sooner ("Response Deadline"). The Response to the Bid Protest must include all supporting documentation. Material submitted after the Response Deadline will not be considered. The Response to the Bid Protest must contain the name, address, e-mail address, and telephone number of the persons representing the protested bidder if different from the protested bidder.

f. **Copy to Protesting Bidder.** A copy of the Response to the Bid Protest and all supporting documents must be concurrently transmitted by the protested bidder to the protesting bidder and any other bidder who has a reasonable prospect of receiving an award depending upon the outcome of the protest.

g. **No Hearing on Bid Protests based on Non-Responsiveness.** No hearing shall be required for bid protests based on lack of responsiveness.

h. **Exclusive Remedy.** The procedures and time limits set forth above are mandatory and are the bidder's sole and exclusive remedy in the event of a bid protest. Protesting and protested bidder's failure to comply with these procedures will constitute a waiver of any right to further pursue a bid protest, including without limitation filing a claim under the California Government Code or the initiation of legal proceedings.

i. **Right to Award.** The City Council reserves the right to award the Contract to the bidder it has determined to be the responsible bidder submitting the lowest responsive bid, and to

issue a notice to proceed with the project notwithstanding any pending or continuing challenge to its determination.

j. **Decision on Protest.** The Executive Director of Public Works or designee will issue a written decision to the City Council on the protest, which shall also be promptly provided to all interested parties.

BID PROPOSAL

The definitions for Bid Items that are identified in the Bid Proposal form are provided in Appendix A.

The AGENCY will check each bid item unit price and amount for all the bids submitted. In case of a discrepancy between the correct product of the quantity multiplied by the unit price and the subtotal amount entered by the BIDDER, the correct unit price shall prevail and the product will be correctly accordingly.

In case of a discrepancy between the correct sum of the individual subtotal amounts and the total bid amount entered by the BIDDER, the correct sum shall prevail. If a unit price is not legible or is missing, the amount for that contract bid item shall be divided by the quantity to arrive at the unit price. The bid total shall be corrected and the results shall be considered as representing the bidder's intention. Proposals in which the prices are obviously unbalanced may be rejected.

If a Bid contains discrepancies that make it difficult or impossible to determine the bidder's intention, then such Bid may be considered unresponsive, in which case the bid may be rejected.

TIME FOR COMPLETION OF IMPROVEMENTS AND LIQUIDATED DAMAGES

The time for completion of this project, and the liquidated damages amount when/if the time for completion is exceeded, is included in the Bid Proposal Section of these Contract Documents.

BIDDERS STATEMENT

In accordance with Section 7028.15(e) of the Business and Professions Code, a licensed contractor shall not submit a bid to the public agency unless his or her contractor's license number appears clearly on the bid, the license expiration date is stated, and the bid contains a statement that representations made therein are made under penalty of perjury. Any bid not containing this information or a bid containing information, which is subsequently false, shall be considered non-responsive and shall be rejected by the public agency. Format for these statements are included in the Bid Proposal section of these Contract Documents.

In accordance with the Section 3300 of the California Public Contract Code, the Agency has determined that the BIDDER shall possess a license in the classification specified in the Notice Inviting Bids.

OWNERSHIP AFFIDAVIT

An Ownership Affidavit is required to be completed and submitted with the Bid Proposal. A form is provided in the Bid Proposal section of these Contract Documents.

PROPOSAL GUARANTY

Each bid shall be accompanied by a Proposal Guaranty as instructed in the Notice Inviting Bids AND PlanetBids. A sample Bid Bond is included in the Bid Proposal Section of these Contract Documents.

LIST OF SUB-CONTRACTORS

The State of California Public Contract Code requires listing of all subcontractors who intend to perform work which is ½ % of the bid or $10,000 (streets, highways and bridge projects), whichever is greater, or ½ % of the bid (buildings, parks, or other projects). A form for this information is provided in the Bid Proposal section of these Contract Documents.

REFERENCES/ADDITIONAL REFERENCES

BIDDER shall include a list of three public agencies for which BIDDER has performed similar work within past three (3) years, and three public agencies for which BIDDER and/or his Subcontractor has performed similar work within the past five (5) years. A form for this information is provided in the Bid Proposal section of these Contract Documents.

NON-COLLUSION AFFIDAVIT

In accordance with Title 23 United States Code Section 112 and Public Contract Code 7106, the AGENCY shall require all bidders to execute and submit a non-collusion affidavit with the Bid Proposal. A copy of the Non-Collusion Affidavit is provided in the Bid Proposal section of these Contract Documents.

NON-DISCRIMINATION CERTIFICATE

Attention is directed to Section 1735 of the California Labor Code, as added by Chapter 643, Statutes of 1939, which reads as follows:

"No discrimination shall be made in the employment of persons upon public works because of the race, religious creed, color, national origin, ancestry, physical handicap, medical condition, marital status, or sex of such persons except as provided in Section 1420, and every contractor for Public Works violating this Section is subject to all penalties imposed for a violation of the Chapter."

A copy of the Certification of Nondiscrimination by Contractors is provided in the Bid Proposal section of these Contract Documents.

STATEMENT REGARDING APPRENTICESHIP REQUIREMENTS

Bidders shall be familiar with the requirements of Section 1777.5 of the California State Labor Code regarding employment of apprentices and shall submit a Statement Regarding Apprenticeship Requirements with the Bid Proposal. A copy of the Statement is provided in the Bid Proposal section of these Contract Documents.

STATEMENT REGARDING "ANTI-KICK-BACK" REQUIREMENTS

Bidders shall be familiar with, and shall agree to comply with, the Copeland "Anti-Kickback" Act (18 USC 74) as supplemented in the Department of Labor regulations (29 CFR, Part 3), and shall submit a Statement Regarding "Anti-Kickback" Requirements with the Bid Proposal. A copy of the Statement is provided in the Bid Proposal section of these Contract Documents.

FLEET COMPLIANCE CERTIFICATION

The City is a Public Works Awarding Body, as defined under Title 13 California Code of Regulations section 2449(c)(46). Accordingly, Bidders must submit, with their Bids, valid Certificates of Reported Compliance (CRC) for the Bidder's fleet and for the fleet(s) of its listed subcontractors (including any applicable leased equipment or vehicles). Bidder must additionally complete and submit the Fleet Compliance Certification, included in the Bid Documents. Failure to provide a CRC for the Bidder, and for all listed subcontractors, or failure to complete the Fleet Compliance Certification, may render the Bid non-responsive.

CONSTRUCTION CONTRACT AGREEMENT, BONDS & INSURANCE

The Construction Contract Agreement, Sample Bonds and Insurance Requirements are all included as appendices in the project Contract Documents.

Following authorization by City Council to award a Construction Contract, written notification will be given by the AGENCY to the successful BIDDER who will, within ten (10) business days, submit to the Agency the completed and signed Construction Contract Agreement, a Performance Bond, a Payment Bond, and evidence of Worker's Compensation Insurance.

Failure to execute a contract and submission of acceptable bonds and insurance as provided herein within the time limit above may be just cause for the annulment of contract award and the forfeiture of the bid proposal guarantee.

No contract shall be binding upon the AGENCY until it has been completely executed by the Contractor, approved by the City Attorney, and executed by the AGENCY.

After the AGENCY executes the Contract and approves the bonds and certificates of liability insurance, the AGENCY will send the successful BIDDER a copy of the fully executed Construction Contract Agreement.

RETURN OF PROPOSAL GUARANTIES

Within ten (10) days after the award of the contract, the AGENCY will return the proposal guaranties, other than Bid Bonds, except any guaranties that have been forfeited.

CITY OF SANTA ANA

PROPOSAL

PROJECT NO.: 23-2601

SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

BID PROPOSAL

TO: CITY COUNCIL OF THE CITY OF SANTA ANA

FROM: _____

REQUIREMENT:

The undersigned bidder declares that they have carefully examined the location of the proposed work, that they have examined the Contract Documents in its entirety and hereby proposes to furnish all material and do all the work required to complete the said work in accordance with said plans (if any) and the specifications for the unit price(s) or lump sum(s) set forth in the following schedule:

Item	Description	Qty	Unit	Unit Price	Amount
1	Santa Ana Zoo Education Hub Building A (Contractor to provide Schedule of Values)	1	LS	$	$
2	Advertisement Sign	1	LS	$	$
3	Construction Permit	1	LS	$	$

CITY OF SANTA ANA
PROPOSAL
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

TOTAL BASE BID	$

The lowest responsible bidder shall be selected based on the total base bid. The City reserves the right to award the Base Bid, and any, all, or none of the add-alternate bid items (if any).

* The quantity for this bid item is shown for bid comparison only. This bid item shall not be subject to the "25%" limit as stated in Section 7-3.5 of the Standard Specifications. The actual amount for this item will be dictated by the actual quantity used, and the Agency reserves the right to increase or decrease the quantity of this item accordingly.

† This bid item is considered a Specialty Item per Section 3-2 of the Standard Specifications.

TIME FOR COMPLETION OF IMPROVEMENTS AND LIQUIDATED DAMAGES

The undersigned bidder hereby proposes to complete the Work for the total base bid amount shown above, within Two Hundred Fifty (250) working days after the commencement date stated in the Notice to Proceed. Upon issuance of the Notice to Proceed, Contractor shall immediately place order for long-lead time items.

The liquidated damages amount, in lieu of the amount specified in Subsection 6-9 of the Standard Specifications, shall be $8,000.00 per calendar day.

Name of Firm _____

Signature of BIDDER _____

Title _____

(If an individual, so state. If a firm or co-partnership, state the firm name and give the names of all individual co-partners composing the firm. If a corporation, state legal name of corporation, and names of President, Secretary, Treasurer and Manager, thereof.)

BIDDER'S STATEMENT

BIDDER understands and agrees that this Bid Proposal, Contract Documents and subsequent Construction Contract Agreement shall constitute the entire agreement between BIDDER and the AGENCY only after it has been accepted by the City Council, endorsed by the Clerk of the Council with her signature and official seal noting hereon the action of approval of the Council, signed by the Public Works Agency Executive Director or his/her duly authorized agent, and signed by the City Attorney, denoting his approval of the form of this document, and its execution, and when it or an exact copy of it has been either delivered to BIDDER or deposited with the United States Postal Service properly addressed to the BIDDER with the correct postage affixed thereto.

BIDDER further agrees that upon delivery (as defined above) of the accepted agreement he/she will furnish AGENCY all required bonds and certificate of liability insurance within ten (10) business days or the funds, check, draft, or BIDDERS bond substituted in lieu thereof accompanying this proposal shall become the property of the AGENCY and shall be considered as payment of damages due to the delay and other causes suffered by AGENCY because of the failure to furnish the necessary bonds and because it is distinctly agreed that the proof of damages actually suffered is difficult to ascertain; otherwise said funds, check, drafts, or BIDDER'S bond substituted in lieu thereof shall be returned to the undersigned.

BIDDER understands that a bid is required for the entire work, the estimated quantities set forth in the bid schedule are solely for the purpose of comparing bids, and that final compensation under the contract will be based upon the actual quantities of work satisfactorily completed. The BIDDER also certifies that the bid is a balanced bid.

In accordance with Section 7028.15 of the California Business and Professions Code, the undersigned certifies under penalty of perjury that the foregoing is true and correct.

Name of Firm _____

Signature of BIDDER _____

Title _____
(If an individual, so state. If a firm or co-partnership, state the firm name and give the names of all individual co-partners composing the firm. If a corporation, state legal name of corporation, and names of President, Secretary, Treasurer and Manager, thereof.)

CONTRACTOR'S LICENSING AND REGISTRATION STATEMENT

The undersigned contractor, or corporate officer, declares under penalty of perjury that he/she and all his/her subcontractors are registered with the State of California Department of Industrial Relations (DIR), and that the following is true and correct.

Contractor's Name: _____

Business Address: _____

Business E-Mail Address: _____

Telephone: _____

State Contractor's License No. and Class: _____

License Expiration Date: _____

State Dept. of Industrial Relations (DIR) Registration No.: _____

State Dept. of Industrial Relations (DIR) Registration Expiration Date: _____

Signed: _____

Title: _____

PREVAILING WAGE COMPLIANCE AND MONITORING STATEMENT

Contractor is aware of the requirements of California Labor Code Section 1720, et seq., as well as California Code of Regulations, Title 8, Section 16,000, et seq., ("Prevailing Wage Laws"), which require the payment of prevailing wage rates and the performance of other requirements on "public works" and "maintenance" projects. Since the services are being performed as part of an applicable "public works" or "maintenance" project, as defined by the Prevailing Wage Laws, and since the total compensation is $1,000 or more, Contractor agrees to fully comply with such Prevailing Wage Laws.

City shall provide Contractor with a copy of the prevailing rates of per diem wages in effect at the commencement of this Agreement. Contractor shall make copies of the prevailing rates of per diem wages for each craft, classification or type of worker needed to execute the services available to interested parties upon request, and shall post copies at the Contractor's principal place of business and at the project site.

Contractor shall defend, indemnify and hold the City, its elected officials, officers, employees and agents free and harmless from any claim or liability arising out of any failure or alleged failure to comply with the Prevailing Wage Laws.

The undersigned certifies that the foregoing is true and correct.

Name of Firm _____

Signature of BIDDER _____

Title _____
(if an individual, so state)

CITY OF SANTA ANA
PROPOSAL
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

OWNERSHIP AFFIDAVIT

STATE OF CALIFORNIA)
COUNTY OF ORANGE) SS:
CITY OF SANTA ANA)

_____ , being duly sworn, deposes and says:

☐ INDIVIDUAL — That he/she is the party making the foregoing proposal:

☐ PARTNERSHIP — That he/she is a member of the co-partnership firm designated as:

_____

_____

and who has been and is duly vested with the authority to make and execute instruments for the co-partnership by:

_____

_____

who constitute the other members of the co-partnership.

☐ CORPORATION — That he is of:

_____

_____

a corporation which is making the foregoing proposal:

☐ JOINT VENTURE — That he is of:

_____

_____

one of the parties making the foregoing proposal as a joint venture, and the he/she has been and is duly vested with the authority to execute instruments for an on behalf of the parties making said bid who are:

_____

_____

that such a bid is genuine and not collusive or sham, and has not in any manner sought by collusion to secure any advantage against the City of Santa Ana or any person interested in the proposed contract, for himself or any other person.

_____
Signature of Bidder

Subscribed and sworn to before me this _____ day of _____ 20 ___

_____
Signature of officer Administering Oath (Notary Public)

CITY OF SANTA ANA
PROPOSAL
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

BID BOND

KNOW ALL PRESENT that,
_____ , as BIDDER, and
_____ , as SURETY,
are held and firmly bound unto the CITY OF SANTA ANA, as AGENCY, in the penal sum of __ _____ Dollars ($_____), which is ten percent (10%) of the total amount bid by BIDDER to AGENCY for the above-stated project, for the payment of which sum, BIDDER and SURETY agree to be bound, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that, whereas BIDDER is about to submit a bid to AGENCY for the above-stated project, if said bid is rejected, or if said bid is accepted and a contract is awarded and entered into by BIDDER in the manner and time specified, then this obligation shall be null and void, otherwise it shall remain in full force and effect in favor of AGENCY.

IN WITNESS WHEREOF the parties hereto have set their names, titles, hands, and seal this _____ day of _____ , 20___.

BIDDER*

_____

_____

SURETY*

_____

_____

Subscribed and sworn to before me _____ this _____ day of _____ , 20___.

Signature: _____

Notary Public in and for the County of _____ , State of _____

* Provide BIDDER/ SURETY name, address, and telephone number and the name, title, address, and telephone number of authorized representative.

CITY OF SANTA ANA
PROPOSAL
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

LIST OF SUB-CONTRACTORS

Section 4100 et. seq. of the Public Contract Code requires listing of all subcontractors with the bid for all subcontract work exceeding the following amount:

- Streets, highways including bridge projects: ½% of the bid or $10,000, whichever is greater
- Buildings, parks, or other projects: ½% of the bid

Section 1725.5 of the Public Contract Code requires all Subcontractors be registered with the State Department of Industrial Relations (DIR).

BIDDER proposes to subcontract certain portions of the work to the firms listed below:

Name _____
License #/Exp. _____
DIR Reg. #/Exp. _____
Location _____
Phone _____
Type Of Work _____
Amount $ _____

Name _____
License #/Exp. _____
DIR Reg. #/Exp. _____
Location _____
Phone _____
Type Of Work _____
Amount $ _____

Name _____
License #/Exp. _____
DIR Reg. #/Exp. _____
License # _____
Location _____
Phone _____
Type Of Work _____
Amount $ _____

Name _____
License #/Exp. _____
DIR Reg. #/Exp. _____
License # _____
Location _____
Phone _____
Type Of Work _____
Amount $ _____

Name _____
License #/Exp. _____
DIR Reg. #/Exp. _____
License # _____
Location _____
Phone _____
Type Of Work _____
Amount $ _____

Name _____
License #/Exp. _____
DIR Reg. #/Exp. _____
License # _____
Location _____
Phone _____
Type Of Work _____
Amount $ _____

_____
Signature of Bidder

REFERENCES

The following are the names, addresses, and telephone numbers for **THREE** public agencies for which the BIDDER has performed similar work within the past three years.

1. _____
Name and Address of Owner.

_____
Name and Telephone Number of person familiar with project.

_____ _____ _____
Contract Amount Type of Work Date Completed

2. _____
Name and Address of owner.

_____
Name and Telephone Number of person familiar with project.

_____ _____ _____
Contract Amount Type of Work Date Completed

3. _____
Name and Address of owner.

_____
Name and Telephone Number of person familiar with project.

_____ _____ _____
Contract Amount Type of Work Date Completed

The following are the names, addresses, and telephone numbers of all brokers and sureties from whom BIDDER intends to procure insurance and bonds.

_____

_____

_____

_____

ADDITIONAL REFERENCES

The following are the names, addresses, and telephone numbers for **THREE** public agencies for which the BIDDER or Subcontractor has performed similar work in the past five years.

1. _____
   Name and Address of Owner.

   _____
   Name and Telephone Number of person familiar with project.

_____	_____	_____
Contract Amount	Type of Work	Date Completed

2. _____
   Name and Address of owner.

   _____
   Name and Telephone Number of person familiar with project.

_____	_____	_____
Contract Amount	Type of Work	Date Completed

3. _____
   Name and Address of owner.

   _____
   Name and Telephone Number of person familiar with project.

_____	_____	_____
Contract Amount	Type of Work	Date Completed

NON-COLLUSION AFFIDAVIT

(Title 23 United States Code Section 112 and Public Contract Code Section 7106)

In conformance with Title 23 United States Code Section 112 and Public Contract Code 7106 the BIDDER declares that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the BIDDER has not directly or indirectly induced or solicited any other BIDDER to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any BIDDER or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the BIDDER has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the BIDDER or any other BIDDER, or to fix any overhead, profit, or cost element of the bid price, or of that of any other BIDDER, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the BIDDER has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

Note: The above Non-collusion Affidavit is part of the Proposal. BIDDERS are cautioned that making a false certification may subject the certifier to criminal prosecution.

Signed _____

State of California
County of _____

Subscribed and sworn to (or affirmed) before me on this _____ day of _____, 20__, by _____, proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me

_____
Notary Public Signature

Notary Public Seal

NON-DISCRIMINATION CERTIFICATE

The undersigned contractor or corporate officer, during the performance of this contract, certifies as follows:

1. The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without, regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

2. The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

3. The Contractor shall send to each labor union or representative of workers with which he/she has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the Contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

4. The Contractor shall comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

5. The Contractor shall furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his/her books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation, to ascertain compliance with such rules, regulations, and orders.

6. In the event of the Contractor's non-compliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, the contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Execution Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulations, or order of the Secretary of Labor, or as otherwise provided by law.

7. The Contractor shall include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontract or purchase order as the administering agency may direct as means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the Contractor may request that the United States enter into such litigation to protect the interests of the United States.

8. Pursuant to California Labor Code Section 1735, as added by Chapter 643 Stats. 1939, and as amended, no discrimination shall be made in the employment of persons upon public works because of race, religious creed, color, national origin, ancestry, physical handicaps, mental condition, marital status, or sex of such persons, except as provided in Section 1420, and any contractor of public works violating this Section is subject to all the penalties imposed for a violation of the Chapter.

Signed: _____

Title: _____

Firm: _____

Date: _____

STATEMENT REGARDING APPRENTICESHIP REQUIREMENTS

The undersigned BIDDER is familiar with the requirements of Section 1777.5 of the State Labor Code regarding employment of apprentices, and understands that contractors on contracts exceeding $30,000 or 20 working days shall:

1. Apply to the joint apprenticeship committee administering the apprenticeship standards of the craft or trade in the area of the site of the public work for a certificate approving the contractor under the apprenticeship standards for the employment and training of apprentices in the area or industry affected.

2. Employ the number of apprentices or the ratio of apprentices to journeymen stipulated in the apprenticeship standards.

3. Contribute to the fund or funds in each craft or trade in which he/she employs journeymen or apprentices on the public work, in the same amount or upon the same basis and in the same manner as the other contractors, except contractors not signatory to the trust agreement shall pay a like amount to the California Apprenticeship Council.

Signed: _____

Title: _____

Firm: _____

Date: _____

STATEMENT REGARDING "ANTI-KICKBACK" REQUIREMENTS

The undersigned is submitting this proposal for performing by contract the work required by these bid documents, agrees to comply with the Copeland "Anti-Kickback" Act (18 USC 74) as supplemented in the Department of Labor regulations (29 CFR, Part 3). This act provides that each contractor or subcontractor shall be prohibited from inducing, by any means, any person employed in the construction or repair of public work, to give up any part of the compensation to which he/she is otherwise entitled.

Signed: _____

Title: _____

Firm: _____

FLEET COMPLIANCE CERTIFICATION

Bidder hereby acknowledges that they have reviewed the California Air Resources Board's policies, rules and regulations and are familiar with the requirements of Title 13, California Code of Regulations, Division 3, Chapter 9, effective on January 1, 2024 (the "Regulation"). Bidder hereby certifies, subject to penalty for perjury, that the option checked below relating to the Bidder's fleet, and/or that of their subcontractor(s) ("Fleet") is true and correct:

The Fleet is subject to the requirements of the Regulation, and the appropriate Certificate(s) of Reported Compliance have been attached hereto.

The Fleet is exempt from the Regulation under section 2449.1(f)(2), and a signed description of the subject vehicles, and reasoning for exemption has been attached hereto.

Bidder and/or their subcontractor is unable to procure R99 or R100 renewable diesel fuel as defined in the Regulation pursuant to section 2449.1(f)(3). Bidder shall keep detailed records describing the normal refueling methods, their attempts to procure renewable diesel fuel and proof that shows they were not able to procure renewable diesel (i.e. third party correspondence or vendor bids).

The Fleet is exempt from the requirements of the Regulation pursuant to section 2449(i)(4) because this Project has been deemed an Emergency, as defined under section 2449(c)(18). Bidder shall only operate the exempted vehicles in the emergency situation and records of the exempted vehicles must be maintained, pursuant to section 2449(i)(4).

The Fleet does not fall under the Regulation or are otherwise exempted and a detailed reasoning is attached hereto.

Name of Bidder: _____

Signature: _____

Name: _____

Title: _____

Date: _____

PUBLIC CONTRACT CODE SECTION 10162 QUESTIONNAIRE

In conformance with Public Contract Code Section 10162, the BIDDER shall complete, under penalty of perjury, the following questionnaire:

Has the BIDDER, any officer of the BIDDER, or any employee of the BIDDER who has a proprietary interest in the BIDDER, ever been disqualified, removed, or otherwise prevented from bidding on, or completing a federal, state, or local government project because of a violation of law or a safety regulation?

Yes _____ No _____

If the answer is yes, explain the circumstances in the following space.

STATEMENT REGARDING COMMUNITY WORKFORCE AGREEMENT (CWA) REQUIREMENTS

This is to certify that the undersigned BIDDER, and subcontractors, have read and understood the CWA entered into by and between the City of Santa Ana, the Los Angeles/Orange Counties Building and Construction Trades Council, and the signatory Craft Councils and Local Unions, effective as of June 6, 2023.

The undersigned BIDDER hereby agrees to comply with all terms and conditions of the CWA, and is capable of completing construction of the project continuously, and without interruptions or delays. If awarded any work covered by the CWA, BIDDER will also be required to sign the Letter of Assent that appears as Attachment A to the CWA.

The undersigned BIDDER has reviewed the Public Works Construction Permit and required deposit described in Section 2-2a and the Notice of Inviting Bids.

Signed: _____

Title: _____

Firm: _____

Date: _____

FORWARD

The Standard Specifications is the 2018 edition, including all supplements at time of bid, of the Standard Specifications for Public Works Construction, including supplements and accompanying Standard Plans, written and promulgated by Public Works Standards, Inc. These Standard Specifications shall control the general provisions, construction materials, and construction methods for this contract, except as amended by the Contract Documents.

The following General Provisions are supplementary and in addition to the provisions of the Standard Specifications, unless otherwise noted. The section and subsection numbering system used in these General Provisions corresponds to that used in the Standard Specifications.

The State of California Department of Transportation Standard Specifications, Standard Plans, and Manual on Uniform Traffic Control Devices, latest edition at time of bid of each, are incorporated herein by reference and are hereby accepted as Reference Specifications. These Reference Specifications are intended to govern certain construction materials, methods, and details except as modified herein or are inconsistent with the provisions herein.

PART 1 - GENERAL PROVISIONS

SECTION 1 - GENERAL

1-2 TERMS & DEFINITIONS

Add the following to this subsection:

Acceptance – The formal written acceptance by the Agency of the completed project.

Agency – City of Santa Ana

Approved Equal –material or product that has been reviewed and approved by the Engineer as similar and equal in all respects and acceptable for use in lieu of that specified.

Approved, Required, Directed – or words of similar import, refer to and indicate that the work or materials shall be "approved," "required," or "directed" by the City of Santa Ana or its duly authorized representative.

Board – City Council of the City of Santa Ana

Bid Proposal – see Bid

City – City of Santa Ana

City Council – The body constituting the awarding authority of the City, namely the City Council of the City of Santa Ana.

Contract Documents – In addition to items specified in the Standard Specifications, Contract Documents shall also include all Appendices as referenced and/or included.

Contractor – The person or persons, co-partnership or corporation, private or municipal, who have entered into contract for this work as parties or party of the second part of his or her legal representatives.

Department – City of Santa Ana Public Works Agency.

Due Notice – A written notification, given in due time, of a proposed action where such notification is required by the contract to be given a specified interval of time (usually 48 hours or two working days) prior to the commencement of the contemplated action. Notification may be from City to Contractor or from Contractor to City.

Engineer – The Executive Director of the Public Works Agency of the City of Santa Ana or his/her authorized representative

Laboratory – Any laboratory of a public agency or a recognized commercial testing laboratory.

Owner – City of Santa Ana

Prompt – The briefest interval of time required for a considered reply, including time required for approval by a governing body.

1-3 ABBREVIATIONS
1-3.2 Common Usage
Add the following to this subsection:

Abbreviation	**Word or Words**
CA MUTCD	California Manual on Uniform Traffic Control Devices
CCPR	Cold Central Plant Recycling
CIR	Cold In-Place Recycling
CIREAM	Cold In-Place Recycling Expanded Asphalt Mix
DCP	Dynamic Cone Penetrometer
EAS	Emulsion-Aggregate Slurry
HDB	Hydrostatic Design Basis
JITT	Just-In-Time Training
NPDES	National Pollutant Discharge Elimination System
PACP	Pipe Assessment & Certification Program
REAP	Rain Event Action Plan
REAS	Rubberized Emulsion Aggregate Slurry
SSPWC	Standard Specifications for Public Works Construction
TEES	Transportation Electrical Equipment Specifications

1-3.3 Institutions
Add the following to this subsection:

Abbreviation	**Word or Words**
AGC	Associated General Contractors of America
APWA	American Public Works Association
ASA	American Standards Association

CALTRANS .....California Department of Transportation
FHWA.....Federal Highway Administration
FRA.....Federal Rail Administration
FTA.....Federal Transit Authority
NASSCO.....National Association of Sewer Service Companies
OCSD.....Orange County Sanitation District
OCTA.....Orange County Transportation Authority
SCG.....Southern California Gas Company
SCE .....Southern California Edison Company

1-6 BIDDING AND SUBMISSION OF THE BID
1-6.2 Subcontractor Listing
Add the following to this subsection:

The Prime Contractor agrees to pay each Subcontractor under this prime contract for satisfactory performance of its contract no later than 10 days from the receipt of each payment the Prime Contractor receives from AGENCY.

The Prime Contractor agrees further to release retainer payments to each Subcontractor within 30 days after the subcontractor's work is satisfactorily completed.

1-7 AWARD AND EXECUTION OF CONTRACT
1-7.1 General
Add the following to this subsection:

The award of the contract, if it is awarded, will be to the lowest responsive, responsible BIDDER whose proposal complies with all requirements described. The award, if made, will be made within 60 working days after the opening of the bids.

No proposal shall be considered binding upon the AGENCY until the execution of the contract by the AGENCY.

The date of the contract shall be the date the contract is executed by the AGENCY.

The AGENCY reserves the right to waive minor irregularities in their consideration of the award of the bid. The award, if made, shall be by mutual consent in writing of the parties signatory to the contract. Alterations or deviations, increases or decreases, additions or omissions, in the plans and specifications may be made and the same shall in no way affect or make void the contract.

1-7.2 Contract Bonds
Add the following to this subsection:

The bonds shall be executed by the successful BIDDER and returned within ten (10) business days after the successful BIDDER has received notice that the contract has been awarded. Each bond shall incorporate, by reference, the contract and shall be signed by both the BIDDER and Surety. The signatures of the BIDDER and the authorized agent of the Surety shall be notarized.

Failure to file acceptable bonds as provided herein within ten (10) business days, after the successful BIDDER has received notice that the contract has been awarded, shall be just cause for the annulment of the award and the forfeiture of the proposal guaranty.

SECTION 2 - SCOPE OF THE WORK

2-1 WORK TO BE DONE

Add the following to this subsection:

The City utilizes construction management (CM) software to manage construction projects. The current software platform is Procore. The contractor shall be required to interface with the CM software for all aspects of construction, including, but not limited to, schedule, submittals, RFIs, contract documents, inspections, and progress payments. The City will provide the contractor's representatives access to the system.

Where the manufacturer of any material or equipment provides written recommendations or instructions for its use or method or installation (including labels, tags, manuals or trade literature), such recommendations or instructions shall be compiled and delivered to the City prior to project acceptance.

2-2 PERMITS

Add the following to this subsection:

The contractor shall comply with all Federal, State or local laws, ordinances, or rules and regulations related to the performance of the work, which include but are not limited to the following:

a. Construction Permit. Contractor shall obtain a Construction Permit prior to the start of construction work. The Permit Fee shall be an estimated cost of the time and material required by the City to provide labor oversight. The Contractor shall be required to provide a valid California State Contractor's License, Santa Ana Business License, Certificate of Insurance and to pay the Permit Fee (refer to current PWA Miscellaneous Fee Schedule), at time of Construction Permit issuance. The permit will be issued by Public Works based upon the approved plans and specifications, and the Construction Contract awarded by the City.

   The Bid Proposal contains a bid item that reflects the total amount required for the Permit Fee. The Permit Fee may be paid by the Contractor at the time of permit issuance. However, the Contractor has the option to fulfill the payment before the second progress payment is made by the City. Failure to comply with the deposit requirement by the second progress payment may result in enforcement actions taken against the Contractor.

   The final Construction Permit cost shall be the true cost of the time and material expended by the City to provide labor oversight and shall be the total amount determined at the completion of construction. If the effort to provide labor oversight exceeds the Permit Fee amount, the Contractor shall pay the City the amount due prior to releasing retention due to Contractor.

b. Business License. Each Prime Contractor and Subcontractor shall obtain and pay for a Santa Ana Business License. Detailed information concerning business license may be obtained from the Finance and Management Services Agency, (714) 647-5447, City Hall. The fees for this license are separate from the Construction permit bid item.

c. Construction Water Permit. Each Prime Contractor or Subcontractor which desires to obtain water from AGENCY-owned fire hydrants for construction or any other purpose shall first obtain and pay for a permit from the Corporate Yard of the City of Santa Ana, at 220 South Daisy Avenue. Information concerning costs and conditions may be obtained from the AGENCY by calling (714) 647-3320. Use of private water from a hose bib is not allowed. The fees for this permit are separate from the Construction permit bid item.

   For safety reasons, the AGENCY will not allow Contractor to stretch construction water hoses across open traffic lanes. Where required, Contractor shall use water truck.

d. Disposal Permit. In accordance with the procedures of the Orange County General Services Administration (GSA), the cost for the disposal of all materials at County landfill sites shall be borne by the Contractor.

e. Building and Electrical Permits. For projects involving building, structural construction, traffic signal or irrigation controller installation, the Prime Contractor shall obtain the necessary building and electrical permits from the Planning & Building Agency. There will be no fees for these permits.

f. State Division of Industrial Safety Permits. In accordance with Section 6500 of the State Labor Code, permits are required for all excavations, which are five feet or deeper, or for all structures being built or demolished, which are more than three stories high.

All permits and fees required by all other Agencies having jurisdiction over any part of the work shall be obtained and paid for by the Contractor, unless otherwise noted on the Plans or in the General Provisions.

2-3RIGHT-OF-WAY
Add the following to this subsection:

When the contractor arranges for temporary use of private property for additional work areas and facilities required for the Contractor's convenience, to meet requirements, or other reason(s), the Contractor shall provide the City with written agreement authorizing use of said property.

2-5 THE CONTRACTOR'S EQUIPMENT AND FACILITIES
2-5.1 General
Add the following to this subsection:

Pursuant to the authority contained in Section 591 of the Vehicle Code, the Department has determined that, such areas as are within the limits of the project and are open to public traffic, the Contractor shall comply with all the requirements set forth in Divisions 11, 12, 13, 14 and 15 of the Vehicle Code. Attention is directed to the statement in Section 591 that this Section shall not relieve him or any person from the duty of exercising due care. The Contractor shall take all

necessary precautions for safe operation of his/her equipment and the protection of the public from injury and damage from such equipment.

Contractor shall comply, and shall ensure all subcontractors comply, with all applicable requirements of the most current version of the regulations imposed by California Air Resources Board (CARB) including, without limitation, all applicable terms of Title 13, California Code of Regulations Division 3, Chapter 9 and all pending amendments (Regulation).

Throughout the Project, and for three (3) years thereafter, Contractor shall make available for inspection and copying any and all documents or information associated with Contractor's and its subcontractors' fleets including, without limitation, the Certificates of Reported Compliance (CRCs), fuel/refueling records, maintenance records, emissions records, and any other information the Contractor is required to produce, keep or maintain pursuant to the Regulation upon two (2) calendar days' notice from the City.

Contractor shall be solely liable for any and all costs associated with compliance with the Regulation as well as for any and all penalties, fines, damages, or costs associated with any and all violations, or failures to comply with the Regulation. Contractor shall defend, indemnify and hold harmless the City, its officials, officers, employees and authorized volunteers free and harmless from any claims, liabilities, costs, penalties or interest arising out of any failure or alleged failure to comply with the Regulation.

2-8 EXTRA WORK
Add the following to this subsection:

The contractor shall proceed with extra work only upon written order from the Engineer.

2-10 DISPUTED WORK
Delete the first paragraph and replace it with the following:

If the Contractor considers any work demanded of him to be outside the requirements of the contract, or if he considers any instruction, ruling or decision of the Engineer to be unfair, he shall within ten days after any such demand is made or instruction, ruling or decision is given, file a written protest with the Engineer, stating clearly and in detail his objections and reasons therefore. Except for such protests and objections as are made of record, in the manner and within the time above stated, the Contractor shall be deemed to have waived and does hereby waive all claims for extra work, damages, and extensions, rulings and decisions of the Engineer.

Upon receipt of any such protest from the Contractor, the Engineer shall review the demand, instruction, ruling or decision objected to and shall promptly advise the Contractor, in writing, of his final decision, which shall be binding on all parties, unless within the ten working days thereafter the Contractor shall file with the Executive Director of the Public Works Agency of the City of Santa Ana a formal protest against said decision of the Engineer. The Executive Director of the Public Works Agency of the City of Santa Ana shall consider and render a final decision on any such protest within 30 days of receipt of same.

SECTION 3 - CONTROL OF THE WORK

3-5 INSPECTION
Add the following to this subsection:

City inspection occurs during construction working hours. Inspection work requested by the contractor outside of the prescribed working hours shall be paid by the contractor at the City's overtime rate.

3-7 CONTRACT DOCUMENTS
3-7.1 General
Add the following to this subsection:

The Contractor shall maintain a control set of plans and specifications within Procore at all times throughout the construction period. As approved by the Engineer, all final locations determined in the field and any deviations from the plans and specifications shall be marked in red on this control set to show the As-Built conditions. Updates to the control set shall be submitted to the Engineer prior to each monthly progress payment. Upon completion of all work, the Contractor shall submit the control set As-Built Plans and report to the Engineer through Procore. Additionally, the Contractor shall provide the following:

Street Improvements: Any deviations from the contract plans such as: alignments, and appurtenance locations shall be noted (drawing sketch) on the control plan and a copy submitted to the Engineer no later than (5) working days from the occurrence.

Storm Drain Improvements: Any deviations from the contract plans such as: alignments, elevations, modifications to pipe/structures sizing/material. Contractor shall also provide CCTV inspection recordings/videos in format required by Engineer.

Sewer Improvements: Any deviations from the contract plans such as: alignments, elevations, modifications to pipe/structures sizing/material. Contractor shall also provide CCTV inspection recordings/videos in format required by Engineer.

Water Improvements: Any deviations from the contract plans such as: alignments and appurtenance locations shall be noted (drawing sketch) on the control plan and a copy submitted to the Engineer no later than (5) working days from the occurrence.

Traffic Improvements: Any deviations from the contract plans such as: location of poles, pull boxes and runs, depth of conduits, number of conductors, and other appurtenant work, for future reference.

Within (15) days of completion of all work, the Contractor shall submit the control set of as-built plans to the Engineer. **Final payment will not be made until this requirement is met.**

3-8 SUBMITTALS
Add the following to this subsection:

All submittals shall be delivered by the preconstruction meeting through PROCORE. Each individual submittal shall include a submittal transmittal listing the minimum information; the project number, a submittal number, submittal subject, specification number, paragraph number, number of pages and a brief description reference.

Purchase Order/Shipping Records. The Contractor shall maintain records of deliveries showing the Contractor's order number, purchase order number, and equipment item number. Labeling or shipping tags shall be included in the records. The records shall be furnished to the Engineer for review if so requested.

3-10 SURVEYING
3-10.1 General
The following supersedes the provisions of this subsection:

The Contractor shall be responsible for directly obtaining the services of a California Licensed Land Surveyor to be in responsible charge of all survey work performed under this contract.

The Contractor shall be responsible for the scheduling of all survey requests.

The Contractor's Surveyor shall provide construction staking for project improvements. A copy of the cut sheets shall be provided to the AGENCY for verification. Also a copy of all updated control set by the Contractor's Surveyor; showing coordinates, elevation, and description shall be submitted, for quality management (as-built checks by Agency).

The AGENCY will provide construction plans and specifications for the project. Construction stakes shall be set per the provided plans and specifications. The Contractor's Surveyor shall notify the AGENCY immediately of any discrepancy or design errors discovered on the plans during staking or when verifying join points.

The Contractor's Surveyor shall research existing County and City records for centerline survey monuments within the project area. Prior to construction, all monuments shall be tied-out and a Corner Record shall be recorded with the County Surveyor per Section 8771 of the Business and Professions Code of the State of California. After completion of construction, any monument disturbed or lost during construction shall be reset, in conformance with Section 8771. Each centerline intersection shall be drawn on a single Corner Record. A copy of all Corner Records shall be submitted to the AGENCY prior to a Notice of Completion being filed.

The Contractor is responsible for maintaining a safe and orderly job site per Occupational Safety and Health Administration (OSHA) standards.

The Contractor shall furnish traffic control as needed to provide a work area free of public and construction traffic for construction staking. Traffic control shall conform to the requirements of the "Watch Area Traffic Control Handbook" (WATCH). Payment for said work shall be included in the other items of work and no additional compensation will be allowed.

3-11 CONTRACT INFORMATION SIGNS
Add the following to this subsection:

Contractor shall furnish, install and maintain a project advertisement sign as detailed in the Appendix of the Contract Documents. The Contractor shall install the project advertisement sign during construction in the location approved by the Engineer. The maintenance includes replacement (if damaged due to the operations of the Contractor) and graffiti removal.

3-12 WORK SITE MAINTENANCE
3-12.1 General
Add the following to this subsection:

The contractor shall keep the work site clean and free from rubbish and debris at the end of every working day. In addition, the Contractor shall be fully responsible for removing any graffiti placed on new improvements or Contractor's equipment daily immediately at the start of the work day.

The City of Santa Ana must comply with the California Green Building Standards Code (Sections 4.408 and 5.408) which requires that most projects recycle and/or divert 65% of construction and demolition waste. Failure to comply with State laws could result in non-compliance actions.

Santa Ana Municipal Code Section 16-36 (a)(1) will ensure that construction and demolition waste generated within the City can be accounted for and recycled. The ordinance states the following,"*All construction and renovation projects subject to the requirements of the California Green Building Standards Code (CALGreen) shall be required to meet the minimum diversion requirements for all project-related C&D debris. All project contractors shall, upon project completion, provide to the executive director all project-related C&D debris collection, disposal and diversion information in the form prescribed by the executive director pursuant to section 4.408.1 and 5.408.1 of the California Green Building Standards Code, 24 CCR, Part 11 as amended."*

To achieve this diversion, the **only** company approved by the City Council to haul construction and demolition material in the City of Santa Ana is Republic Services. Please contact them to arrange for the collection and recycling of your construction debris. Your cooperation is appreciated.

Republic Services
2700 N Main Street, Suite 1000
Santa Ana, CA 92705
SantaAna@RepublicServices.com
Phone Number: (657) 467-6220

Please be advised that persons who generate solid waste on the premises may personally collect, transport, and dispose of their own solid waste providing that they do so in accordance with all governing laws and regulations and dispose of such solid waste at a site permitted by the California Department of Resources Recovery and Recycling (CalRecycle).

Persons who generate solid waste on the premises may personally collect, transport, and dispose of their own solid waste providing that they do so in accordance with all governing laws and regulations and dispose of such solid waste at a site permitted by the California Integrated Waste Management Board.

3-12.2 Air Pollution Control
Add the following to this subsection:

All organic solvents used must comply with the rules, regulations and orders of the South Coast Air Quality Management District (SCAQMD) relating to organic solvents.

3-12.3 Noise Control

The Contractor shall comply with all local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the contract. Each internal combustion engine, used for any purpose on the job or related to the job, shall be equipped with a muffler of a type recommended by the Manufacturer. The noise level from the Contractor's operations shall not exceed 95 dba at a distance of 50 feet. This requirement in no way relieves the Contractor from responsibility for complying with local ordinances regulating noise level.

The said noise level requirements shall apply to all equipment on the job or related to the job, including but not limited to trucks, transit mixers, or transient equipment that may or may not be owned the Contractor. The use of loud signals shall be avoided in favor of light warnings, except those required by safety laws for the protection of personnel.

3-12.4.2 Storage in Public Streets
Add the following to this subsection:

Storage of equipment and materials on City residential streets or in the public right of way during non-working hours shall not be permitted, and may only be placed in the public right of way for purposes of use that day.

Overnight stockpiling of construction debris or excavated materials is not allowed. Contractor must obtain written approval from the Engineer prior to storage of construction materials and equipment on the street where improvements are planned, but at minimum, adequate flashing barricades shall be provided.

No area is available within the contract limits for the exclusive use of the Contractor. Use of the Contractor’s work areas shall be at the Contractor’s own risk, and the City of Santa Ana shall not be held liable for damage to or loss of materials or equipment located within such areas.

The Contractor shall remove equipment, materials, and rubbish from the work areas and other City of Santa Ana – owned property that the Contractor occupies at the conclusion of each working day.

City-owned property cannot be used as a construction yard, except within project limits, where it may be available for licensing as determined by the engineer's requirements.

3-12.6.1 Water Pollution Control – General
Add the following to this subsection:

All work related to demolition, lot clearing, and grading is to be done in accordance with all applicable federal, state and local regulations, standards and codes governing demolition and any other trade work done in conjunction with any demolition. The owner/contractor at all times shall keep the project site free from the accumulation of waste materials or rubbish caused by the owner/contractor's operations.

Santa Ana Municipal Code (SAMC) Section 16-2 and Section 18, Article IV, prohibit any prohibited discharges of sediment, trash, debris, rubbish, etc., from being deposited into the gutter or street, and stormdrain system. SAMC Section 16-2 states: "*No person shall sweep, push, propel or deposit or cause to be swept, pushed, propelled or deposited into any gutter or street in the city, the accumulation of paper, metal, foil, dirt, trash or rubbish that accumulates upon public or private sidewalks or parkways.*" Failure to adhere to this policy may result in the issuance of an Administrative Citation.

Owner/Contractor is responsible for providing applicable erosion, sediment, waste management, and tracking control Best Management Practices (BMPs) at the project site. Guidelines for proper BMP implementation are outlined in the *Construction Runoff Guidance Manual for Contractors, Project Owners, and Developers*, developed by the Orange County Stormwater Program, in coordination with the City of Santa Ana and other Cities of Orange County. Please see the following website for more guidance information.

3-12.6.3 Storm Water Pollution Prevention Plan (SWPPP)
Add the following to this subsection:

<u>Erosivity Waivers</u>

Projects that are smaller than 5-acres and occur during the dry season (i.e. May – September) may qualify for an Erosivity Waiver. The Engineer will determine if the project qualifies for an Erosivity Waiver and will notify the Contractor. The Contractor shall not assume the project qualifies for an Erosivity Waiver without consulting the Engineer.

If the Engineer determines the project qualifies for an Erosivity Waiver, the Contractor shall submit an Erosion and Sediment Control Plan (ESCP) for review by the Engineer. The Contractor shall implement Best Management Practices (BMPs) per the California Storm Water Quality Association (CASQA) Construction BMP fact sheets and as shown in the approved ESCP, unless granted approval by the Engineer. The AGENCY will assist the Contractor with filing the Erosivity Waiver on the Stormwater Multiple Application and Report Tracking System (SMARTS) website.

In the event the Erosivity Waiver expires and the project is not complete or the Erosivity Waiver is no longer valid (i.e. project area increases), the AGENCY will notify the Contractor and the Contractor shall comply with the National Pollution Discharge Elimination System (NPDES)

General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (Order WQ 2022-0057-DWQ), as outlined below.

NPDES Construction General Permit Coverage

This project has been identified as a Risk Level ____ Project and shall comply with all requirements outlined in the National Pollution Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (Order WQ 2022-0057-DWQ), hereinafter referred to as the Construction General Permit. The Construction General Permit can be found on the State Water Resources Control Board Website at the link below. The AGENCY strongly recommends that all Contractors review the Construction General Permit prior to submitting a bid for the project.

https://www.waterboards.ca.gov/water_issues/programs/stormwater/construction/general_permit_reissuance.html

As part of the permitting process, the Contractor shall prepare and administer a SWPPP. The purpose of the SWPPP is to mitigate any pollutants associated with construction activities from entering the Municipal Separate Storm Sewer System (MS4) or receiving waters. All work required to comply with the Construction General Permit shall be performed by the Contractor. By submitting a bid, the Contractor acknowledges the requirements of the Construction General Permit.

After award of the contract and prior to the Contractor commencing work, the Contractor shall submit a SWPPP for review by the AGENCY. The SWPPP, at a minimum, shall include all required items and information outlined in the Construction General Permit. The Contractor shall have a licensed Qualified SWPPP Developer (QSD) prepare the SWPPP. The AGENCY may link the Contractor's QSD as a "Data Entry Person" on the Stormwater Multiple Application and Report Tracking System (SMARTS) website, allowing the Contractor's QSD to access the project and upload all necessary Permit Registration Documents (PRD). The AGENCY, as the Legally Responsible Party (LRP), will certify and submit all documents on SMARTS to the Santa Ana Regional Water Quality Control Board (Regional Board). The Contractor shall not commence work until the Notice of Intent (NOI) has been deemed active by the Regional Board.

The final approved version of the SWPPP shall be kept at the construction site at all times, for the duration of the contract, and the Contractor shall implement all BMPs per the California Stormwater Quality Association (CASQA) Construction BMP fact sheets and as shown in the SWPPP, unless granted approval by the AGENCY. Failure to implement BMPs properly and any activities deemed out of compliance with the Construction General Permit may result in enforcement actions taken against the Contractor by the AGENCY. The Contractor shall update and/or amend the SWPPP, as necessary, following the procedures outlined in the Construction General Permit.

The Contractor shall have a licensed Qualified SWPPP Developer (QSD), licensed Qualified SWPPP Practitioner (QSP), or trained delegate conduct all necessary inspections, reporting, and stormwater sampling as outlined in the Construction General Permit. Contractor shall submit to the AGENCY all inspections, reports, and sampling data for review via email on a weekly basis.

Extra erosion and sediment control BMPs shall be available on-site in order to replace failed BMPs or to be implemented during storm events. The Contractor shall mitigate ALL non-stormwater discharges from the construction site, unless granted approval by the AGENCY. The area adjacent to the construction site shall remain free of sediment and shall be swept regularly to be kept clean.

The Contractor shall submit an Annual Report, as outlined in the Construction General Permit, for the reporting period of July 1st through June 30th. For the previous reporting period, the Contractor must submit the Annual Report no later than **August 15th**. If construction ends prior to June 30th, the Contractor shall submit the Annual Report within **20 working days** of project completion. The Annual Report shall be prepared by the Contractor's QSD and shall be submitted to the AGENCY for approval. Upon approval by the AGENCY, the Contractor's QSD shall upload the Annual Report to SMARTS. The AGENCY will certify and submit the Annual Report to the Regional Board. Failure to submit the Annual Report as specified herein may result in Liquidated Damages, as outlined in the Bid Proposal.

Upon completion of the project, final stabilization of the construction site (i.e. landscaping and final paving complete), and removal of all construction equipment and materials, the Contractor shall submit a Notice of Termination (NOT) as outlined in the Construction General Permit. The NOT shall be prepared by the Contractor's QSP and/or QSD. The Contractor shall submit the NOT to the AGENCY for approval. Upon approval by the AGENCY, the Contractor's QSD shall upload the NOT to SMARTS. The AGENCY will certify and submit the NOT to the Regional Board. The NOT shall be submitted to the AGENCY within **20 working days** of project completion. Failure to submit the NOT as specified herein shall result in Liquidated Damages, as outlined in the Bid Proposal.

The Contractor shall be liable for all violations and fines levied against the AGENCY by Federal, State, or Local Agencies for violation(s) of the Construction General Permit. The Contractor shall notify the AGENCY of any activities, past, current, or future, that may be considered non-compliant with the Construction General Permit within **1 working day** of becoming aware of said activity.

SECTION 4 - CONTROL OF MATERIALS

4-1 GENERAL

Should the Contractor fail to correct deficiencies or public nuisances that have been created because of his/her operation, then these will be considered to be of an emergency nature, and will call for the AGENCY to move in on the project to take corrective action. Such work will be done on a force account basis with an additional callout charge. There is a minimum two-hour charge for labor on any callout plus an additional callout charge of $300.

4-4 TESTING

Add the following to this subsection:

Material testing will be performed by the Orange County EMA Materials Laboratory or a private laboratory engaged by the AGENCY for the construction of this project.

The AGENCY will bear the cost of testing material which meets the requirements indicated in these General Provisions. The cost of retesting of material that fails to pass the first test shall be borne by the Contractor.

SECTION 5 - LEGAL RELATIONS AND RESPONSIBILITIES

5-2 SPECIAL NOTICES
Add the following to this subsection:

Per Section 1771.4(a)(2) of the California Labor Code, Contractors are required to post job site notices, as prescribed by regulation.

5-3 LABOR
5-3.2 Prevailing Wages
Add the following to this subsection:

Certified Payroll Records shall be submitted to the Engineer every two weeks beginning with the actual start day of construction, and shall be consecutively numbered until the completion of the work. Progress payments will be withheld pending receipt of any outstanding reports.

The Contractor shall assure that a qualified supervisor is present at all times when work is being performed.

5-4 INSURANCE
5-4.2 General Liability Insurance
The provisions of this subsection apply except as herein modified:

The Contractor shall provide insurance coverage limits as detailed in the Certificate of Liability Insurance. The Certificate of Liability Insurance is included in Appendix D of the Contract Documents.

The Certificate of Liability insurance shall be provided by the successful BIDDER within ten (10) business days, after the successful BIDDER has received notice that the contract has been awarded. Failure to provide shall be just cause for the annulment of the award and the forfeiture of the proposal guaranty.

Contractor shall procure and maintain for the duration of the contract, and for 5 years thereafter, insurance against claims for injuries to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the Contractor, its agents, representatives, employees, and sub-contractors.

MINIMUM SCOPE AND LIMIT OF INSURANCE

Coverage shall be at least as broad as:

1. **Commercial General Liability** (CGL). Insurance Services Office (ISO) Form CG 0001 covering CGL on an "occurrence" basis, including products and completed operations, property damage, bodily injury and personal & advertising injury with limits no less than

$5,000,000 per occurrence and $10,000,000 in the aggregate. Umbrella and excess insurance policies can be used to meet the required limits.

2. **Automobile Liability** (AL). Insurance Services Office Form CA 0001 covering Code 1(any auto), with combined single limit no less than $5,000,000.

3. **Workers' Compensation** (WC). As required by the State of California, with statutory limits, and Employers' Liability insurance with a limit of no less than$1,000,000 per accident, policy, employee for bodily injury or disease.

4. **Builder's Risk** (Course of Construction) (BR). Utilizing an "All Risk" (Special Perils) coverage form, with limits equal to the completed value of the project and no co-insurance penalty provisions.

5. **Surety Bonds** as described below.

6. **Professional Liability** (PL) (if Design/Build). With limits no less than $1,000,000 per occurrence or claim, and $2,000,000 policy aggregate.

7. **Pollution Legal Liability** and/or Errors and Omissions (PLL). With limits no less than $1,000,000 per occurrence or claim, and $2,000,000 policy aggregate.

These insurance requirements shall not in any way act to reduce coverage that is broader or includes higher limits than the minimums shown above. If Contractor maintains broader coverage and/or higher limits than the minimums shown above, City shall be entitled to the broader coverage and/or the higher limits maintained by Contractor. Insurance provided under this contract shall not contain any restrictions or limitations which are inconsistent with City's rights under this contract.

Self-Insured Retentions

Self-insured retentions must be declared to and approved by City. At the option of City, Contractor shall cause its insurer(s) to reduce or eliminate such self-insured retentions as respects City; or Contractor shall provide a financial guarantee satisfactory to City guaranteeing payment of losses and related investigations, claim administration, and defense expenses.

Other Insurance Provisions

The insurance policies are to contain, or be endorsed to contain, the following provisions:

1. City of Santa Ana, its City Council, officers, officials, employees, agents, and volunteers are to be covered as additional insureds on Contractor's CGL and AL policies with respect to liability arising out of work operations performed by or on behalf of Contractor including materials, parts, and equipment furnished in connection with such work or operations and automobiles owned, leased, hired, or borrowed by or on behalf of Contractor. Additional insured status can be provided in the form of an endorsement to Contractor's insurance.

2. For any claims related to this project, Contractor's insurance coverage shall be primary insurance coverage as respects City of Santa Ana, its City Council, officers, officials,

employees, agents, and volunteers. Any insurance or self-insurance maintained by City of Santa Ana, its City Council, officers, officials, employees, agents, or volunteers shall not contribute with it.

3. A severability of interest provision must apply for all the additional insureds, ensuring that Contractor's insurance shall apply separately to each insured against whom a claim is made or suit is brought, except with respect to the insurer's limits of liability.

4. Contractor hereby grants to City a waiver of subrogation which any insurer of said Contractor may acquire against City of Santa Ana, its City Council, officers, officials, employees, agents and volunteers" by virtue of the payment of any loss under such insurance. Contractor agrees to obtain any endorsement(s) that may be necessary to affect this waiver of subrogation, but this provision applies regardless of whether or not City has received a waiver of subrogation endorsement from any insurer(s).

5. Each insurance policy required by this clause shall provide that coverage shall not be canceled, suspended, voided, reduced in scope or in limits, non-renewed by the carrier, or materially changed except after thirty (30) days prior written notice has been given to City and ten (10) days prior written notice of policy cancellation or non-renewal due to non-payment.

6. Certificate Holder on each Evidence of Insurance certificate shall be: City of Santa Ana, **Attention: (Name of Department Staff Responsible for Agreement)**, 20 Civic Center Plaza **M-XX (Responsible Staff's Department Mail Box)**, Santa Ana, CA 92701. The name and location of project must be indicated in the Description of Operations section of each certificate.

Builder's Risk (Course of Construction) Insurance

Contractor may submit evidence of Builder's Risk insurance in the form of Course of Construction coverage. Such coverage shall name City of Santa Ana as a loss payee as its interest may appear.

If the project does not involve new or major reconstruction, at the option of City, an Installation Floater may be acceptable. For such projects, a Property Installation Floater shall be obtained that provides for the improvement, remodel, modification, alteration, conversion or adjustment to existing buildings, structures, processes, machinery and equipment. The Property Installation Floater shall provide property damage coverage for any building, structure, machinery or equipment damaged, impaired, broken, or destroyed during the performance of the Work, including during transit, installation, and testing at City's site.

Claims Made Policies

If any coverage required is written on a claims-made coverage form:

1. The retroactive date must be shown, and this date must be before the execution date of the contract.

2. Insurance must be maintained and evidence of insurance must be provided for at least five (5) years after completion of work.

3. If coverage is cancelled or non-renewed, and not replaced with another claims-made policy form with a retroactive date prior to the contract effective, or start of work date, Contractor must purchase extended reporting period coverage for a minimum of five (5) years after completion of work.

4. A copy of the claims reporting requirements must be submitted to City.

Acceptability of Insurers

Insurance is to be placed with insurers authorized to conduct business in the state of California with a current A.M. Best rating of no less than A:VII, unless otherwise acceptable to CITY.

Waiver of Subrogation

Contractor hereby agrees to waive rights of subrogation which any insurer of Contractor may acquire from Contractor by virtue of the payment of any loss. Contractor agrees to obtain any endorsement that may be necessary to affect this waiver of subrogation. The Workers' Compensation policy shall be endorsed with a waiver of subrogation in favor of City for all work performed by Contractor, its employees, agents and sub-contractors.

Verification of Coverage

Contractor shall furnish City with original Certificates of Insurance including all required amendatory endorsements (or copies of the applicable policy language effecting coverage required by this clause). A statement on a Certificate(s)/Evidence of Insurance will not be accepted in lieu of the actual endorsements required herein. Failure to obtain the required documents prior to the work beginning shall not waive Contractor's obligation to provide them. City reserves the right to require complete, certified copies of all required insurance policies, including endorsements, required by these specifications, at any time.

Sub-Contractors

Contractor shall require and verify that all sub-contractors maintain insurance meeting all requirements stated herein, and Contractor shall ensure that City is an additional insured on insurance required from sub-contractors. For CGL coverage, sub-contractors shall provide coverage with a form at least as broad as CG 20 38 04 13.

Surety Bonds

Contractor shall provide the following Surety Bonds:

1. Bid Bond

2. Performance Bond

3. Payment Bond

4. Maintenance Bond

The Payment Bond and the Performance Bond shall be in a sum equal to the contract price. If the Performance Bond provides for a one-year warranty a separate Maintenance Bond is not necessary. If the warranty period specified in the contract is for longer than one year a Maintenance Bond equal to 10% of the contract price is required. Bonds shall be duly executed by a responsible corporate surety, authorized to issue such bonds in the State of California and secured through an authorized agent with an office in California.

Failure to Maintain Insurance Coverage

If Contractor, for any reason, fails to maintain insurance coverage which is required pursuant to this contract, the same shall be deemed a material breach of contract. City, at its sole option, may terminate this contract at any time and obtain damages from Contractor resulting from said breach.

Special Risks or Circumstances

City reserves the right to modify these requirements, including limits, based on the nature of the risk, prior experience, insurer, coverage, or other circumstances.

5-4.3 Worker's Compensation Insurance
Add the following to this subsection:

The Contractor shall furnish the Agency with satisfactory proof of Worker's Compensation Insurance. The insurance shall be taken out with a responsible insurance carrier authorized under the laws of the State of California and satisfactory to the Agency. For work that is sublet, the contract shall require the subcontractor similarly provide Worker's Compensation Insurance for the subcontractor's employees.

5-7 SAFETY

5-7.1 Worksite Safety

Add the following to this subsection:

The contractor is responsible for requiring the wearing of appropriate personal protective equipment (PPE) at all times in all operations of construction to protect against any exposure to hazardous conditions.

PPE Clothing

A. The CONTRACTOR shall require each employee, agent, or Subcontractor to wear:

1. appropriate attire in accordance with the provisions of the Contract Documents and herein.

B. Clothing:

a. Employee dress should be neat in appearance and consistent with good dressing attire, no large holes, obscenities, or inappropriate images.
b. Shirts and long pants must be worn always on the site.
c. Sleeveless shirts and tank tops are not permitted.
d. Clothing should not be torn or frayed.
e. Clothing contaminated by oily, flammable, toxic or caustic materials should not be worn until properly cleaned.
f. Certain tasks may require the wearing of fire-resistant materials, such as Nomex or leather. In such circumstances, extremely flammable clothing material such as nylon should be discouraged.
g. All employees shall wear ANSI hard hats, and safety glasses while on construction sites.
h. At a minimum, CONTRACTOR employees shall wear ANSI Class 2 safety vest while working within the following areas:

1) Where the potential exists for exposure to vehicular traffic.
2) When working in vicinity of operating mobile equipment.
3) Public right of way where speeds do not exceed 50 miles per hour (mph).
4) when working adjacent to public right of way and not protected
5) by City property fencing.
6) City of Santa Ana construction sites.

i. CONTRACTOR employees shall wear ANSI Class 3 safety vest while working in the public right of way where vehicle speeds exceed 50 mph, during nighttime work, and/or when working along a federal aid highway during daytime or nighttime hours.

C. Footwear:

a. Tennis shoes, sneakers, open-toed shoes, and sandals are prohibited in construction areas.

b. Safety footwear meeting the requirements of ASTM F2413, "Standard Specification for Performance Requirements for Foot Protection", is required in construction and process areas. ASTM numbers must be legible on the tongue or insides of shoes.

    1) Protective footwear shall be selected based on hazards associated with work tasks/activities (i.e., electrical hazards, puncture hazards, crush hazards, heat).
    2) Soles should be made of slip-resistant materials, and not worn to the point where slip resistance is compromised.
    3) Footwear shall have protective toecaps (i.e., composite, steel).

5-7.2.2 Shoring Plan
Add the following to this subsection:

Contractor is required to submit an engineered shoring design to the City for review and acceptance a minimum of 30 days before the scheduled start of excavation. Excavation may not begin until the City accepts the shoring design and Contractor submits an approved permit from the State Division of Industrial Safety. The submittal must cover all required trenches, pits, and tunneling or jacking operations and include any related calculations.

All shoring shall comply with Cal/OSHA Technical Manual (OTM) Section V: Chapter 2 - Excavations: Hazard Recognition in Trenching and Shoring. Design calculations must follow the guidelines set forth in Title 8, Article 6, of the Construction Safety Orders of the Department of Industrial Relations (DIR). The shoring submittal must be stamped by a California registered civil or structural engineer.

The shoring design must provide appropriate support for the soil adjacent to and/or under any excavation where trenching or excavation is five feet deep or greater. The completed shoring drawings should include a detailed procedure for the installation and removal of the shoring. Accepted methods of analysis should be used. Loads should be in accordance with the Construction Safety Orders or a soils report by a geotechnical consultant. All members should be secured to prevent sliding, falling, or kickouts.

5-7.8 Steel Plate Covers
5-7.8.1 General
Add the following to this subsection:

When backfilling operation of an excavation in the travel way, whether transverse or longitudinal cannot be properly completed within a work day, steel plate bridging with a non-skid surface and shoring may be required to preserve unobstructed traffic flow.

5-7.8.2 Thickness
Add the following to this subsection:

For spans greater than five (5) feet-three (3) inches, a structural design for the steel plate bridging shall be prepared by a California registered civil engineer and approved by the Engineer. Steel plate bridging shall be designed for HS20-44 truck loading per Caltrans Bridge Design Specifications Manual. The Contractor shall maintain steel plates with a non-skid surface having

a minimum coefficient of friction equivalent to 0.35 as determined by California Test Method 342. The contractor may use standard steel plate with known coefficient of friction equal or exceeding 0.35.

5-7.8.3 Installation
Add the following to this subsection:

The following shall apply:

1. Steel plate installation shall be recessed by milling existing pavement to set flush with finish grade.

2. Steel plate shall fit snug and installed to operate with minimum noise. Bridging shall be secured against displacement.

3. Steel plate used for bridging must extend a minimum of twelve (12") inches beyond the edge of the trench.

4. The pavement shall be cold planned a depth equal to the thickness of the plate and to a width and length equal to the dimensions of the plate.

Multiple steel plates shall be butted and tack welded as needed to secure plates 6" minimum. The trench shall be adequate to support the bridging and the traffic load. Contractor shall be responsible for determining whether shoring is necessary. The Contractor shall be responsible for the appropriate selection and maintenance of the steel plates, and shoring.

Unless specified, steel plate bridging at any given location shall not exceed four (4) consecutive working days in any given week. Backfilling of excavation shall be covered with a minimum of three (3) inches of temporary layer of cold asphalt concrete.

The following table shows the required minimal thickness of steel plate bridging for a given trench width:

Trench Width	Minimum Plate Thickness
1 foot-11 inches	¾ inch
2 feet-7 inches	$^{7}/_{8}$ inch
3 feet-5 inches	1 inch
5 feet-3 inches	1 ¾ inch

A Rough Road sign (W8-8) with black lettering on an orange background shall be used in advanced of steel plate bridging. This is to be used along with any other required construction signing.

SECTION 6 - PROSECUTIONAND PROGRESS OF THE WORK

6-1 CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK

6-1.1 Construction Schedule

Add the following to this subsection:

A working day shall be defined as outlined below, and the Contractor's activities shall be confined accordingly:

1. From 9:00 a.m. to 3:00 p.m., Monday through Friday, for work requiring temporary lane closures, i.e. those having less than a 24-hour duration, and for work at major intersections. As an alternative, construction at major intersections may be permitted on Fridays, at night or on weekends, at the discretion of the Engineer.

2. From 7:00 a.m. to 5:00 p.m., Monday through Friday, within work areas having either no lane closures or having continuous lane closures, i.e. 24-hour closures lasting more than one day. For work in, or adjacent to, residential areas, work shall not commence prior to 8:00 a.m.

Deviation from these hours/days shall not be permitted without the prior consent of the Engineer, except in emergencies involving immediate hazard to persons or property, or as specified otherwise.

Holidays as herein referred to shall be deemed to be:

- New Year's Day
- Martin Luther King Day
- President's Day
- Cesar Chavez Day
- Memorial Day
- Independence Day
- Labor Day
- Veteran's Day
- Thanksgiving Day and the day after
- Christmas Eve through New Year's Day

In addition to the holidays listed above, the City has a holiday moratorium; refer to City of Santa Ana Standard Plan No. 1160.

The Contractor is required to submit a comprehensive baseline schedule to the Engineer for approval before commencing construction. This schedule must detail the sequence of construction activities, including major milestones and critical path tasks. Throughout the construction phase, the Contractor shall provide monthly updates to the baseline schedule, reflecting the current progress of the project, completed tasks, work planned for the upcoming month, and any schedule changes.

In addition to the baseline schedule and monthly updates, the Contractor shall also provide a rolling 3-week look-ahead schedule. This schedule should offer a detailed outlook of planned activities for the upcoming three-week period, focusing on immediate work activities as well as work completed in the previous week. The rolling look-ahead schedule must be submitted to the Engineer weekly to facilitate timely assessment and coordination of upcoming construction activities.

6-6 SUSPENSION OF THE WORK
6-6.1 General
Add the following to this subsection:

Should suspension of work be ordered by reason of the failure of the contractor to carry out orders or to perform any provisions of the contract; or by reason of weather conditions being unsuitable for performing any item or items of work; the contractor, at its expense, shall do all the work necessary to provide a safe, smooth, and unobstructed passageway through construction for use by public traffic during the period of such suspension. In the event that the contractor fails to perform the work above specified, the City will perform such work and the cost thereof will be deducted from payment due or to become due to the contractor.

If a suspension of work is ordered by the Engineer, due to the failure on the part of the contractor to carry out orders given or to perform any provision of the contract, the days on which the suspension order is in effect shall be considered working days.

SECTION 7 - MEASUREMENT AND PAYMENT

7-2 LUMP SUM WORK
Add the following to this subsection:

Contractor shall submit for approval a schedule of values for all lump sum work. Failure to submit may delay payment for said work.

7-3 PAYMENT
7-3.1 General
Add the following to this subsection:

Payment for any items of work required by the plans, specifications or other contract documents, which are not covered by a contract bid item, shall be considered as included in other items and no additional compensation shall be paid therefore.

7-3.4 Mobilization
Add the following to this subsection:

Mobilization shall consist of preparatory work and operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to the project site. Mobilization shall additionally include the establishment of any temporary facilities, utilities, construction fencing and barricades, and the provision and installation of project signs.

A minimum of one week before the start of construction, the Contractor shall video all areas where construction is to take place. The video shall be supplied to the Engineer before constructions begins. Videos will serve as a record of the existing conditions for disputes that may arise from restoration and should therefore be taken along the line of construction and site access and staging areas at sufficient detail as necessary to clearly depict details of existing conditions. Videos shall

be a DVD or digital, in color, indexed and catalogued in such a manner that each photographed area is readily identifiable and shall also indicate the date and time (hours, minutes and seconds) when it was made. The Contractor shall also video any unusual conditions encountered during construction that are not already a matter of photographic record. In any areas where existing conditions cannot be determined by means of videos, the areas shall be restored as approved by the Engineer at the Contractor's expense. All videos shall become the property of the City.

Payment for mobilization shall be considered as included in the other items of work and no additional compensation will be allowed therefore.

7-4 PAYMENT FOR EXTRA WORK

7-4.1 General

Add the following to this subsection:

For such extra work the contractor shall receive payment as agreed upon in writing, or shall be paid on force account. Work involving contract unit prices, the contractor shall not exceed any of the quantities in the proposal unless prior authorization from the engineer is obtained in writing.

7-4.3 Markup

7-4.3.1 Work by the Contractor

The following supersedes the provisions of this subsection:

The following percentages shall be added to the Contractor's costs and shall constitute the markup for all overhead and profits:

1) Labor 20%
2) Materials 15%
3) Equipment Rental..... 15%
4) Other Items and Expenditures..... 15%

To the sum of the costs and markups provided for in this subsection, 1 percent shall be added as compensation for bonding.

7-4.3.2 Work by the Subcontractor

The following supersedes the provisions of this subsection:

When all or any part of the extra work is performed by a Subcontractor, the markup established in 7-4.3.1 shall be applied to the Subcontractor's actual cost of such work. A markup of 10 percent on the first $5,000 of the subcontracted portion of the extra work and a markup of 5 percent on work added in excess of $5,000 of the subcontracted portion of the extra work may be added by the Contractor.

7-6 COST ESCALATION

The following supersedes the provisions of this subsection:

2. Fixed Price Contract and Prohibition on Price Escalation

The Contract Price is firm and not subject to escalation for labor, materials, fuel, or other input costs except as explicitly provided in this Contract. The Contractor acknowledges that all bids include allowances for inflation, market fluctuations, and other foreseeable changes in costs, and waives any right to claim additional compensation for such changes.

3. No Price Escalation for Delays

The Contractor shall not be entitled to any price adjustment for delays caused by factors within their control, including but not limited to inadequate staffing, substandard workmanship, or failure to procure materials on time.

For delays caused by the agency or third parties beyond the Contractor's control, the Contractor may request a time extension but shall not receive additional compensation unless authorized through a written change order.

In the case of force majeure events (e.g., natural disasters), the Contractor may request both a time extension and, where justified, a price adjustment for documented cost increases, subject to agency approval.

4. Price Adjustments for Added Scope

Any changes in the scope of work, including additional work requested by the agency, must be authorized through a written change order. If the added scope results in material or labor cost increases, the Contractor may submit a request for price adjustment, which must include detailed cost breakdowns and supporting documentation. All such adjustments must be agreed upon prior to executing the change order.

Any price adjustments related to changes in scope will be subject to the same terms and conditions as the original contract, including the prohibition on escalation for general market fluctuations.

5. Subcontractor Agreements and Cost Escalation Due to Delays or Change Orders

The Contractor is responsible for ensuring that any change orders or modifications to the project schedule do not result in unforeseen cost escalations with subcontractors.

If a change order or added scope extends the project timeline beyond the term of the Contractor's agreements with its subcontractors and results in additional costs

due to the expiration or renegotiation of those agreements, these potential costs must be clearly identified and agreed upon before the change order is executed.

All potential subcontractor cost escalations due to the extension of subcontractor agreements must be fully disclosed and agreed upon at the time of change order execution. Any claims for additional compensation related to subcontractor agreements that were not disclosed and agreed upon at the time of change order execution will not be considered.

6. Limitations on Subsequent Claims

Once a change order is executed, no claims for additional costs related to subcontractor agreement expiration or subcontractor price escalations will be entertained unless explicitly included in the change order. The Contractor waives the right to submit subsequent claims for price increases related to expired subcontractor agreements or market conditions arising after change order execution, except in the case of a documented force majeure event.

7. Documentation Requirements

The Contractor must provide detailed documentation, including subcontractor agreements, pricing schedules, and any escalation clauses, to support any claims for increased costs due to delays, added scope, or subcontractor agreement expirations. Documentation must be provided at the time of the change order request, and no subsequent claims will be considered unless fully supported by prior documentation.

8. Mutual Agreement Requirement for Change Orders

Both the Contractor and the agency must mutually agree on all potential cost impacts, including those related to subcontractor agreements, before executing any change order. The agreed-upon costs shall be considered final, and no further claims related to the specific change order will be accepted unless explicitly provided for in the terms of the change order.

SECTION 8 - FACILITIES FOR CITY PERSONNEL .....Not Used

SECTION 9 - CLAIMS RESOLUTION PROCEDURES

9-1 PUBLIC CONTRACT CODE SECTIONS 10240 AND 20104

Public Contract Code Section 10240 and Public Contract Code Section 20104 are hereby recognized and accepted as Reference General Provisions of these Specifications.

For purposes of the new law, "claim" means a separate demand by a contractor, sent by registered or certified mail with return receipt requested, for one or more of the following:

- a time extension, including a claim for relief from damages or penalties for delay assessed by a public entity.

- payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.

- payment of an amount that is disputed by the public entity.

Upon receipt of a claim, the following steps apply:

- the public entity must conduct a reasonable review of the claim and provide a written statement to the contractor within 45 days identifying what portion of the claim is disputed and what portion is undisputed; this time period may be extended by mutual agreement of the parties

- the claimant must furnish reasonable documentation to support the claim

- any payment due on an undisputed portion of the claim must be processed and made within 60 days after the public entity issues its written statement (amounts not timely paid bear interest at 7% annually)

- public entity's failure to timely issue a written statement on the claim results in the claim being deemed rejected in its entirety

- if claimant disputes the public entity's written response, or if the public entity fails to respond to a claim within the time prescribed, the claimant may demand in writing an informal conference to meet and confer

- upon receipt of such a demand, the public entity must schedule a meet and confer conference within 30 days

- within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of it remains in dispute, the public entity must provide a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed

- any payment due on the undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement

- any disputed portion of the claim, as identified by the contractor in writing, shall be submitted to nonbinding mediation, with the public entity and the claimant sharing the associated costs equally

- if mediation is not successful, the parts of the claim remaining in dispute become subject to applicable procedures outside of the statute (for example, litigation or arbitration)

9-2 PUBLIC CONTRACT CODE SECTION 9204

Any claims made by contractor relating to this project will be governed by Public Contract Code Section 9204, as appearing in full below:

(a) The Legislature finds and declares that it is in the best interests of the state and its citizens to ensure that all construction business performed on a public works project in the state that is complete and not in dispute is paid in full and in a timely manner.

(b) Notwithstanding any other law, including, but not limited to, Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2, Chapter 10 (commencing with Section 19100) of Part 2, and Article 1.5 (commencing with Section 20104) of Chapter 1 of Part 3, this section shall apply to any claim by a contractor in connection with a public works project.

(c) For purposes of this section:

(1) "Claim" means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:

(A) A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.

(B) Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.

(C) Payment of an amount that is disputed by the public entity.

(2) "Contractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who has entered into a direct contract with a public entity for a public works project.

(3) (A) "Public entity" means, without limitation, except as provided in subparagraph (B), a state agency, department, office, division, bureau, board, or commission, the California State University, the University of California, a city, including a charter city, county, including a charter county, city and county, including a charter city and county, district, special district, public authority, political subdivision, public corporation, or nonprofit transit corporation wholly owned by a public agency and formed to carry out the purposes of the public agency.

(B) "Public entity" shall not include the following:

(i) The Department of Water Resources as to any project under the jurisdiction of that department.

(ii) The Department of Transportation as to any project under the jurisdiction of that department.

(iii) The Department of Parks and Recreation as to any project under the jurisdiction of that department.

(iv) The Department of Corrections and Rehabilitation with respect to any project under its jurisdiction pursuant to Chapter 11 (commencing with Section 7000) of Title 7 of Part 3 of the Penal Code.

(v) The Military Department as to any project under the jurisdiction of that department.

(vi) The Department of General Services as to all other projects.

(vii) The High-Speed Rail Authority.

(4) "Public works project" means the erection, construction, alteration, repair, or improvement of any public structure, building, road, or other public improvement of any kind.

(5) "Subcontractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who either is in direct contract with a contractor or is a lower tier subcontractor.

(d) (1) (A) Upon receipt of a claim pursuant to this section, the public entity to which the claim applies shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the claimant a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, a public entity and a contractor may, by mutual agreement, extend the time period provided in this subdivision.

(B) The claimant shall furnish reasonable documentation to support the claim.

(C) If the public entity needs approval from its governing body to provide the claimant a written statement identifying the disputed portion and the undisputed portion of the claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, the public entity shall have up to three days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide the claimant a written statement identifying the disputed portion and the undisputed portion.

(D) Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. If the public entity fails to issue a written statement, paragraph (3) shall apply.

(2) (A) If the claimant disputes the public entity's written response, or if the public entity fails to respond to a claim issued pursuant to this section within the time prescribed, the

claimant may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the public entity shall schedule a meet and confer conference within 30 days for settlement of the dispute.

(B) Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the public entity shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. Any disputed portion of the claim, as identified by the contractor in writing, shall be submitted to nonbinding mediation, with the public entity and the claimant sharing the associated costs equally. The public entity and claimant shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. The public entity and claimant shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.

(C) For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

(D) Unless otherwise agreed to by the public entity and the contractor in writing, the mediation conducted pursuant to this section shall excuse any further obligation under Section 20104.4 to mediate after litigation has been commenced.

(E) This section does not preclude a public entity from requiring arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if mediation under this section does not resolve the parties' dispute.

(3) Failure by the public entity to respond to a claim from a contractor within the time periods described in this subdivision or to otherwise meet the time requirements of this section shall result in the claim being deemed rejected in its entirety. A claim that is denied by reason of the public entity's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the claimant.

(4) Amounts not paid in a timely manner as required by this section shall bear interest at 7 percent per annum.

(5) If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a public entity because privity of contract does not exist, the contractor may present to the

public entity a claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on his or her own behalf or on behalf of a lower tier subcontractor, that the contractor present a claim for work which was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the claim be presented to the public entity shall furnish reasonable documentation to support the claim. Within 45 days of receipt of this written request, the contractor shall notify the subcontractor in writing as to whether the contractor presented the claim to the public entity and, if the original contractor did not present the claim, provide the subcontractor with a statement of the reasons for not having done so.

(e) The text of this section or a summary of it shall be set forth in the plans or specifications for any public works project that may give rise to a claim under this section.

(f) A waiver of the rights granted by this section is void and contrary to public policy, provided, however, that (1) upon receipt of a claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or binding arbitration, as applicable; and (2) a public entity may prescribe reasonable change order, claim, and dispute resolution procedures and requirements in addition to the provisions of this section, so long as the contractual provisions do not conflict with or otherwise impair the timeframes and procedures set forth in this section.

(g) This section applies to contracts entered into on or after January 1, 2017.

(h) Nothing in this section shall impose liability upon a public entity that makes loans or grants available through a competitive application process, for the failure of an awardee to meet its contractual obligations.

(i) This section shall remain in effect only until January 1, 2027, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2027, deletes or extends that date.

PART 4 - EXISTING IMPROVEMENTS

SECTION 402 - UTILITIES

402-1 LOCATION
402-1.1 General
Add the following to this subsection:

The contractor is responsible to determine the exact location and depth of utilities and its service connections during construction. The contractor shall notify the City of the exact location of any utility or service connection which is not shown or is incorrectly shown on the plans.

In addition to calling Dig Alert, the contractor shall be expected to maintain liaison with the affected utility company representatives, and shall notify them prior to beginning of the job and each time the particular utility is or could possibly be affected at least 24 hours in advance.

All existing utility access frames and covers, both private and public, shall be located and marked with paint on the pavement surface by the Contractor.

Upon completion of the project, the Contractor shall remove all painted utility markings done by him/her or the respective utility owners from the surfaces of sidewalks, driveway approaches, curbs and gutters using the removal method acceptable to the Engineer. Any damage to sidewalks, driveway approaches, curbs and gutters due to the Contractor's removal operation shall be repaired at the Contractor's expense and to the satisfaction of the Engineer. Payment for removing utility markings shall be included in the other items of work, and no additional compensation shall be allowed therefore.

If utility construction work within the area is required during the construction of this project, the Contractor is directed to cooperate with the utility company(s) and their workers to assure proper installation of the utilities with a minimum of conflict.

PART 6 - TEMPORARY TRAFFIC CONTROL

SECTION 600 - ACCESS

600-1 GENERAL
Add the following to this subsection:

Intersections shall be kept open until work takes place within the intersection. Local vehicular and pedestrian access, including access to driveways and businesses, shall be maintained at all times. Pedestrian access across both streets in an intersection must be maintained at all times with a minimum 4-foot width.

Notifications:

Prior to the start of construction operations, the Contractor shall notify the Police and Fire Departments of the AGENCY, giving the approximate starting date, completion date, and the name and telephone number of responsible persons who may be contacted at any hour in the event of a critical condition requiring immediate correction. At least two weeks prior to starting work, the Contractor shall notify the Orange County Transportation Authority (OCTA) bus service of the approximate starting date and completion date.

Construction Notices:
At least two weeks prior to starting work, the Contractor shall deliver notices supplied by the AGENCY to the residents and businesses in the area affected by the construction. Initial notifications shall be distributed to the following:

- All businesses and residences within a 1,000-foot radius of the project
- If adjacent to a neighborhood, the entire neighborhood shall be notified

At least 48 hours before working on a street, the contractor shall contact the residents and businesses of that street by written notice to provide information as to the typwe of work, closure, type of inconvenience and the expected duration. The written notice shall be a tag shape similar to the sample

shown in the Appendix of the Contract Documents and be hung on door knobs and all parked vehicles on the street. In the event of a delay after the notice has been delivered, the contractor shall provide an updated notice to the residents and businesses. After construction completion on the street, the contractor shall collect any notices that are not picked up by the resident or business.

Temporary Construction Signs:

Contractor shall furnish, install and maintain temporary construction signs as detailed in the Appendix of the Contract Documents. The signs shall be mounted on Type II barricades and secured with sandbags to prevent overturning. The contractor shall install the temporary construction signs during construction at locations approved by the Engineer. The maintenance includes, but is not limited to the relocation for the different construction phases, replacement (if damaged due to the operations of the Contractor) and graffiti removal.

Temporary Parking Removal Signs:

The signs for temporary parking removal during construction shall be a minimum of 12" x 18" as shown in the Appendix of the Contract Documents. The signs shall be posted 48 hours prior to the temporary parking removal. A sign shall be posted at the beginning of the parking removal area, the beginning of every block, and every 100 -150 feet thereafter.

Payment for notifications, construction notices, temporary construction signs, and temporary parking removal signs shall be included in the other items of work and no additional compensation will be allowed therefore, and shall include all labor and materials necessary to manufacture, install and maintain the signs and barricades.

SECTION 601 - TEMPORARY TRAFFIC CONTROL FOR CONSTRUCTION AND MAINTENANCE WORK ZONES

601-1 GENERAL
Add the following to this subsection:

All signs used for traffic control shall be illuminated or reflectorized when they are used during hours of darkness. All cones, pylons, barricades, or posts used in the diversion of traffic shall be reflectorized. All shall be maintained in a like new condition at all times. All signing, barricading and diversion of traffic shall be subject to the approval of the Engineer. The Contractor shall provide a telephone number at which the Contractor's representatives can be reached in case an emergency which requires replacement or relocation of the required traffic control devices should occur.

CITY OF SANTA ANA
APPENDIX A
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

DEFINITION OF BID ITEMS

DEFINITION OF BID ITEMS

The unit prices paid for the items listed in the Contractor's Proposal as defined herein shall be considered full compensation for furnishing all labor, materials, tools, and equipment, and doing all work involved in furnishing and installing the materials complete and in place, in accordance with the details shown on the Plans, as specified herein, and as directed by the Engineer.

All incidental work which is neither shown on the Plans nor otherwise specified, and which is necessary to complete the improvements as shown on the Plans and as specified in the Contract Documents (defined in the Contract/Agreement), shall be furnished and installed as though such work were shown on the Plans or specified in the Contract Documents, and no additional compensation shall be allowed therefore.

The scope of work includes, but is not limited to, each bid item listed in the Contractor's Proposal and as described in the following.

Bid Item No. 1 - Santa Ana Zoo Education Hub Building A (Contractor to provide Schedule of Values)

The work under this item consist of demolishing, grading, compacting and constructing all items in accordance with the Santa Ana Zoo Education Hub Building A (Phase 1 and related sitework) per Appendix I, Construction Plans, Standard Specifications, Storm Water Pollution Prevention Plan (SWPPP), and Contract Document Specifications related to Phase 1. All permits and fees required by all other Agencies having jurisdiction over any part of the work shall be obtained and paid for by the Contractor, unless otherwise noted on the Plans or in the General Provisions. This includes a 120-calendar day landscaping and irrigation maintenance period, where the contactor is responsible for improper, defective, unsound, or diseased conditions that may appear which that period. This maintenance period includes all work involved in caring for and establishing the new landscape and shall be in accordance with the Standard Specifications, plans, and Contract Document Specifications.

Payment for this item shall be at the contract Lump Sum listed in the Bid Proposal, and shall include full compensation for doing all work, including furnishing all materials, labor, equipment, tools, disposal of all removed materials and incidentals as required and no additional compensation will be allowed therefore. Contractor is to provide a detailed schedule of values for this item prior to the start of construction.

Bid Item No. 2 - Project Advertisement Sign

Payment for this item shall be at the contract unit price bid per Each as listed in the Bid Proposal, and shall include full compensation for doing all work; including furnishing all materials, labor, equipment, tools, and incidentals as required and no additional compensation will be allowed therefore.

Bid Item No. 3 - Construction Permit

The work under this item consists of obtaining a Construction Permit at the City of Santa Ana Public Works Development Services counter and making the required deposit (refer to Section 2-2a, Construction Permit, of these Special Provisions).

Payment for this item shall be at the contract Lump Sum listed in the Bid Proposal, and shall include full compensation for doing all work and no additional compensation will be allowed therefore.

CITY OF SANTA ANA
APPENDIX B
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

CONSTRUCTION CONTRACT AGREEMENT

CITY OF SANTA ANA
CONSTRUCTION CONTRACT AGREEMENT
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

This CONSTRUCTION CONTRACT is made and entered into this _____ day of _____, 20___ by and between the City of Santa Ana, California, a charter city and municipal corporation organized and existing under the Constitution and laws of the State of California (hereinafter "CITY"), and _____ _____ (hereinafter "CONTRACTOR").

WITNESSETH:

The CITY and the CONTRACTOR, for the consideration hereinafter named, mutually agree as follows:

1. CONTRACTOR agrees to perform all the work and furnish all the materials at its own cost and expense necessary to construct and complete in a good and workmanlike manner and to the satisfaction of the City Engineer of the CITY, the _____ (hereinafter referred to as the "WORK OF IMPROVEMENT") identified in and in accordance with the Contract Documents prepared by the City's Public Works Agency and approved by the City Council.

2. The complete Construction Contract consists of the "Contract Documents" as defined by the Standard Specifications for Public Works Construction and which include the following:

   - Notice Inviting Bids
   - Information to Bidders
   - Bid Proposal
   - Bid Bond
   - Contract Form
   - Contract Bonds
   - General Provisions
   - Special Provisions
   - Technical Provisions and Project Plans
   - Community Workforce Agreement
   - Appendices

   In case of conflict between the Contract Documents, the precedence of documents shall be as established in the Standard Specifications for Public Works Construction.

3. CITY agrees to pay and CONTRACTOR agrees to accept in full payment to complete the WORK OF IMPROVEMENT the sum total amount not to exceed _____ _____, as set forth and identified in the BID PROPOSAL, which is attached hereto and incorporated herein as Exhibit "A."

   The BID PROPOSAL contains a schedule of unit price(s) or lump sum(s) based on approximate quantities only, and the City does not expressly or by implication agree that the actual amount of work will correspond therewith, but reserves the right to increase or decrease the amount of any class or portion of the work or to omit portions of the work as may be deemed necessary or advisable.

4. CONTRACTOR agrees to complete the WORK OF IMPROVEMENT within the time specified in the Time for Completion of Improvements section of the BID PROPOSAL (Exhibit "A") including commencing construction within the timeframe therein specified after issuance of a Notice to Proceed.

5. The CONTRACTOR will pay, and will require all subcontractors to pay, all employees on the WORK OF IMPROVEMENT a salary or wage at least equal to the prevailing salary or wage established for such work as set forth in the wage determinations for this work in accordance with applicable State and Federal law.

6. If applicable, the CONTRACTOR shall adhere to the CITY'S Community Workforce Agreement (CWA), a pre-hire collective bargaining agreement, which establishes the labor relations policies and procedures for CONTRACTOR to follow in the crafts persons employed to complete the WORK OF IMPROVEMENT as more fully described in the CWA. The CWA may be found on the City's website at: https://www.santa-ana.org/documents/community-workforce-agreement/

7. CONTRACTOR shall, after award of this Contract, furnish two bonds to be approved by the CITY, one in the amount of One Hundred Percent (100%) of the Contract price, to guarantee the faithful performance of the work (Performance Bond), and one in the amount of One Hundred Percent (100%) of the Contract price to guarantee payment of all claims for labor and materials furnished (Payment Bond). This Contract shall not become effective until such bonds are supplied to and approved by the CITY.

8. CONTRACTOR shall, prior to the release of the performance and payment bonds or the retention payment, furnish a warranty performance and payment bond (Warranty Bond). Said Warranty Bond shall also be required as a condition of project acceptance. For projects up to Five Hundred Thousand Dollars ($500,000), the Warranty Bond amount shall be the greater of Ten Thousand Dollars ($10,000) or Twenty Percent (20%) of the final contract price. For projects above Five Hundred Thousand Dollars ($500,000), the Warranty Bond amount shall be the greater of One Hundred Thousand Dollars ($100,000) or Ten Percent (10%) of the final contract price.

9. CONTRACTOR shall, after award of this Contract, furnish Certificates of Liability Insurance and Worker's Compensation Insurance as outlined in the General Provisions, to be approved by the CITY.

10. INDEMNIFICATION.
    To the fullest extent allowed by law, CONTRACTOR and its Subcontractors hereby agree to defend, indemnify, and hold harmless CITY, its City Council, boards and commissions, officers, agents, employees, representatives and volunteers (hereinafter collectively referred to as "Indemnitees"), through legal counsel acceptable to CITY, from and against any liability, claims, actions, costs, damages or losses, including reasonable costs and attorney's fees, for injury, including death to any person or damage to any property, arising directly or indirectly from, or in any manner relating to, any of the following:

    (i) Performance or nonperformance of the Work of Improvement by CONTRACTOR or its Subcontractors of any lower tier;
    (ii) Performance or nonperformance by CONTRACTOR or its Subcontractors of any lower tier, of any of the obligations under the Contract Documents;
    (iii) The construction activities of CONTRACTOR or its Subcontractors of any lower tier, either on the project site or on other properties;
    (iv) The payment or nonpayment by CONTRACTOR of any of its Subcontractors of any lower tier, for Work of Improvement performed on or off the project site; and
    (v) Any personal injury, property damage or economic loss to third persons related to and arising

from the performance or nonperformance by CONTRACTOR or its Subcontractors of any lower tier, of the Work of Improvement.

(vi) The indemnity obligations of Subcontractors provided by this Section shall be included in all subcontract documents issued by CONTRACTOR.

Nothing in the Contract Documents shall be construed to give rise to any implied right of indemnity in favor of CONTRACTOR against CITY or any other Indemnitee.

IN WITNESS WHEREOF, the parties hereto have executed this Construction Contract on the day and year first above written.

ATTEST:

JENNIFER L. HALL
Clerk of the Council

CITY OF SANTA ANA

ALVARO NUÑEZ
City Manager

APPROVED AS TO FORM:

SONIA R. CARVALHO
City Attorney

By: _____

Senior Assistant City Attorney

CONTRACTOR:
Company:

_____
NAME:
Title:

RECOMMENDED FOR APPROVAL:

NABIL SABA, PE
Executive Director
Public Works Agency

CITY OF SANTA ANA
APPENDIX C
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

BONDS

CITY OF SANTA ANA

APPENDIX C

PROJECT NO.: 23-2601

SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

PERFORMANCE BOND

WHEREAS, the City of Santa Ana (hereinafter referred to as the "City") has awarded to _____, (hereinafter referred to as the "Contractor") an agreement for Contract No._____, (hereinafter referred to as the "Project");

WHEREAS, the work to be performed by the Contractor is more particularly set forth in the Contract Documents for the Project dated _____, (hereinafter referred to as "Contract Documents"), the terms and conditions of which are expressly incorporated herein by reference; and

WHEREAS, the Contractor is required by said Contract Documents to perform the terms thereof and to furnish a bond for the faithful performance of said Contract Documents.

NOW, THEREFORE, we, the undersigned Contractor and _____ as Surety, a corporation organized and duly authorized to transact business under the laws of the State of California, are held and firmly bound unto the City in the sum of _____ Dollars, ($_____), said sum being not less than one hundred percent (100%) of the total amount of the Contract, for which amount well and truly to be made, we bind ourselves, our heirs, executors and administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that, if the Contractor, his or its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and agreements in the Contract Documents and any alteration thereof made as therein provided, on its part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their intent and meaning; and shall faithfully fulfill all obligations including the one (1) year guarantee of all materials and workmanship; and shall indemnify and save harmless the City, its officials, officers, employees, and authorized volunteers, as stipulated in said Contract Documents, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect.

As a part of the obligation secured hereby and in addition to the face amount specified therefore, there shall be included costs and reasonable expenses and fees including reasonable attorney's fees, incurred by the City in enforcing such obligation.

As a condition precedent to the satisfactory completion of the Contract Documents, unless otherwise provided for in the Contract Documents, the above obligation shall hold good for a period of one (1) year after the acceptance of the work by the City, during which time if Contractor shall fail to make full, complete, and satisfactory repair and replacements and totally protect the City from loss or damage resulting from or caused by defective materials or faulty workmanship. The obligations of Surety hereunder shall continue so long as any obligation of Contractor remains. Nothing herein shall limit the City's rights or the Contractor or Surety's obligations under the Contract, law or equity, including, but not limited to, California Code of Civil Procedure Section 337.15.

Whenever Contractor shall be, and is declared by the City to be, in default under the Contract Documents, the Surety shall remedy the default pursuant to the Contract Documents, or shall promptly, at the City's option:

i. Take over and complete the Project in accordance with all terms and conditions in the Contract Documents; or

ii. Obtain a bid or bids for completing the Project in accordance with all terms and conditions in the Contract Documents and upon determination by Surety of the lowest responsive and responsible bidder, arrange for a Contract between such bidder, the Surety and the City, and make available as work progresses sufficient funds to pay the cost of completion of the Project, less the balance of the contract price, including other costs and damages for which Surety may be liable. The term "balance of the contract price" as used in this paragraph shall mean the total amount payable to Contractor by the City under the Contract and any modification thereto, less any amount previously paid by the City to the Contractor and any other set offs pursuant to the Contract Documents.

iii. Permit the City to complete the Project in any manner consistent with California law and make available as work progresses sufficient funds to pay the cost of completion of the Project, less the balance of the contract price, including other costs and damages for which Surety may be liable. The term "balance of the contract price" as used in this paragraph shall mean the total amount payable to Contractor by the City under the Contract and any modification thereto, less any amount previously paid by the City to the Contractor and any other set offs pursuant to the Contract Documents.

Surety expressly agrees that the City may reject any contractor or subcontractor which may be proposed by Surety in fulfillment of its obligations in the event of default by the Contractor.

Surety shall not utilize Contractor in completing the Project nor shall Surety accept a bid from Contractor for completion of the Project if the City, when declaring the Contractor in default, notifies Surety of the City's objection to Contractor's further participation in the completion of the Project.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract Documents or to the Project to be performed thereunder shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract Documents or to the Project.

[REMAINDER OF PAGE LEFT INTENTIONALLY BLANK]

CITY OF SANTA ANA

APPENDIX C

PROJECT NO.: 23-2601

SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

IN WITNESS WHEREOF, we have hereunto set our hands and seals this _____ day of _____, 20___.

(Corporate Seal)

_____
Contractor/ Principal

By_____

Title_____

(Corporate Seal)

_____
Surety

By _____
Attorney-in-Fact

(Attach Attorney-in-Fact Certificate)

Title_____

The rate of premium on this bond is _____ per thousand. The total amount of premium charges is $_____.
(The above must be filled in by corporate attorney.)

THIS IS A REQUIRED FORM

Any claims under this bond may be addressed to:

(Name and Address of Surety) _____
_____
_____

(Name and Address of Agent or Representative for service of process in California, if different from above) _____
_____
_____

(Telephone number of Surety and Agent or Representative for service of process in California) _____

CITY OF SANTA ANA
APPENDIX C
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

Notary Acknowledgment

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA
COUNTY OF _____

On _____, 20___, before me, _____, Notary Public, personally
Date — Name And Title Of Officer (e.g. "Jane Doe, Notary Public")
appeared _____, who proved to me on the basis of satisfactory
Name(s) of Signer(s)
evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Place Notary Seal Above

_____
Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

CAPACITY CLAIMED BY SIGNER

☐ Individual
☐ Corporate Officer

_____
Title(s)

☐ Partner(s) ☐ Limited ☐ General
☐ Attorney-In-Fact
☐ Trustee(s)
☐ Guardian/Conservator
☐ Other:

Signer is representing:
Name Of Person(s) Or Entity(ies)

_____

_____

DESCRIPTION OF ATTACHED DOCUMENT

_____
Title or Type of Document

_____
Number of Pages

_____
Date of Document

_____
Signer(s) Other Than Named Above

NOTE: This acknowledgment is to be completed for Contractor/Principal.

CITY OF SANTA ANA

APPENDIX C

PROJECT NO.: 23-2601

SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

Notary Acknowledgment

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STATE OF CALIFORNIA
COUNTY OF _____

On _____, 20___, before me, _____, Notary Public, personally
Date — Name And Title Of Officer (e.g. "Jane Doe, Notary Public")

appeared _____, who proved to me on the basis of satisfactory
Name(s) of Signer(s)

evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Place Notary Seal Above

_____
Signature of Notary Public

OPTIONAL

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CAPACITY CLAIMED BY SIGNER

☐ Individual
☐ Corporate Officer

_____
Title(s)

☐ Partner(s) ☐ Limited ☐ General
☐ Attorney-In-Fact
☐ Trustee(s)
☐ Guardian/Conservator
☐ Other:

Signer is representing:
Name Of Person(s) Or Entity(ies)

_____
_____

DESCRIPTION OF ATTACHED DOCUMENT

_____
Title or Type of Document

_____
Number of Pages

_____
Date of Document

_____
Signer(s) Other Than Named Above

NOTE: This acknowledgment is to be completed for the Attorney-in-Fact. The Power-of Attorney to local representatives of the bonding company must also be attached.

END OF PERFORMANCE BOND

CITY OF SANTA ANA
BONDS
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

PAYMENT BOND (LABOR AND MATERIALS).

WHEREAS, the City of Santa Ana (hereinafter designated as the "City"), has awarded to _____, (hereinafter designated as the "Principal") an agreement for Contract No._____, (hereinafter referred to as the "Project");

WHEREAS, the work to be performed by the Principal is more particularly set forth in the Contract Documents for the Project dated _____, (hereinafter referred to as "Contract Documents"), the terms and conditions of which are expressly incorporated herein by reference; and

WHEREAS, said Principal is required to furnish a bond in connection with said contract; providing that if said Principal or any of its subcontractors shall fail to pay for any materials, provisions, provender, equipment, or other supplies used in, upon, for or about the performance of the work contracted to be done, or for any work or labor done thereon of any kind, or for amounts due under the Unemployment Insurance Code or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of said Principal and its subcontractors with respect to such work or labor the Surety on this bond will pay for the same to the extent hereinafter set forth.

NOW THEREFORE, we, the Principal and _____, as Surety, are held and firmly bound unto the City in the penal sum of _____ Dollars ($_____) lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if said Principal, his or its subcontractors, heirs, executors, administrators, successors or assigns, shall fail to pay any of the persons named in Civil Code section 9100, fail to pay for any materials, provisions or other supplies, used in, upon, for or about the performance of the work contracted to be done, or for any work or labor thereon of any kind, or amounts due under the Unemployment Insurance Code with respect to work or labor performed under the contract, or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department or Franchise Tax Board from the wages of employees of the contractor and his subcontractors pursuant to Revenue and Taxation Code Section 18663, with respect to such work and labor the Surety or Sureties will pay for the same, in an amount not exceeding the sum herein above specified, and also, in case suit is brought upon this bond, all litigation expenses incurred by the City in such suit, including reasonable attorneys' fees, court costs, expert witness fees and investigation expenses.

This bond shall inure to the benefit of any of the persons named in Civil Code Section 9100 so as to give a right of action to such persons or their assigns in any suit brought upon this bond.

It is further stipulated and agreed that the Surety on this bond shall not be exonerated or released from the obligation of this bond by any change, extension of time for performance, addition, alteration or modification in, to, or of any contract, plans, specifications, or agreement pertaining or relating to any scheme or work of improvement herein above described, or pertaining or relating to the furnishing of labor, materials, or equipment therefore, nor by any change or modification of any terms of payment or extension of the time for any payment pertaining or relating to any scheme or work of improvement herein above described, nor by any rescission or attempted rescission or attempted rescission of the contract, agreement or bond, nor by any conditions precedent or subsequent in the bond attempting to limit the right of recovery of claimants

otherwise entitled to recover under any such contract or agreement or under the bond, nor by any fraud practiced by any person other than the claimant seeking to recover on the bond and that this bond be construed most strongly against the Surety and in favor of all persons for whose benefit such bond is given, and under no circumstances shall Surety be released from liability to those for whose benefit such bond has been given, by reason of any breach of contract between the owner or the City and original contractor or on the part of any obligee named in such bond, but the sole conditions of recovery shall be that claimant is a person described in Civil Code Section 9100, and has not been paid the full amount of his claim.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract to be performed thereunder, shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of Contract, including but not limited to, the provisions of Sections 2819 and 2845 of the California Civil Code.

IN WITNESS WHEREOF, we have hereunto set our hands and seals this _____ day of _____, 20__.

(Corporate Seal)

_____
Contractor/ Principal

By_____

Title_____

(Corporate Seal)

_____
Surety

By _____
Attorney-in-Fact

(Attach Attorney-in-Fact Certificate)

Title_____

Notary Acknowledgment

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA
COUNTY OF _____

On _____, 20___, before me, _____, Notary Public, personally
Date — Name And Title Of Officer (e.g. "Jane Doe, Notary Public")

appeared _____, who proved to me on the basis of satisfactory
Name(s) of Signer(s)

evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Place Notary Seal Above

_____
Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

CAPACITY CLAIMED BY SIGNER

☐ Individual
☐ Corporate Officer

_____
Title(s)

☐ Partner(s) ☐ Limited ☐ General
☐ Attorney-In-Fact
☐ Trustee(s)
☐ Guardian/Conservator
☐ Other:

Signer is representing:
Name Of Person(s) Or Entity(ies)

_____

_____

DESCRIPTION OF ATTACHED DOCUMENT

_____
Title or Type of Document

_____
Number of Pages

_____
Date of Document

_____
Signer(s) Other Than Named Above

NOTE: This acknowledgment is to be completed for Contractor/Principal.

Notary Acknowledgment

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA
COUNTY OF _____

On _____, 20___, before me, _____, Notary Public, personally
Date — Name And Title Of Officer (e.g. "Jane Doe, Notary Public")
appeared _____, who proved to me on the basis of satisfactory
Name(s) of Signer(s)
evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Place Notary Seal Above

_____
Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

CAPACITY CLAIMED BY SIGNER

- ☐ Individual
- ☐ Corporate Officer

_____
Title(s)

- ☐ Partner(s)
  - ☐ Limited
  - ☐ General
- ☐ Attorney-In-Fact
- ☐ Trustee(s)
- ☐ Guardian/Conservator
- ☐ Other:

Signer is representing:
Name Of Person(s) Or Entity(ies)

_____

_____

DESCRIPTION OF ATTACHED DOCUMENT

_____
Title or Type of Document

_____
Number of Pages

_____
Date of Document

_____
Signer(s) Other Than Named Above

NOTE: This acknowledgment is to be completed for the Attorney-in-Fact. The Power-of-Attorney to local representatives of the bonding company must also be attached.

END OF PAYMENT BOND

CITY OF SANTA ANA
BONDS
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

WARRANTY PERFORMANCE AND PAYMENT BOND
(To be submitted upon project completion as a condition of project acceptance)

KNOW ALL MEN BY THESE PRESENTS that _____, as CONTRACTOR, and _____, a corporation, organized and existing under the laws of the State, and duly authorized to transact business under the laws of the State of California, as SURETY, are held and firmly bound unto the City of Santa Ana, as AGENCY, in the penal sum of _____ _____ Dollars ($_____) for the above stated project, for the payment of which sum, CONTRACTOR and SURETY agree to be bound, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that, whereas CONTRACTOR has been awarded and is about to enter into the annexed Contract Agreement with AGENCY dated _____ for _____, if CONTRACTOR faithfully warrants the work done under said Contract Agreement against material or quality defects for a period of one year after acceptance by the AGENCY, then this obligation shall be null and void, otherwise it shall remain in full force and effect in favor of AGENCY; provided that any alterations in the obligations or time for completion made pursuant to the terms of the contract documents shall not in any way release either CONTRACTOR or SURETY, and notice of such alterations is hereby waived by SURETY.

IN WITNESS WHEREOF the parties hereto have set their names, titles, hands, and seal this _____ day of _____, 20___.

CONTRACTOR*_____
_____

SURETY*_____
_____

Subscribed and sworn to before me, _____, this _____ day of _____, 20___.

Signature: _____

Notary Public in and for the County of _____, State of _____

Rate of premium on this bond is $ _____ per thousand.
Total amount of premium charge is $ _____. ***To be filled in by Surety***

**Provide CONTRACTOR / ADMITTED SURETY name, address, and telephone number and the name, title, address, and telephone number of authorized representative.*

CITY OF SANTA ANA
APPENDIX D
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

CERTIFICATE OF INSURANCE

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 10/24/2024

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME: Name of Contact Person for Insurance Broker/Agent	
Name of Insurance Broker / Insurance Agent	PHONE (A/C, No, Ext): (XXX) XXX-XXXX	FAX (A/C, No): (XXX) XXX-XXXX
Address	E-MAIL ADDRESS: XXXXXXXXXXXXX@XXXXXXXXXXXXXXXXXXX.XXX	
Address	INSURER(S) AFFORDING COVERAGE	NAIC #
Phone No.	INSURER A : Name of Insurance Carrier	License #
INSURED	INSURER B : Name of Insurance Carrier	License #
Name of Vendor	INSURER C : Name of Insurance Carrier	License #
Vendor's Contact Person/Department	INSURER D : Name of Insurance Carrier	License #
Address	INSURER E : Name of Insurance Carrier	License #
Phone No.	INSURER F : Name of Insurance Carrier	License #

COVERAGES **CERTIFICATE NUMBER:** Certificate of Insurance # **REVISION NUMBER:** Usually blank

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X **COMMERCIAL GENERAL LIABILITY** ☐ CLAIMS-MADE ☒ OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: ☒ POLICY ☐ PRO-JECT ☐ LOC ☐ OTHER:	Y	Y	XXXXXX-XXXXX-XXXXXX-XX	Valid From	Valid To	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 1,000,000.00 $ For Lease/Rental $ Can be blank $ 1,000,000.00 $ 2,000,000.00 $ 2,000,000.00
B	**AUTOMOBILE LIABILITY** X ANY AUTO ☐ OWNED AUTOS ONLY ☐ SCHEDULED AUTOS ☐ HIRED AUTOS ONLY ☐ NON-OWNED AUTOS ONLY	Y	Y	XXXXXXX-XXXXXXX-XXXXX	Valid From	Valid To	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1,000,000.00 - or- $ 1,000,000.00 $ 2,000,000.00 $ 1,000,000.00
C	X **UMBRELLA LIAB** ☒ OCCUR X **EXCESS LIAB** ☐ CLAIMS-MADE ☐ DED ☐ RETENTION $	Y	Y	XXXXXX-XXXXXX-XXXXXXX	Valid From	Valid To	EACH OCCURRENCE AGGREGATE	$ 5,000,000.00 $ 5,000,000.00
D	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y / N ANYPROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? ☐ **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	N / A	Y	XXXXX-XXXXXX-XXXXXXXX	Valid From	Valid To	☒ PER STATUTE ☐ OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	$ 1,000,000.00 $ 1,000,000.00 $ 1,000,000.00
E, F	Sexual Abuse & Molestation Professional Liability	Y	Y	XXXXXX-XXXXXX-XXXXXXX	Valid From	Valid To	Each Occurrence or Claim Aggregate	$1,000,000.00 $1,000,000.00 $2,000,000.00

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

Location / Address / Name of Project / Event / Etc. Identifying information only.

CERTIFICATE HOLDER

City of Santa Ana
Attention: Department or Department Representative Name
Address of Department, M-XX
Santa Ana, CA 92701

CANCELLATION 30 Days Notice

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Signature of Insurance Broker/Agent is necessary

SAMPLE

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ADDITIONAL INSURED ENDORSEMENT
FOR COMMERCIAL GENERAL LIABILITY POLICY

Insurance Company _____

This endorsement modifies such insurance as is afforded by the provisions of Policy # _____ relating to the following:

1. The City of Santa Ana, 20 Civic Center Plaza, Santa Ana, California 92701; its officers, employees, agents, volunteers and representatives are named as additional insureds ("additional insureds") with regard to liability and defense of suits arising from the operations and uses performed by or on behalf of the named insured.

2. With respect to claims arising out of the operations and uses performed by or on behalf of the named insured, such insurance as is afforded by this policy is primary and is not additional to or contributing with any other insurance carried by or for the benefit of the additional insureds.

3. This insurance applies separately to each insured against whom claim is made or suit is brought except with respect to the company's limits of liability. The inclusion of any person or organization as an insured shall not affect any right which such person or organization would have as a claimant if not so included.

4. With respect to the additional insureds, this insurance shall not be cancelled, or materially reduced in coverage or limits except after thirty (30) days written notice has been given to the City of Santa Ana, 20 Civic Center Plaza, Santa Ana, California 92701.

(Completion of the following, including countersignature, is required to make this endorsement effective.)

Effective _____, this endorsement form as a part of
Policy # _____
Issued to _____
Named Insured

Countersigned by _____
Authorized Representative

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

No. 5193

State of _____

County of _____

On _____ (DATE) before me, _____ (NAME, TITLE OF OFFICER - E.G., "JANE DOE, NOTARY PUBLIC")

personally appeared _____ (NAME(S) OF SIGNER(S))

☐ personally known to me - OR - ☐ proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

_____ SIGNATURE OF NOTARY

OPTIONAL SECTION

CAPACITY CLAIMED BY SIGNER

Though statute does not require the Notary to fill in the data below, doing so may prove invaluable to persons relying on the document.

☐ INDIVIDUAL

☐ CORPORATE OFFICER(S)

_____ TITLE(S)

☒ PARTNER(S) ☐ LIMITED ☐ GENERAL

☐ ATTORNEY-IN-FACT

☐ TRUSTEE(S)

☐ GUARDIAN/CONSERVATOR

☐ OTHER: _____

SIGNER IS REPRESENTING:

NAME OF PERSON(S) OR ENTITY(IES)

_____

_____

OPTIONAL SECTION

THIS CERTIFICATE MUST BE ATTACHED TO THE DOCUMENT DESCRIBED AT RIGHT:

Though the data requested here is not required by law, it could prevent fraudulent reattachment of this form.

TITLE OR TYPE OF DOCUMENT _____

NUMBER OF PAGES _____ DATE OF DOCUMENT _____

SIGNER(S) OTHER THAN NAMED ABOVE _____

SAMPLE

©1993 NATIONAL NOTARY ASSOCIATION • 8236 Remmet Ave., P.O. Box 7184 • Canoga Park, CA 91309-7184

HOW TO FILL OUT THE ALL-PURPOSE ACKNOWLEDGMENT

On January 1, 1993, the "all-purpose" acknowledgment certificate, as prescribed in California Civil Code Section 1189, became mandatory for all acknowledgments performed in the state. Though the all-purpose form had, since January 1, 1991, been allowed as an alternative to statutory and other forms when the parties were signing as individuals, corporate officers, partners, attorneys-in-fact or in any other representative capacity, it now replaces all of these other forms, which may no longer be used after December 31, 1992. The all-purpose form should not be used for jurats or proofs by subscribing witness.

(1-2) **NAME OF STATE and NAME OF COUNTY** in which Notary performs notarization.

(3) **DATE OF NOTARIZATION.** Actual month, day and year in which signer(s) appear(s) before Notary in named state and county.

(4) **NAME & TITLE OF NOTARIZING OFFICER.** In the case of a Notary, "Notary Public" would be the title.

(5) **NAME OF SIGNER(S)** appearing before Notary. Initials and spelling of all names should agree with document signature and ID cards.

(6) **CHECK LEFT BOX** if signer is personally known to Notary. **CHECK RIGHT BOX** if Notary identifies signer through either (a) ID cards or (b) oath of credible witness.

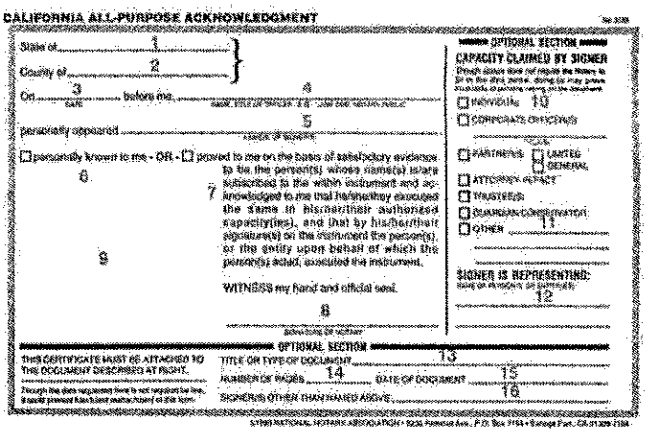
(7) **CROSS OUT** inapplicable letters and words [person(s), name(s), is/are, he/she/they, his/her/ their, capacity(ies), signature(s)], or **CIRCLE** applicable words to agree with number and sex of signer(s) in space 5.

(8) **SIGNATURE OF NOTARY** exactly as name appears on commissioning papers, in space 4 and in seal.

(9) **NOTARY SEAL IMPRINT,** clearly affixed.

SPACES 10-12 OPTIONAL. While law doesn't obligate the Notary to fill in this critical data, its omission may cause the document to be questioned or challenged.

(10) **CHECK APPROPRIATE BOX** to indicate whether signer is signing as individual on his or her own behalf, or as corporate officer **(WRITE IN CORPORATE TITLE),** partner, attorney-in-fact, trustee, guardian/conservator, or in another capacity.



SPACES 13-16 OPTIONAL. Omission of data here will not affect document's validity. However, by completing these spaces, Notaries can deter fraudulent reattachment of certificate to an unintended document.

(13) **TITLE OR TYPE OF DOCUMENT NOTARIZED,** such as "Deed of Trust."

(14) **NUMBER OF PAGES IN DOCUMENT NOTARIZED.** Do not count certificate as a page.

(15) **DATE OF DOCUMENT NOTARIZED.** Most, but not all documents will have date, usually at top or following signature space; this normally indicates date of signing. If none, insert: "NO DATE."

(16) **SIGNER(S) OTHER THAN NAMED IN SPACE 5.** Since all signers may not be named on same notarial certificate, here insert name(s) of signer(s) that appear(s) or will appear on other certificates — as many as space allows. If none, insert: "NO OTHER SIGNERS."

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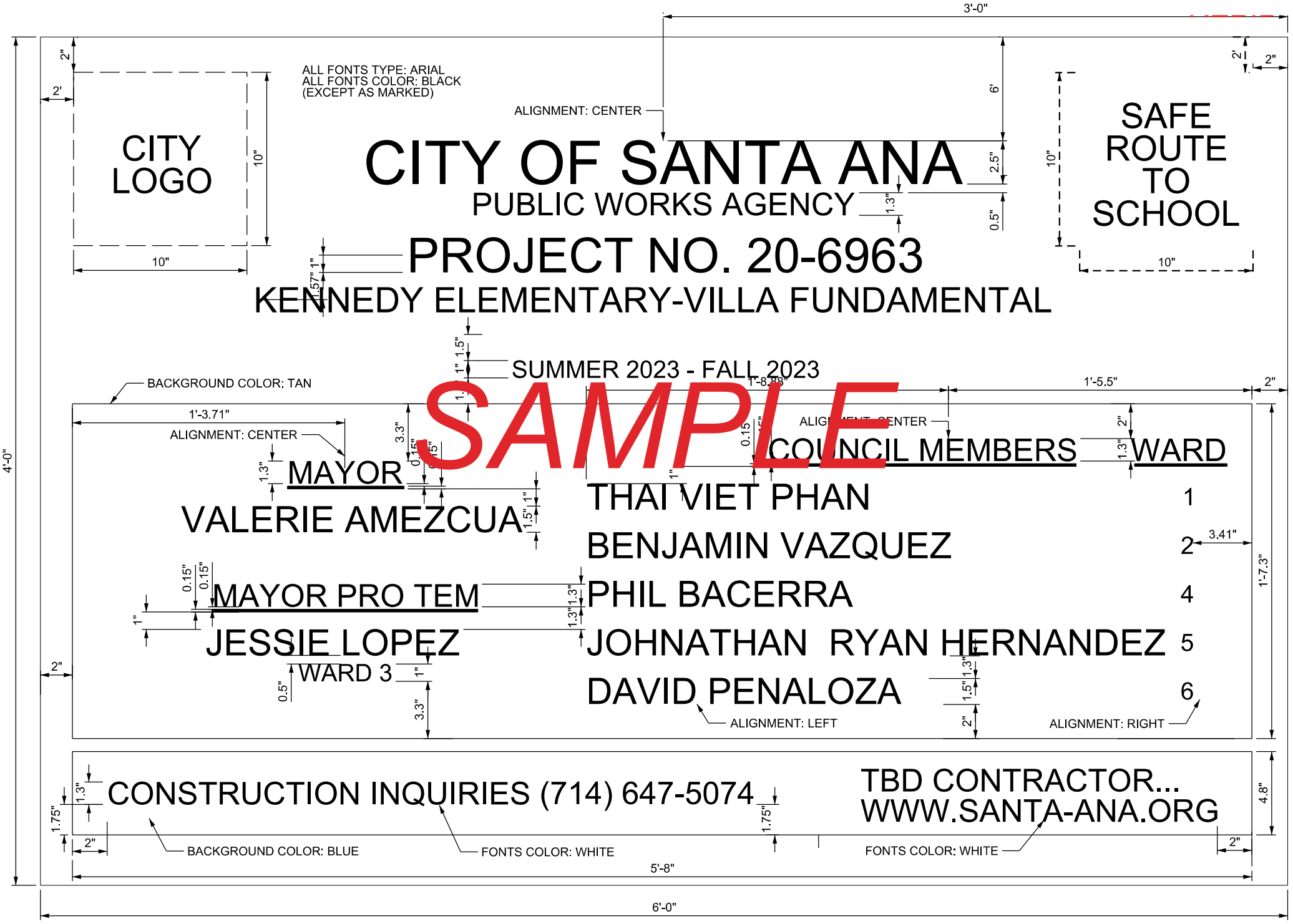
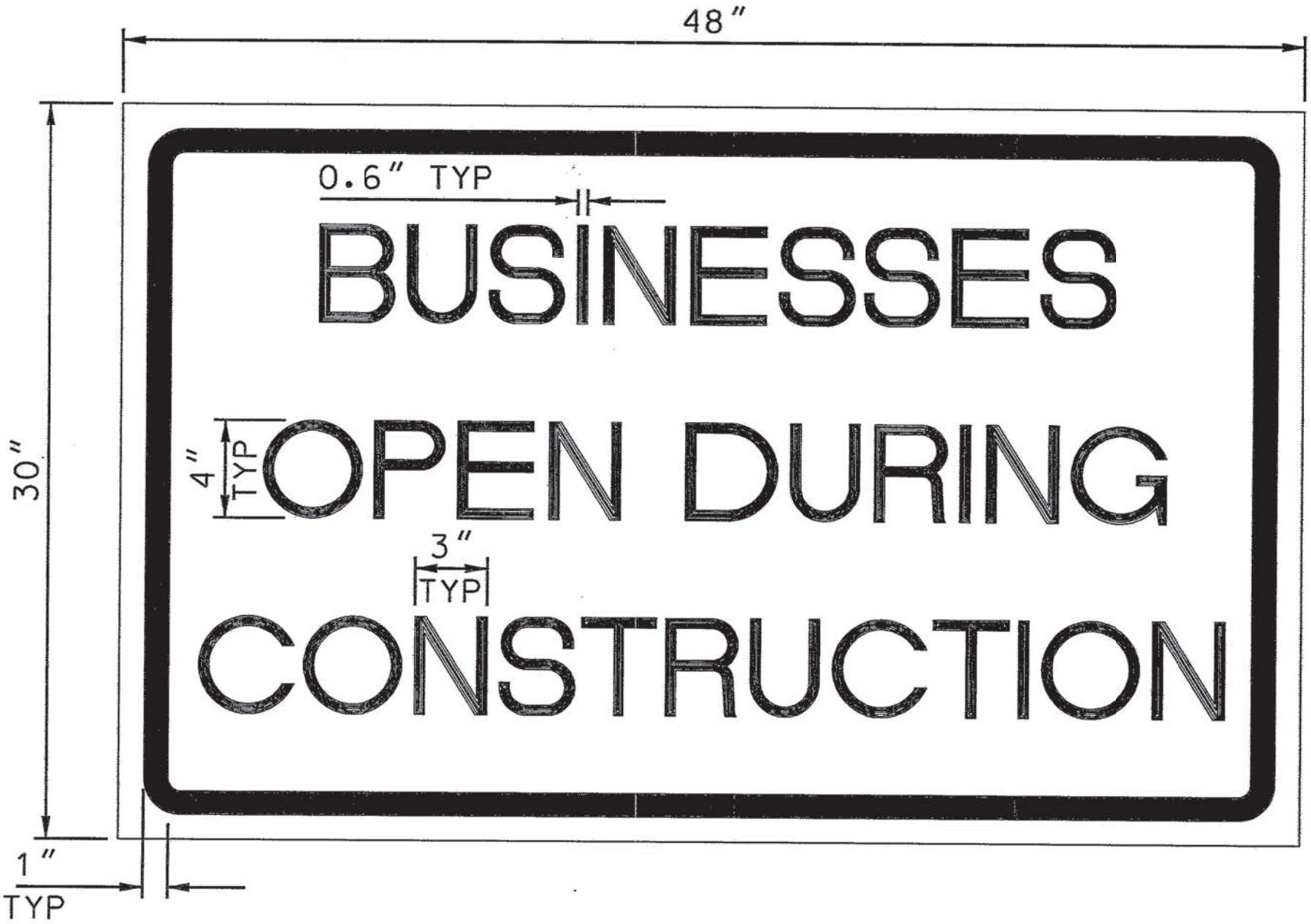
NATIONAL NOTARY ASSOCIATION
8236 Remmet Ave., P.O. Box 7184
Canoga Park, CA 91309-7184
Telephone: 818-713-4000

P12607

CITY OF SANTA ANA
APPENDIX E
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

CONSTRUCTION SIGNAGE AND NOTICES


3'-0"
6'
2.5"
0.5"
1.3"
ALIGNMENT: CENTER
ALL FONTS TYPE: ARIAL
ALL FONTS COLOR: BLACK
(EXCEPT AS MARKED)
CITY LOGO
10"
2"
2'
SAFE ROUTE TO SCHOOL
CITY OF SANTA ANA
PUBLIC WORKS AGENCY
PROJECT NO. 20-6963
KENNEDY ELEMENTARY-VILLA FUNDAMENTAL
SUMMER 2023 - FALL 2023
SAMPLE
BACKGROUND COLOR: TAN
1'-3.71"
1'-5.5"
ALIGNMENT: CENTER
MAYOR
VALERIE AMEZCUA
MAYOR PRO TEM
JESSIE LOPEZ
WARD 3
COUNCIL MEMBERS
WARD
THAI VIET PHAN 1
BENJAMIN VAZQUEZ 2
PHIL BACERRA 4
JOHNATHAN RYAN HERNANDEZ 5
DAVID PENALOZA 6
3.41"
1'-7.3"
4'-0"
ALIGNMENT: LEFT
ALIGNMENT: RIGHT
CONSTRUCTION INQUIRIES (714) 647-5074
TBD CONTRACTOR...
WWW.SANTA-ANA.ORG
BACKGROUND COLOR: BLUE
FONTS COLOR: WHITE
FONTS COLOR: WHITE
4.8"
1.75"
5'-8"
6'-0"



NOTES:
SIGN DIMENSIONS: 30" x 48" x 0.080 ALUM.
BLACK LETTERING/BORDER ON AN ORANGE BACKGROUND
LETTER SIZE AND SPACING AS SHOWN

PUBLIC NOTIFICATION

has been awarded a construction contract by your city or county for street & concrete improvements in your area. The following improvements will start on or about the following dates and times:

_____

- ☐ Curb and Gutter Remove and Replace
- ☐ Grinding
- ☐ Asphalt Repair
- ☐ Asphalt Overlay
- ☐ Street Excavation
- ☐ Sand Blasting
- ☐ Street Striping
- ☐ Curb Painting
- ☐ Crack Sealing
- ☐ Tree Trimming
- ☐ Root Pruning
- ☐ Other _____

Your help in following all traffic controls, parking restrictions and in not allowing water to run into the street from your property will help in expediting the construction. The City or County Inspector will be on site during construction and will be happy to answer any of your questions and provide any assistance needed. Thank you.

AVISO AL PUBLICO

La compania de construccion que a sido contratada para hacer obras en su area. Los siguientes trabajos comensaran mas o menos en las fechas suguientes:

_____

- ☐ Obra de Banquetas
- ☐ Moler el Pavimento
- ☐ Reparacion de Pavimento
- ☐ Renovacion de Pavimento
- ☐ Excavacion de Calles
- ☐ Sand Blasting
- ☐ Pintar Lineas
- ☐ Pintas Bordo de Banqueta
- ☐ Rellenar Grietas
- ☐ Podar Arboles
- ☐ Podar Raizos
- ☐ Otro _____

Su cooperacion al seguir todas las senales de transito, obedecer las restricciones de no estacionar, y no dejar que agua corra a la calle ayudara a evitar demoras en la construccion. Una persona oficial estara presente durante la construccion para ayudar y contestar preguntas. Gracias.

14"

18"

TOW-AWAY
NO STOPPING

DATE TIME

? A.M. TO ?P.M.

MM/DD/YY

VEHICLES WILL BE
TOWED AWAY
AT OWNERS EXPENSE

CITY OF SANTA ANA
APPENDIX F
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

STANDARD PLANS

https://www.santa-ana.org/engineering-standards-and-plans/

CITY OF SANTA ANA
APPENDIX G
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

BID PROTEST FEE PAYMENT FORM

CITY OF SANTA ANA
APPENDIX G
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

Bid Protest Fee Payment Form

Any Bid Protest shall be required to include the payment of a nonrefundable fee of $2,026.00 as referenced in the Project Specifications Section – Instruction To Bidders For Proposal Submission – Bid Protest, a. Bid Protest Fee.

Payments must be made within normal Finance Cashier Hours (refer to website for updated hours https://www.santa-ana.org/permits-counter/). Please bring completed form to the counter along with the method of payment to continue the Bid Protest procedure. Any Bid Protest submitted without proof of payment will not be reviewed and will be returned to the protesting bidder.

Project Name: _____

Project Number: _____

Contractor Name (Payee): _____

Contractor Address: _____

Payment Amount: $2,026.00

Account: 08617001-5XXXX

CITY OF SANTA ANA
APPENDIX H
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

COMMUNITY WORKFORCE AGREEMENT (CWA)

COMMUNITY WORKFORCE AGREEMENT

BY AND BETWEEN

THE CITY OF SANTA ANA

AND

LOS ANGELES/ORANGE COUNTIES

BUILDING AND CONSTRUCTION TRADES COUNCIL

AND THE SIGNATORY CRAFT COUNCILS AND UNIONS

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CITY OF SANTA ANA
COMMUNITY WORKFORCE AGREEMENT

This Community Workforce Agreement ("Agreement") is entered into on June 6, 2023 ("Effective Date"), by and between the City of Santa Ana, a municipal corporation ("City"), the Los Angeles/Orange Counties Building and Construction Trades Council ("Trades Council"), and the signatory Craft Councils and Local Unions signing this Agreement (collectively, the "Union" or "Unions"). This Agreement establishes the labor relations policies and procedures for the City, the Contractors awarded contracts for Project Work and for the crafts persons employed by the Contractors and represented by the Unions engaged in the Project Work as more fully described below. The City, Trades Council and Unions are hereinafter referred to herein, as the context may require, as "Party" or "Parties."

It is understood by the Parties to this Agreement that for the duration of this Agreement, it shall be the policy of the City for all Project Work (as defined in Section 2.2.) to be contracted exclusively to Contractors who agree to execute and be bound by the terms of this Agreement, directly or through the Letter of Assent (a form of which is attached as **"Attachment A"**), and to require each of its subcontractors, of whatever tier, to become so bound. The City shall include, directly or by incorporation by reference, the requirements of this Agreement in the advertisement of and/or specifications for each and every contract for Project Work to be awarded by the City.

It is further understood that the City shall actively administer and enforce the obligations of this Agreement to ensure that the benefits envisioned from it flow to all Parties, the Contractors and crafts persons working under it, and the residents of the City. The City shall therefore designate a "CWA Administrator," either from its own staff or an independent contractor, to serve as the City's liaison for Contractors and other persons; monitor compliance with this Agreement; assist, as the authorized representative of the City, in developing and implementing the programs referenced herein, all of which are critical to fulfilling the intent and purposes of the Parties and this Agreement; and to otherwise implement and administer this Agreement.

ARTICLE 1
DEFINITIONS

Section 1.1 "Agreement" or "CWA" means this Community Workforce Agreement.

Section 1.2 "Apprentice" means those employees indentured and participating in a Joint Labor/Management Apprenticeship Program approved by the State of California, Department of Industrial Relations, Division of Apprenticeship Standards.

Section 1.3 "Construction Contract" or "Construction Contracts" means any contract entered into by the City, for the construction of Project Work as specified in Section 2.2.

Section 1.4 "Contractor" means any individual firm, partnership or corporation, or combination thereof, including joint ventures, which is an independent business enterprise and which has entered into a Construction Contract with the City or any of its contractors or any of the City's or

contractor's subcontractors of any tier, with respect to the construction of any part of a Project under contract terms and conditions approved by the City and which incorporate this Agreement.

Section 1.5 "City" means the City of Santa Ana.

Section 1.6 "Joint Labor/Management Apprenticeship Program" means a joint Union and Contractor administered apprenticeship program certified by the State of California, Department of Industrial Relations, Division of Apprenticeship Standards.

Section 1.7 "Letter of Assent" means the document that each Contractor (of any tier) must sign and submit to the City before beginning any Project Work, which formally binds such Contractor(s) to adherence to all the forms, requirements and conditions of this Agreement in the form attached hereto as "**Attachment A.**"

Section 1.8 "CWA Administrator" means the City's authorized representative who will be the liaison between the City, Contractors, and the Unions; responds to inquiries about the CWA; charged with monitoring compliance with the CWA, developing and implementing programs set forth in the CWA including but not limited to grievance procedures.

Section 1.9 "Project", "Project Work" or "City Project" means Capital Improvement Program projects administered through the City of Santa Ana Public Works Agency, subject to the State of California public contracting laws, pursuant to a Construction Contract entered into by the City, and as further described in Section 2.2.

Section 1.10 "Specialty Contracts" means a contract for Project Work with a specialty contractor which is either limited to a particular single trade or craft or limited to a singular scope of work (i.e. installing a toilet.)

Section 1.11 "Master Labor Agreements" means the local collective bargaining agreements of the signatory Unions having jurisdiction over the Project Work and which have signed this Agreement.

Section 1.12 "Subscription Agreement" means the contract between a Contractor and a Union's Labor/Management Trust Fund(s) that allows the Contractor to make the appropriate fringe benefit contributions in accordance with the terms of the Master Labor Agreements.

Section 1.13 The use of masculine or feminine gender or titles in this Agreement should be construed as including both genders and not as gender limitations unless the Agreement clearly requires a different construction. Further, the use of Article titles and/or Section headings are for information only, and carry no legal significance.

ARTICLE 2
SCOPE OF THE AGREEMENT

Section 2.1 General This Agreement shall apply to all of the City's Project Work, as defined in Section 2.2, performed by those Contractor(s) of whatever tier that have contracts awarded for

such work, for the development of the City's facilities which, jointly, constitute the Project, and have been designated by the City for construction or rehabilitation. The CWA administrator will submit annual reports to the City Council on this agreement.

Section 2.2 Specific Project Work covered by this Agreement is defined and limited to:

2.2.1 All Public Works construction, as defined by the California Public Contract Code, and major rehabilitation work pursuant to "prime multi-trade construction contracts" that exceed seven hundred fifty thousand dollars ($750,000) and all subcontracts flowing from these prime multi-trade contracts.

2.2.2 All prime "Specialty Contracts," as defined in Section 1.10 that exceed one hundred thousand dollars ($100,000) and all subcontracts flowing from these specialty contracts.

2.2.3 The City may, at any time and at its sole discretion, determine to build additional buildings, facilities, and other projects under this Agreement which are not otherwise covered as Project Work.

2.2.4 Any Affordable Housing projects that receive City funds.

2.2.5 This Agreement is not intended to, and shall not apply to any work advertised for bids or performed at any time prior to the Effective Date, or after the expiration or termination of this Agreement, except as otherwise provided herein. This Agreement shall in no way limit the City's right to terminate, modify or rescind any construction contract and/or any related subcontract or agreement. Should the City remove or terminate any contract or agreement for construction that does not fall within the scope of this Agreement and thereafter authorize that work be commenced on any contract for such construction, the contract for construction shall be performed under the terms of this Agreement.

Section 2.3 Bundling of Contracts

2.3.1 The City, in its sole discretion, may seek to group (or "bundle") for bidding, contracts not meeting the threshold of Section 2.2 above. (Small contracts for like types of work, scheduled to be undertaken at the same facility or on the same project site, and within the same timeframe, will be considered for such bundling, consistent with economies of scale, and the purposes of this Agreement); and

2.3.2 Project Work will not be intentionally split, divided or otherwise separated for contract award purposes to avoid application of this Agreement.

Section 2.4 Applicability This Agreement shall not apply to any work of any Contractor other than that on Project Work specifically covered by this Agreement.

Section 2.5 Exclusions Items specifically excluded from the scope of this Agreement include the following:

2.5.1 Work of non-manual employees, including but not limited to: superintendents; teachers; supervisors (except those covered by Master Labor Agreements above the level of general foreman); staff engineers; time keepers; mail carriers; clerks; office workers; messengers; guards; safety personnel; emergency medical and first aid technicians; and other professional, engineering, executive, administrative, supervisory and management employees;

2.5.2 Equipment and machinery owned or controlled and operated by the City;

2.5.3 All off-site manufacture and handling of materials, equipment or machinery; provided, however, that lay down or storage areas for equipment or material and manufacturing (prefabrication) sites, dedicated solely to the Project, and the movement of materials or goods between such locations and a Project site are within the scope of this Agreement;

2.5.4 All work performed by City employees, the CWA Administrator, design teams (including, but not limited to architects engineers and master planners), or any other consultants for the City (including, but not limited to, project managers and construction managers and their employees where not engaged in Project Work) and their sub-consultants, and other employees of professional service organizations, not performing manual labor within the scope of this Agreement; provided, however, that it is understood and agreed that Surveyors and Building/Construction Inspector and Field Soils and Materials Testers (Inspectors) are a covered craft under the Agreement. This inclusion applies to the scope of work defined in the State of California Wage Determination for said Craft. This shall also specifically include such work where it is referred to by utilization of such terms as "quality control" or "quality assurance." Every Surveyor and Inspector performing under the wage classifications of Surveyor and Building/Construction Inspector and Field Soils and Material Testers under a professional services agreement or a construction contract shall be bound to all applicable requirements of the CWA. Covered Work as defined by this Agreement shall be performed pursuant to the terms and conditions of this Agreement regardless of the manner in which the work was awarded;

2.5.5 Any work performed near, or leading to a site of work covered by this Agreement and undertaken by state, county or other governmental bodies, or their Contractors; or by public utilities, or their Contractors; and/or by adjacent third-party landowners; and/or by the City or its Contractors (for work which is not within the scope of this Agreement);

2.5.6 Off-site maintenance of leased equipment and on-site supervision of such work;

2.5.7 It is recognized that certain equipment and systems of a highly technical and specialized nature will have to be installed at the Project. The nature of the equipment and systems, together with requirements of a manufacturer's warranty, may dictate that it be prefabricated, pre-piped, and/or pre-wired and that it be installed under the supervision and direction of the Owner's and/or manufacturer's personnel. The Unions agree to install such material, equipment and systems without incident, or allow such installation to be performed by the manufacturer's employees or a contractor certified by the manufacturer where the Unions are unable to perform

such work or the warranty requires the work to be performed by the employees of the manufacturer or a contractor certified by the manufacturer. If a warranty on the manufacturer's specialty or technical equipment or systems purchased by the Owner requires that the installation of such specialty or technical equipment or system be performed by the manufacturer's own personnel, then such installation may be performed by the manufacturer's own personnel. If a warranty on the manufacturer's specialty or technical equipment or systems purchased by the Owner requires that the installation of such specialty or technical equipment or system be performed by a contractor certified by the manufacturer, and there are no Union signatory contractors certified by the manufacturer to install and/or perform such work, then such installation may be performed by such certified contractor. The General Contractor shall notify the Unions at the pre-job conference of the use of this provision and shall provide copies of the written warranty that require that the work be performed by the manufacturer's own personnel, or a contractor certified by the manufacturer, to the affected Union. When the warranty does not require installation by the manufacturer's own personnel or a contractor certified by the manufacturer, the Unions agree to perform and install such work under the supervision and direction of the manufacturer's representative. This shall not apply to construction equipment.

2.5.8 Non-construction support services contracted by the City, City consultants, the CWA Administrator, or Contractor in connection with a Project;

2.5.9 Laboratory work for testing.

2.5.10 Coverage Exception This Agreement shall not apply if the City receives funding or assistance from any Federal, State, local or other public entity for the Construction Contract if a requirement, condition or other term of receiving that funding or assistance, at the time of the awarding of the contract, is that the City not require, bidders, contractors, or other persons or entities to enter into an agreement with one or more labor organizations. The City agrees that it will make a reasonable effort to establish the enforcement of this Agreement with any governmental agency or granting authority.

2.5.11 Work on the Project performed as a result of a threat to life, limb or property or other emergency circumstances requiring immediate action.

Section 2.6 Awarding of Contracts for Project Work

2.6.1 The City and/or the Contractors, as appropriate, have the absolute right to award contracts or subcontracts on Project Work to any Contractor notwithstanding the existence or non-existence of any agreements between such Contractor and any Union parties, provided only that such Contractor is ready, willing, and able to execute and comply with this Agreement should such Contractor be awarded work covered by this Agreement.

2.6.2 It is agreed that all Contractors of whatever tier, who have been awarded Project Work contracts, shall be required to accept and be bound to the terms and conditions of this Agreement, and shall evidence their acceptance by the execution of the Letter of Assent set forth in "**Attachment A**" hereto, prior to the commencement of any Project Work. At the time that any Contractor enters into a subcontract with any subcontractor of any tier providing for the performance of the construction contract, the Contractor shall provide a copy of this Agreement to

said subcontractor and shall require the subcontractor, as a part of accepting the award of a construction subcontract, to agree in writing in the form of a Letter of Assent to be bound by each and every provision of this Agreement prior to the commencement of work on the Project. No Contractor or subcontractor shall commence Project Work without having first provided a copy of the Letter of Assent as executed by it to the CWA Administrator and to the Trades Council before the commencement of Project Work.

Section 2.7 Master Labor Agreements

2.7.1 The provisions of this Agreement, including the Master Labor Agreements as such may be changed from time-to-time and which also are incorporated herein by reference, shall apply to Project Work. This Agreement is not intended to supersede such Master Labor Agreements between any of the Contractors performing construction work on the Project and a Union signatory thereto except to the extent the provisions of this Agreement are inconsistent with such Master Labor Agreements, in which event the provisions of this Agreement shall apply. However, such does not apply to work performed under the National Cooling Tower Agreement, the National Stack Agreement, the National Transit Division Agreement (NTD), work within the jurisdiction of the International Union of Elevator Constructors, and all instrument calibration and loop checking work performed under the terms of the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians except that Article 9 dealing with Strikes, Work Stoppages and Lock-Outs, Work Assignments and Jurisdictional Disputes, and Settlement of Grievances and Disputes shall apply to such work. Where a subject is covered by the provisions of a Master Labor Agreement and not in conflict with the provisions of this Agreement, the provisions of the Master Labor Agreement shall apply. It is specifically agreed that no later agreement shall be deemed to have precedence over this Agreement unless signed by all parties signatory hereto who are then currently employed or represented at the Project. Any dispute as to the applicable source between this Agreement and any Master Labor Agreements for determining the wages, hours of working conditions of employees on this Project shall be resolved under the procedures established in Article 10.

2.7.2 It is understood that this Agreement, together with the referenced Master Labor Agreements, constitutes a self-contained, stand-alone agreement and by virtue of having become bound to this Agreement, the Contractor will not be obligated to sign any other local, area or national collective bargaining agreement as a condition of performing work within the scope of this Agreement (provided, however, that the Contractor may be required to sign a uniformly applied, non-discriminatory Subscription Agreement at the request of the trustees or administrator of a trust fund established pursuant to Section 302 of the Labor Management Relations Act, and to which such Contractor is bound to make contributions under this Agreement, provided that such Subscription Agreement does not purport to bind the Contractor beyond the terms and conditions of this Agreement and/or expand its obligation to make contributions pursuant thereto). It shall be the responsibility of the prime Contractor to have each of its subcontractors sign the appropriate Subscription Agreement, with the appropriate Craft Union prior to the subcontractor beginning work on Project Work.

Section 2.8 Binding Signatories Only This Agreement shall only be binding on the signatory Parties hereto, and shall not apply to the parents, affiliates, subsidiaries, or other ventures of any such Party not performing Project Work.

Section 2.9 Other City Work Nothing contained herein shall be interpreted to prohibit, restrict, or interfere with the performance of any other operation, work or function not covered by this Agreement, which may be performed by City employees or contracted for by the City for its own account, on its property or in and around a Project site.

Section 2.10 Separate Liability It is understood that the liability of the Contractor(s) and the liability of the separate Unions under this Agreement shall be several and not joint. The Unions agree that this Agreement does not have the effect of creating any joint employment status between or among the City or CWA Administrator and/or any Contractor.

Section 2.11 Completed Project Work As areas of Project Work are accepted by the City, this Agreement shall have no further force or effect on such items or areas except where the Contractor is directed by the City or its representatives to engage in repairs, modification, check-out and/or warranties functions required by its contract(s) with the City under the original contract.

ARTICLE 3
UNION RECOGNITION AND EMPLOYMENT

Section 3.1 Recognition The Contractor recognizes the Trades Council and the Unions as the sole and exclusive bargaining representative for the employees engaged in Project Work. Contractors further recognize that the Unions shall be the primary source of all craft labor employed on the Projects. In the event that a Contractor has its own core workforce, said Contractor shall follow the procedures outlined below.

Section 3.2 Contractor Selection of Employees The Contractor shall have the right to determine the competency of all employees, the number of employees required, the duties of such employees within their craft jurisdiction, and shall have the sole responsibility for selecting employees to be laid off, consistent with Section 3.3 and Section 4.2, below. The Contractor shall also have the right to reject any applicant referred by a Union for any reason, subject to any reporting pay required by Section 6.6; provided, however, that such right is exercised in good faith and not for the purpose of avoiding the Contractor's commitment to employ qualified workers through the procedures endorsed in this Agreement.

Section 3.3 Referral Procedures

3.3.1 For signatory Unions now having a job referral system contained in a Master Labor Agreement, the Contractor agrees to comply with such system and it shall be used exclusively by such Contractor, except as modified by this Agreement. Such job referral system will be operated in a nondiscriminatory manner and in full compliance with federal, state, and local laws and regulations which require equal employment opportunities and non-discrimination. All of the foregoing hiring procedures, including related practices affecting apprenticeship, shall be operated

so as to consider the goals of the City to encourage employment of City residents on the Project, and to facilitate the ability of all Contractors to meet their employment needs.

3.3.2 The local Unions will exert their best efforts to recruit and refer sufficient numbers of skilled craft workers to fulfill the labor requirements of the Contractor, including specific employment obligations to which the Contractor may be legally and/or contractually obligated; and to refer apprentices as requested to develop a larger, skilled workforce. The Unions will work with their affiliated regional and national unions, and jointly with the CWA Administrator and others designated by the City, to identify and refer competent craft persons as needed for Project Work, and to identify and hire individuals, particularly residents of the City, for entrance into joint labor/management apprenticeship programs, or to participate in other identified programs and procedures to assist individuals in qualifying and becoming eligible for such apprenticeship programs, all maintained to increase the available supply of skilled craft personnel for Project Work and future construction of maintenance work to be undertaken by the City.

3.3.3 The Union shall not knowingly refer an employee currently employed by a Contractor on a covered Project to any other Contractor.

Section 3.4 Non-Discrimination in Referral, Employment, and Contracting The Unions and Contractors agree that they will not discriminate against any employee or applicant for employment in hiring and dispatching on the basis of race, color, religion, sex, gender, national origin, age, membership in a labor organization, sexual orientation, political affiliation, marital status or disability. Further, it is recognized that the City has certain policies, programs, and goals for the utilization of local small business enterprises. The Parties shall jointly endeavor to assure that these commitments are fully met, and that any provisions of this Agreement which may appear to interfere with local small business enterprises successfully bidding for work within the scope of this Agreement shall be carefully reviewed, and adjustments made as may be appropriate and agreed upon among the Parties, to ensure full compliance with the spirit and letter of the City's policies and commitment to its goals for the significant utilization of local small businesses as direct Contractors or suppliers for Project Work.

Section 3.5 Employment of City Residents

3.5.1 The Unions and Contractors agree that, to the extent allowed by law, and as long as they possess the requisite skills and qualifications, the Unions will exert their best efforts to refer and/or recruit sufficient numbers of skilled craft "Local Residents," as defined herein, to fulfill the requirements of the Contractors. In recognition of the fact that the City and the communities surrounding Project Work will be impacted by the construction of the Project Work, the parties agree to support the hiring of workers from the residents of these surrounding areas, as well as Veterans and individuals who have successfully completed the Building Trades Multi-Craft Core Curriculum Pre-Apprenticeship Program, regardless of where they reside, for Project Work. Towards that end, the Unions shall exert their best efforts to encourage and provide referrals and utilization of qualified workers, first, to those residing in U. S. Postal Service zip codes which overlap all of the City of Santa Ana, as set forth in "**Attachment B**" attached hereto, as well as Veterans, regardless of where they reside ("Tier 1"). If the Unions cannot provide the Contractors in the attainment of a sufficient number of qualified workers from Tier 1, second, the Unions shall

exert their best efforts to then recruit and identify for referral qualified workers residing within the County of Orange and individuals who have successfully completed the Building Trades Multi-Craft Core Curriculum Pre-Apprenticeship Program, regardless of where they reside ("Tier 2"). For Dispatch purposes, employees residing within either of these two (2) tiers, as well as Veterans and individuals who have successfully completed the Building Trades Multi-Craft Core Curriculum Pre-Apprenticeship Program, regardless of where they reside, shall be referred to as Local Residents.

3.5.2 A goal of 30% of the total work hours performed on each Project shall be performed by Local Residents.

3.5.3 The Unions agree to support the operation of pre-apprentice referral programs in the City. Further, the Unions agree to place on their referral roles or in their apprentice training programs, as appropriate and needed, qualified persons sent to them by designated City organizations or other organizations working with the City to increase construction industry work opportunities for City residents.

Section 3.6 Requirements on Contractors To facilitate the dispatch of Local Residents, all Contractors will be required to utilize the Craft Employee Request Form whenever they are requesting the referral of any employee from a Union referral list for any Covered Project, a sample of which is attached as "**Attachment C**." When Local Residents are requested by the Contractors, the Unions will refer such workers regardless of their place in the Unions' hiring halls' list and normal referral procedures.

Section 3.7 Helmets to Hardhats The Contractors and the Unions recognize a desire to facilitate the entry into the building and construction trades of Veterans who are interested in careers in the building and construction industry. The Contractors and Unions agree to utilize the services of non-profit Veterans support organizations, including but not limited to, the Center for Military Recruitment, Assessment and Veterans Employment (hereinafter "Center") and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the Parties. For purposes of this Agreement the term "Eligible Veteran" shall have the same meaning as the term "veteran" as defined under Title 5, Section 2108(1) of the United States Code as the same may be amended or re-codified from time to time. It shall be the responsibility of each qualified applicant to provide the Unions with proof of his/her status as an Eligible Veteran.

3.7.1 The Unions and Contractors agree to coordinate with non-profit Veteran organizations, including, the Center to create and maintain an integrated database of veterans interested in working on this Project Work and of apprenticeship and employment opportunities for working on Project Work. To the extent permitted by law, the Unions will give credit to such Veterans for bona fide, provable past experience.

Section 3.8 Core Employees

3.8.1 Contractors not currently signatory to a Master Labor Agreement may employ, as needed, first, a member of its core workforce, then an employee through a referral from the appropriate Union hiring hall, then a second core employee, then a second employee through the referral system, and so on until a maximum of five (5) core employees are employed in the Contractor's workforce, thereafter, all additional employees in the affected trade or craft shall be requisitioned from the craft hiring hall in accordance with Section 3.3. In the laying off of employees, the number of core employees shall not exceed one-half plus one of the workforce for an employer with 10 or fewer employees, assuming the remaining employees are qualified to undertake the work available. As part of this process, and in order to facilitate the contract administration procedures, as well as appropriate fringe benefit fund coverage, all Contractors shall require their core employees and any other persons employed other than through the referral process, to register with the appropriate Union hiring hall, if any, prior to their first day of employment at a project site.

3.8.2 The core work force is comprised of those employees whose names appeared on the Contractor's active payroll for sixty (60) of the one hundred (100) working days immediately before award of Project Work to the Contractor; who have worked at least two-thousand (2,000) hours in the construction craft in which they are employed, during the prior four (4) years; who possess any license required by state or federal law for the Project Work to be performed; and, who have the ability to safely perform the basic functions of the applicable trade.

3.8.3 Prior to each Contractor performing any work on the Project, each Contractor shall provide a list of his core employees to the CWA Administrator and the Trades Council. Failure to do so will prohibit the Contractor from using any core employees. Upon request by any Party to this Agreement, the Contractor hiring any core employee shall provide satisfactory proof (i.e., payroll records, quarterly tax records, driver's license, voter registration, postal address and such governmental documentation) evidencing the core employee's qualification as a core employee to the CWA Administrator and the Trades Council.

Section 3.9 Time for Referral If any Union's registration and referral system does not fulfill the requirements for specific classifications requested by any Contractor within forty-eight (48) hours (excluding Saturdays, Sundays and holidays), that Contractor may use employment sources other than the Union registration and referral services, and may employ applicants meeting such classification from any other available source. The Contractors shall inform the Union of any applicants hired from other sources and such applicants shall register with the appropriate hiring hall, if any, before commencing work.

Section 3.10 Lack of Referral Procedure If a signatory Union does not have a job referral system as set forth in Section 3.3 above, the Contractors shall give the Union equal opportunity to refer applicants. Contractors shall notify the Union of employees so hired, as set forth in Section 3.5.

Section 3.11 Union Membership Employees are not required to become or remain union members or pay dues or fees as a condition of performing Project Work under this Agreement.

Contractors shall make and transmit all deductions for union dues, fees, and assessments that have been authorized by employees in writing in accordance with the applicable Master Labor Agreement. Nothing in this Section 3.11 is intended to supersede independent requirements of applicable Master Labor Agreements as to those Contractors otherwise signatory to such Master Labor Agreements and as to the employees of those Contractors who are performing Project Work

Section 3.12 Individual Seniority Except as provided in Section 4.3, individual seniority shall not be recognized or applied to employees working on Project Work; provided, however, that group and/or classification seniority in a Union's Master Labor Agreement as of the Effective Date of this Agreement shall be recognized for purposes of layoffs.

Section 3.13 Foremen The selection and number of craft foreman and/or general foreman shall be the responsibility of the Contractor. All foremen shall take orders exclusively from the designated Contractor representatives. Craft foreman shall be designated as working foreman at the request of the Contractors.

Section 3.14 Out of State Workers In determining compliance with the targeted hiring goals of Section 3.5 above, hours of Project Work performed by residents of states other than California will be excluded from the calculation.

ARTICLE 4
UNION ACCESS AND STEWARDS

Section 4.1 Access to Project Sites Authorized representatives of the Union shall have access to Project Work, provided that they do not interfere with the work of employees and further provided that such representatives shall notify the person charged with on-site project supervision and fully comply with posted visitor, security and safety rules.

Section 4.2 Stewards

4.2.1 Each signatory Union shall have the right to dispatch a working journeyperson as a steward for each shift, and shall notify the Contractor in writing of the identity of the designated steward or stewards prior to the assumption of such person's duties as steward. Such designated steward or stewards shall not exercise any supervisory functions. There will be no non-working stewards. Stewards will receive the regular rate of pay for their respective crafts.

4.2.2 In addition to his/her work as an employee, the steward should have the right to receive, but not to solicit, complaints or grievances and to discuss and assist in the adjustment of the same with the employee's appropriate supervisor. Each steward should be concerned only with the employees of the steward's Contractor and, if applicable, subcontractor(s), and not with the employees of any other Contractor. A Contractor will not discriminate against the steward in the proper performance of his/her Union duties.

4.2.3 When a Contractor has multiple, non-contiguous work locations at one site, the Contractor may request and the Union shall appoint such additional working stewards as the

Contractor requests to provide independent coverage of one or more such locations. In such cases, a steward may not service more than one work location without the approval of the Contractor.

4.2.4 The stewards shall not have the right to determine when overtime shall be worked or who shall work overtime.

Section 4.3 Steward Layoff/Discharge Contractor agrees to notify the appropriate Union twenty-four (24) hours before the layoff of a steward, except in the case of disciplinary discharge for just cause. If the steward is protected against such layoff by the provisions of the applicable Master Labor Agreement, such provisions shall be recognized when the steward possesses the necessary qualifications to perform the remaining work. In any case in which the steward is discharged or disciplined for just cause, the appropriate Union will be notified immediately by the Contractor, and such discharge or discipline shall not become final (subject to any later filed grievance) until twenty-four (24) hours after such notice has been given.

ARTICLE 5
WAGES AND BENEFITS

Section 5.1 Wages All employees covered by this Agreement shall be classified in accordance with work performed and paid by the Contractors the hourly wage rates for those classifications in compliance with the applicable prevailing wage rate determination established pursuant to applicable law. If a prevailing rate increases under law, the Contractor shall pay that rate as of its effective date under the law. This Agreement does not relieve Contractors directly signatory to a Master Labor Agreement with one of the Unions signing this Agreement from paying all of the wages set forth in such Agreements.

Section 5.2 Benefits

5.2.1 Contractors shall pay contributions to the established employee benefit funds in the amounts designated in the appropriate Master Labor Agreement and make all employee–authorized deductions in the amounts designated in the appropriate Master Labor Agreement, however, such contributions shall not exceed the contribution amounts set forth in the applicable prevailing wage determination. This Agreement does not relieve Contractors directly signatory to one or more of the Master Labor Agreements from making all contributions set forth in those Master Labor Agreements without reference to the foregoing.

5.2.2 The Contractor adopts and agrees to be bound by the written terms of the applicable, legally established, trust agreement(s) specifying the detailed basis on which payments are to be made into, and benefits paid out of, such trust funds for its employees. The Contractor authorizes the Parties to such trust funds to appoint trustees and successor trustees to administer the trust funds and hereby ratifies and accepts the trustees so appointed as if made by the Contractor.

5.2.3 Each Contractor and subcontractor is required to certify to the CWA Administrator that it has paid all benefit contributions due and owing to the appropriate Trust(s) prior to the receipt of its final payment and/or retention. Further, upon timely notification by a Union to the CWA Administrator, the CWA Administrator shall work with any prime Contractor or

subcontractor who is delinquent in payments to assure that proper benefit contributions are made, to the extent of requesting the City or the prime Contractor to withhold payments otherwise due such Contractor, until such contributions have been made or otherwise guaranteed.

Section 5.3 Wage Premiums Wage premiums, including but not limited to pay based on height of work, hazard pay, scaffold pay and special skills shall not be applicable to work under this Agreement, except to the extent provided for in any applicable prevailing wage determination.

ARTICLE 6
HOURS OF WORK, OVERTIME, SHIFTS AND HOLIDAYS

Section 6.1 Hours of Work Eight (8) hours per day between the hours of 6:00 a.m. and 5:30 p.m., plus one-half (½) hour unpaid lunch approximately mid-way through the shift, shall constitute the standard work day. Forty (40) hours per week shall constitute a regular week's work. The work week will start on Sunday and conclude on Saturday. The foregoing provisions of this Article are applicable unless otherwise provided in the applicable prevailing wage determination, or unless changes are permitted by law and such are agreed upon by the Parties. Nothing herein shall be construed as guaranteeing any employee eight (8) hours per day or forty (40) hours per week, or a Monday through Friday standard work schedule.

Section 6.2 Place of Work Employees shall be at their place of work (as designated by the Contractor), at the starting time and shall remain at their place of work, performing their assigned functions, until quitting time. The place of work is defined as the gang or tool box or equipment at the employee's assigned work location or the place where the foreman gives instructions. The Parties reaffirm their policy of a fair day's work for a fair day's wage. Except as provided in Section 6.6, there shall be no pay for time not worked unless the employee is otherwise engaged at the direction of the Contractor.

Section 6.3 Overtime Overtime shall be paid in accordance with the requirements of the applicable prevailing wage determination. There shall be no restriction on the Contractor's scheduling of overtime or the nondiscriminatory designation of employees who will work overtime. There shall be no pyramiding of overtime (payment of more than one form of overtime compensation for the same hour) under any circumstances.

Section 6.4 Shifts and Alternate Work Schedules

6.4.1 Alternate starting and quitting time and/or shift work may be performed at the option of the Contractor upon three (3) days' prior notice to the affected Union(s), unless a shorter notice period is provided for in the applicable Master Labor Agreement If two shifts are worked, each shall consist of eight (8) hours of continuous work exclusive of a one-half (½) hour non-paid lunch period, for eight (8) hours pay. The last shift shall start on or before 6:00 p.m. The first shift starting at or after 6:00 a.m. is designated as the first shift, with the second shift following.

6.4.2 Contractors, the Trades Council and the Union recognize the economic impact upon the City and City residents of the Project being undertaken by the City and agree that all Parties to

this Agreement desire and intend Project Work to be undertaken in a cost efficient and effective manner to the highest standard of quality and craftsmanship. Recognizing the economic conditions, the Parties agree that, except to the extent permitted by law, employees performing Project Work shall not be entitled to any differentials or additional pay based upon the shift or work schedule of the employees. Instead, all employees working on Project Work shall be paid at the same base rate regardless of shift or work schedule worked.

6.4.3 Because of operational necessities, the second shift may, at the City's direction, be scheduled without the preceding shift having been worked. It is recognized that the City's operations and/or mitigation obligations may require restructuring of normal work schedules. Except in an emergency or when specified in the City's bid specification, the Contractor shall give affected Union(s) at least three (3) days' notice of such schedule changes.

Section 6.5 Holidays Recognized holidays for Project Work shall be those set forth and governed by the prevailing wage determination(s) applicable to such Project Work.

Section 6.6 Show-up Pay

6.6.1 Except as otherwise required by State law, Employees reporting for work and for whom no work is provided, except when given prior notification not to report to work, shall receive two (2) hours pay at the regular straight time hourly rate. Employees who are directed to start work shall receive four (4) hours of pay at the regular straight time hourly rate. Employees who work beyond four (4) hours shall be paid for actual hours worked. Whenever reporting pay is provided for employees, they will be required to remain at the Project Site and available for work for such time as they receive pay, unless released earlier by the principal supervisor of the Contractor(s) or his/her designated representative. Each employee shall furnish his/her Contractor with his/her current address and telephone number, and shall promptly report any changes to the Contractor.

6.6.2 An employee called out to work outside of his/her shift shall receive a minimum of two (2) hours pay at the appropriate rate. This does not apply to time worked as an extension of (before or after) the employee's normal shift.

6.6.3 When an employee leaves the job or work location of his/her own volition, or is discharged for cause or is not working, the employee shall only be paid for actual time worked.

Section 6.7 Meal Periods The Contractor will schedule a meal period of no more than one-half hour duration at the work location at approximately mid-point of the schedule shift; provided, however, that the Contractor may, for efficiency of the operation, establish a schedule which coordinates the meal periods of two or more crafts. An employee may be required to work through his meal period because of an emergency or a threat to life or property, or for such other reasons as are in the applicable Master Labor Agreement, and if he is so required, he shall be compensated in the manner established in the applicable Master Labor Agreement.

Section 6.8 Make-up Days To the extent permitted by the applicable general wage determination, when an employee has been prevented from working for reasons beyond the control of the employer, including, but not limited to inclement weather or other natural causes, during the

regularly scheduled work week, a make-up day may be worked on a non-regularly scheduled work day for which an employee shall receive eight (8) hours pay at the straight time rate of pay or any premium rate required for such hours under the state prevailing wage law.

ARTICLE 7
WORK STOPPAGES AND LOCK-OUTS

Section 7.1 No Work Stoppages or Disruptive Activity The Trades Council and the Unions signatory hereto agree that neither they, and each of them, nor their respective officers or agents or representatives, shall incite or encourage, condone or participate in any strike, walk-out, slow-down, picketing, observing picket lines or other activity of any nature or kind whatsoever, for any cause or dispute whatsoever with respect to or in any way related to Project Work, or which interferes with or otherwise disrupts, Project Work, or with respect to or related to the City or Contractors, including, but not limited to, economic strikes, unfair labor practice strikes, safety strikes, sympathy strikes and jurisdictional strikes whether or not the underlying dispute is arbitrable. Any such actions by the Trades Council, or Unions, or their members, agents, representatives or the employees they represent shall constitute a violation of this Agreement. The Trades Council and the Union shall take all steps necessary to obtain compliance with this Article and neither should be held liable for conduct for which it is not responsible.

Section 7.2 Employee Violations The Contractor may discharge any employee violating Section 7.1 above and any such employee will not be eligible for rehire under this Agreement.

Section 7.3 Standing to Enforce The City, the CWA Administrator, or any Contractor affected by an alleged violation of Section 7.1 shall have standing and the right to enforce the obligations established therein.

Section 7.4 Expiration of Master Labor Agreement If the Master Labor Agreement, or any local, regional, and other applicable collective bargaining agreements expire during the term of the Project, the Union(s) agree that there shall be no work disruption of any kind as described in Section 7.1 above as a result of the expiration of any such agreement(s) having application on this Project and/or failure of the involved Parties to that agreement to reach a new contract. Terms and conditions of employment established and set at the time of bid shall remain established and set. Otherwise to the extent that such agreement does expire and the Parties to that agreement have failed to reach concurrence on a new contract, work will continue on the Project on one of the following two (2) options, both of which will be offered by the Unions involved to the Contractors affected:

7.4.1 Each of the Unions with a contract expiring must offer to continue working on the Project under interim agreements that retain all the terms of the expiring contract, except that the Unions involved in such expiring contract may each propose wage rates and employer contribution rates to employee benefit funds under the prior contract different from what those wage rates and employer contributions rates were under the expiring contracts. The terms of the Union's interim agreement offered to Contractors will be no less favorable than the terms offered by the Union to any other employer or group of employers covering the same type of construction work in Orange County.

7.4.2 Each of the Unions with a Master Labor Agreement expiring must offer to continue working on the Project under all the terms of the expiring contract, including the wage rates and employer contribution rates to the employee benefit funds, if the Contractor affected by that expiring contract agrees to the following retroactive provisions: if a new Master Labor Agreement, local, regional or other applicable labor agreement for the industry having application at the Project is ratified and signed during the term of this Agreement and if such new labor agreement provides for retroactive wage increases, then each affected Contractor shall pay to its employees who performed work covered by this Agreement at the Project during the hiatus between the effective dates of such expired and new labor agreements, an amount equal to any such retroactive wage increase established by such new labor agreement, retroactive to whatever date is provided by the new labor agreement for such increase to go into effect, for each employee's hours worked on the Project during the retroactive period. All Parties agree that such affected Contractors shall be solely responsible for any retroactive payment to its employees.

7.4.3 Some Contractors may elect to continue to work on the Project under the terms of the interim agreement option offered under paragraph 7.4.1 and other Contractors may elect to continue to work on the Project under the retroactivity option offered under paragraph 7.4.2. To decide between the two options, Contractors will be given one week after the particular labor agreement has expired or one week after the Union has personally delivered to the Contractors in writing its specific offer of terms of the interim agreement pursuant to paragraph 7.4.1, whichever is the later date. If the Contractor fails to timely select one of the two options, the Contractor shall be deemed to have selected the provisions of 7.4.2.

Section 7.5 No Lockouts Contractors shall not cause, incite, encourage, condone or participate in any lock-out of employees with respect to Project Work during the term of this Agreement. The term "lock-out" refers only to a Contractor's exclusion of employees in order to secure collective bargaining advantage, and does not refer to the discharge, termination or layoff of employees by the Contractor for any reason in the exercise of rights pursuant to any provision of this Agreement, or any other agreement, nor does "lock-out" include the City's decision to stop, suspend or discontinue any Project Work or any portion thereof for any reason.

Section 7.6 Best Efforts to End Violations

7.6.1 If a Contractor contends that there is any violation of this Article or Section 8.3, it shall notify, in writing, the Executive Secretary of the Trades Council, the Senior Executive of the involved Union(s) and the CWA Administrator. The Executive Secretary and the leadership of the involved Union(s) will immediately instruct, order and use their best efforts to cause the cessation of any violation of the relevant Article.

7.6.2 If the Union contends that any Contractor has violated this Article, it will notify that the Contractor and the CWA Administrator, setting forth the facts which the Union contends violate the Agreement, at least twenty-four (24) hours prior to invoking the procedures of Section 7.8. The CWA Administrator shall promptly order the involved Contractor(s) to cease any violation of the Article.

Section 7.7 Withholding of services for failure to pay wages and fringe benefits

7.7.1 Notwithstanding any provision of this Agreement to the contrary, it shall not be a violation of this Agreement for any Union to withhold the services of its members (but not the right to picket) from a particular Contractor who:

(a) fails to timely pay its weekly payroll; or

(b) fails to make timely payments to the Union's Joint Labor/Management Trust Funds in accordance with the provisions of the applicable Master Labor Agreements. Prior to withholding its members' services for the Contractor's failure to make timely payments to the Union's Joint Labor/Management Trust Funds, the Union shall give at least ten (10) days (unless a lesser period of time is provided in the Union's Master Labor Agreement, but in no event less than forty-eight (48) hours) written notice of such failure to pay by registered or certified mail, return receipt requested, and by facsimile transmission to the involved Contractor and to the City. Union will meet within the ten (10) day period to attempt to resolve the dispute.

7.7.2 Upon the payment of the delinquent Contractor of all monies due and then owing for wages and/or fringe benefit contributions, the Union shall direct its members to return to work and the Contractor shall return all such members back to work.

Section 7.8 Expedited Enforcement Procedure Any party, including the City, which the Parties agree is a Party to the Agreement for purposes of this Article and an intended beneficiary of this Article, or the CWA Administrator, may institute the following procedures, in lieu of or in addition to any other action at law or equity, when a breach of Section 7.1 or 7.5, above, or Section 8.3 is alleged.

7.8.1 The Party invoking this procedure shall notify the first arbitrator identified in the List of Arbitrators attached hereto as **Attachment D.** If this arbitrator identified in Attachment D is unavailable at any time, any one of the permanent Arbitrators who is notified shall appoint his alternate to hear the matter. Expenses incurred in arbitration shall be borne equally by the Parties involved in the arbitration and the decision of the arbitrator shall be final and binding on the Parties, provided, however, that the arbitrator shall not have the authority to alter or amend or add to or delete from the provisions of this Agreement in any way. Notice to the arbitrator shall be by the most expeditious means available, with notices to the Parties alleged to be in violation, and to the Trades Council if it is a Union alleged to be in violation. For purposes of this Article, written notice may be given by telegram, facsimile, hand delivery or overnight mail and will be deemed effective upon receipt.

7.8.2 Upon receipt of said notice, the arbitrator named above or his/her alternate shall sit and hold a hearing within twenty-four (24) hours if it is contended that the violation still exists, but not sooner than twenty-four (24) hours after notice has been dispatched to the Executive Secretary and the Senior Official(s) as required by Section 7.6, as above.

7.8.3 The arbitrator shall notify the Parties of the place and time chosen for this hearing. Said hearing shall be completed in one session, which, with appropriate recesses at the arbitrator's

discretion, shall not exceed 24 hours unless otherwise agreed upon by all Parties. A failure of any Party or Parties to attend said hearings shall not delay the hearing of evidence or the issuance of any award by the arbitrator.

7.8.4 The sole issue at the hearing shall be whether or not a violation of Sections 7.1 or 7.5, above, or Section 8.3 has in fact occurred. The arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation. The award shall be issued in writing within three (3) hours after the close of the hearing, and may be issued without an opinion. If any Party desires a written opinion, one shall be issued within fifteen (15) days, but its issuance shall not delay compliance with, or enforcement of, the Award. The arbitrator may order cessation of the violation of the Article and other appropriate relief, and such award shall be served on all Parties by hand or registered mail upon issuance.

7.8.5 Such award shall be final and binding on all Parties and may be enforced by any court of competent jurisdiction upon the filing of this Agreement and all other relevant documents referred to herein above in the following manner. Written notice of the filing of such enforcement proceedings shall be given to the other Party. In any judicial proceeding to obtain a temporary order enforcing the arbitrator's award as issued under this Article, all Parties waive the right to a hearing and agree that such proceedings may be ex parte. Such agreement does not waive any Party's right to participate in a hearing for a final order of enforcement. The court's order or orders enforcing the arbitrator's award shall be served on all Parties by hand or by delivery to their address as shown on this Agreement (for a Union), as shown on their business contract for work under this Agreement (for a Contractor) and to the representing Union (for an employee), by certified mail by the Party or Parties first alleging the violation.

7.8.6 Any rights created by statute or law governing arbitration proceedings inconsistent with the above procedure or which interfere with compliance hereto are hereby waived by the Parties to whom they accrue.

7.8.7 The fees and expenses of the arbitrator shall be equally divided between the Party or Parties initiating this procedure and the respondent Party or Parties.

ARTICLE 8
WORK ASSIGNMENTS AND JURISDICTIONAL DISPUTES

Section 8.1 Assignment of Work The assignment of Project Work will be solely the responsibility of the Contractor performing the work involved; and such work assignments will be in accordance with the Plan for the Settlement of Jurisdictional Disputes in the Construction Industry (the "Plan") or any successor Plan.

Section 8.2 The Plan All jurisdictional disputes on Project Work between or among the building and construction trades Unions and the craft employers parties to this Agreement, shall be settled and adjusted according to the present Plan established by the Building and Construction Trades Department or any other plan or method of procedure that may be adopted in the future by the Building and Construction Trades Department. Decisions rendered shall be final, binding and conclusive on the Employers and Unions parties to this Agreement.

8.2.1 If a dispute arising under this Article involves the Southwest Mountain States Regional Council of Carpenters or any of its subordinate bodies, an Arbitrator shall be chosen by the procedures specified in Article V, Section 5, of the Plan from a list composed of John Kagel, Robert Hirsch, and Thomas Pagan, and the Arbitrator's hearing on the dispute shall be held at the offices of the Trades Council within fourteen (14) days of the selection of the Arbitrator. All other procedures shall be as specified in the Plan.

Section 8.3 No Work Disruption Over Jurisdiction All jurisdictional disputes shall be resolved without the occurrence of any strike, work stoppage, or slow-down of any nature, and the Employer's assignment shall be adhered to until the dispute is resolved. Individuals violating this section shall be subject to immediate discharge.

Section 8.4 Pre-Job Conferences As provided in Article 16, each Contractor will conduct a pre-job conference with the appropriate affected Union(s) prior to commencing work; provided however, at no time shall the City be responsible for additional costs related to, associated with, or resulting from Union(s) jurisdictional disputes. The Trades Council and the CWA Administrator shall be advised in advance of all such conferences and may participate if they wish.

Section 8.5 Resolution of Jurisdictional Disputes If any actual or threatened strike, sympathy strike, work stoppage, slow down, picketing, hand-billing or otherwise advising the public that a labor dispute exists, or interference with the progress of Project Work by reason of a jurisdictional dispute or disputes occurs, the Parties shall exhaust the expedited procedures set forth in the Plan, if such procedures are in the plan then currently in effect, or otherwise as in Article 7 above.

ARTICLE 9
MANAGEMENT RIGHTS

Section 9.1 Contractor and City Rights The Contractors and the City have the sole and exclusive right and authority to oversee and manage construction operations on Project Work without any limitations unless expressly limited or required by a specific provision of this Agreement or an MLA. In addition to the following and other rights of the Contractors enumerated in this Agreement, the Contractors expressly reserve their management rights and all the rights conferred upon them by law. The Contractor's rights include, but are not limited to, the right to:

(a) Plan, direct and control operations of all work;

(b) Hire, promote, transfer and layoff their own employees, respectively, as deemed appropriate to satisfy work and/or skill requirements;

(c) Promulgate and require all employees to observe reasonable job rules and security and safety regulations;

(d) Discharge, suspend or discipline their own employees for just cause;

(e) Utilize, in accordance with City approval, any work methods, procedures or techniques, and select, use and install any types or kinds of materials, apparatus or equipment,

regardless of source of manufacture or construction; assign and schedule work at their discretion; and

(f) Assign overtime, determine when it will be worked and the number and identity of employees engaged in such work, subject to such provisions in the applicable Master Labor Agreement (s) requiring such assignments be equalized or otherwise made in a nondiscriminatory manner.

Section 9.2 Specific City Rights In addition to the following and other rights of the City enumerated in this Agreement, the City expressly reserves its management rights and all the rights conferred on it by law. The City's rights (and those of the Contract Administrator on its behalf) include but are not limited to the right to:

(a) Inspect any construction site or facility to ensure that the Contractor follows the applicable safety and other work requirements;

(b) Require Contractors to establish a different work week or shift schedule for particular employees as required to meet the operational needs of the Project Work at a particular location;

(c) At its sole option, terminate, delay and/or suspend any and all portions of the covered work at any time; prohibit some or all work on certain days or during certain hours of the day to accommodate the ongoing operations of the City's Facilities and/or to mitigate the effect of ongoing Project Work on businesses and residents in the neighborhood of the Project site; and/or require such other operational or schedule changes it deems necessary, in its sole judgment, to effectively maintain its primary mission and remain a good neighbor to those in the area of its facilities. (In order to permit the Contractors and Unions to make appropriate scheduling plans, the City will provide the CWA Administrator, and the affected Contractor(s) and Union(s) with reasonable notice of any changes it requires pursuant to this section; provided, however, that if notice is not provided in time to advise employees not to report for work, show-up pay shall be due pursuant to the provision of Article 6, Section 6.6);

(d) Approve any work methods, procedures and techniques used by Contractors whether or not these methods, procedures or techniques are part of industry practices or customs; and

(e) Investigate and process complaints, through the CWA Administrator, in the matter set forth in Articles 7 and 10.

Section 9.3 Use of Materials There should be no limitations or restriction by Union upon a Contractor's choice of materials or design, nor, regardless of source or location, upon the full use and utilization, of equipment, machinery, packaging, precast, prefabricated, prefinished, or preassembled materials, tools or other labor saving devices, subject to the application of the State Public Contracts and Labor Codes as required by law. The onsite installation or application of such items shall be performed by the craft having jurisdiction over such work.

Section 9.4 Special Equipment, Warranties and Guaranties

9.4.1 It is recognized that certain equipment of a highly technical and specialized nature may be installed at Project Work sites. The nature of the equipment, together with the requirements for manufacturer's warranties, may dictate that it be prefabricated pre-piped and/or pre-wired and that it be installed under the supervision and direction of the City's and/or manufacturer's personnel. The Unions agree to install such equipment without incident.

9.4.2 The Parties recognize that the Contractor will initiate from time to time the use of new technology, equipment, machinery, tools, and other labor-savings devices and methods of performing Project Work. The Union agrees that they will not restrict the implementation of such devices or work methods. The Unions will accept and will not refuse to handle, install or work with any standardized and/or catalogue: parts, assemblies, accessories, prefabricated items, preassembled items, partially assembled items, or materials whatever their source of manufacture or construction.

9.4.3 If any disagreement between the Contractor and the Unions concerning the methods of implementation or installation of any equipment, or device or item, or method of work, arises, or whether a particular part or pre-assembled item is a standardized or catalog part or item, the work will precede as directed by the Contractor and the Parties shall immediately consult over the matter. If the disagreement is not resolved, the affected Union(s) shall have the right to proceed through the procedures set forth in Article 10.

Section 9.5 No Less Favorable Treatment The parties agree that Project Work will not receive less favorable treatment than that on any other project which the Unions, Contractors and employees work.

ARTICLE 10
SETTLEMENT OF GRIEVANCES AND DISPUTES

Section 10.1 Cooperation and Harmony on Site

10.1.1 This Agreement is intended to establish and foster continued close cooperation between management and labor. The Trades Council shall assign a representative to this Project for the purpose of assisting the local Unions, and working with the CWA Administrator, together with the Contractors, to complete the construction of the Project economically, efficiently, continuously and without any interruption, delays or work stoppages.

10.1.2 The CWA Administrator, the Contractors, Unions, and employees collectively and individually, realize the importance to all Parties of maintaining continuous and uninterrupted performance Project Work, and agree to resolve disputes in accordance with the grievance provisions set forth in this Article or, as appropriate, those of Article 7 or 8.

10.1.3 The CWA Administrator shall oversee the processing of grievances under this Article and Articles 7 and 8, including the scheduling and arrangements of facilities for meetings, selection of the arbitrator from the agreed-upon panel to hear the case, and any other administrative

matters necessary to facilitate the timely resolution of any dispute; provided, however, it is the responsibility of the principal parties to any pending grievance to insure the time limits and deadlines are met.

Section 10.2 Processing Grievances Any questions arising out of and during the term of this Agreement involving its interpretation and application, which includes applicable provisions of the Master Labor Agreement, but not jurisdictional disputes or alleged violations of Section 7.1 and 7.4 and similar provisions, shall be considered a grievance and subject to resolution under the following procedures.

Step 1. Employee Grievances When any employee subject to the provisions of this Agreement feels aggrieved by an alleged violation of this Agreement, the employee shall, through his local Union business representative or, job steward, within ten (10) working days after the occurrence of the violation, give notice to the work site representative of the involved Contractor stating the provision(s) alleged to have been violated. A business representative of the local Union or the job steward and the work site representative of the involved Contractor shall meet and endeavor to resolve the matter within ten (10) working days after timely notice has been given. If they fail to resolve the matter within the prescribed period, the grieving party may, within ten (10) working days thereafter, pursue Step 2 of this grievance procedure provided the grievance is reduced to writing, setting forth the relevant information, including a short description thereof, the date on which the alleged violation occurred, and the provision(s) of the Agreement alleged to have been violated. Grievances and disputes settled at Step 1 shall be non-precedential except as to the parties directly involved.

Union or Contractor Grievances Should the Union(s) or any Contractor have a dispute with the other Party(ies) and, if after conferring within ten (10) working days after the disputing Party knew or should have known of the facts or occurrence giving rise to the dispute, a settlement is not reached within five (5) working days, the dispute shall be reduced to writing and processed to Step 2 in the same manner as outlined in Step 1 above for the adjustment of an employee complaint.

Step 2. The business manager of the involved Union or his designee, together with the site representative of the involved Contractor, and the labor relations representative of the CWA Administrator, shall meet within seven (7) working days of the referral of the dispute to this second step to arrive at a satisfactory settlement thereof. If the Parties fail to reach an agreement, the dispute may be appealed in writing in accordance with the provisions of Step 3 within seven (7) calendar days after the initial meeting at Step 2.

Step 3. (a) If the grievance shall have been submitted but not resolved under Step 2, either the Union of Contractor Party may request in writing to the CWA Administrator (with copy(ies) to the other Party(ies) within seven (7) calendar days after the initial Step 2 meeting, that the grievance be submitted to an arbitrator selected from the agreed upon list in "Attachment (D)" attached hereto, on a rotational basis in the order listed. The CWA Administrator shall notify the parties to the grievance of the date, time and location of the hearing. The failure of any party to attend said hearing shall not delay the hearing of evidence or the issuance of any decision by the arbitrator. The decision of the arbitrator shall be final and binding on all parties.

Should any party seek confirmation of the award made by the arbitrator, the prevailing party shall be entitled to receive its reasonable attorney fees and costs.

(b) Failure of the grieving Party to adhere to the time limits established herein shall render the grievance null and void. The time limits established herein may be extended only by consent of the Parties involved at the particular step where the extension is agreed upon. The arbitrator shall have the authority to make decisions only on issues presented and shall not have the authority to change, amend, add to or detract from any of the provisions of this Agreement.

(c) The fees and expenses incurred by the arbitrator, as well as those jointly utilized by the Parties (i.e. conference room, court reporter, etc.) in arbitration, shall be divided equally by the Parties to the arbitration, including Union(s) and Contractor(s) involved.

Section 10.3 Limit on Use of Procedures The procedures contained in this Article shall not be applicable to any alleged violation of Articles 7 or 8, with a single exception that any employee discharged for violation of Section 7.2, or Section 8.3, may resort to the procedures of this Article to determine only if he/she was, in fact, engaged in that violation.

Section 10.4 Notice The CWA Administrator (and the City, in the case of any grievance regarding the Scope of this Agreement), shall be notified by the involved Contractor of all actions at Steps 2 and 3, and further, the CWA Administrator shall, upon its own request, be permitted to participate fully as a party in all proceedings at such steps.

ARTICLE 11
REGULATORY COMPLIANCE

Section 11.1 Compliance with All Laws The Trades Council and all Unions, Contractors, and their employees shall comply with all applicable federal and state laws, ordinances and regulations including, but not limited to, those relating to safety and health, employment and applications for employment. All employees shall comply with the safety regulations established by the City, the CWA Administrator or the Contractor. Employees must promptly report any injuries or accidents to a supervisor.

Section 11.2 Prevailing Wage Compliance All Contractors shall comply with the state laws and regulations, as well as Santa Ana Municipal Code section 33-206 on prevailing wages. Compliance with this obligation may be enforced by the appropriate parties through Article 10 above, or by pursing the remedies available under state law through the Labor Commissioner or the Department of Industrial Relations.

Section 11.3 Violations of Law Should there be a finding by a Court or administrative tribunal of competent jurisdiction that a Contractor has violated federal and/or state law or regulation, the City, upon notice to the Contractor that it or its subcontractors is in such violation (including any finding of non-compliance with the California prevailing wage obligations as enforced pursuant to DIR regulations), the City, and in the absence of the Contractor or subcontractor remedying such violation, may take such action as it is permitted by law or contract to encourage that

Contractor to come into compliance, including, but not limited to, assessing fines and penalties and/or removing the offending Contractor from Project Work.

ARTICLE 12
SAFETY AND PROTECTION OF PERSON AND PROPERTY

Section 12.1 Safety

12.1.1 It shall be the responsibility of each Contractor to ensure safe working conditions and employee compliance with any safety rules contained herein or established by the City or the Contractor, whichever is most restrictive shall apply. It is understood that employees have an individual obligation to use diligent care to perform their work in a safe manner and to protect themselves and the property of the Contractor and the City.

12.1.2 Employees shall be bound by the safety, security and visitor rules established by the Contractor and/or the City. These rules will be published and posted. An employee's failure to satisfy his/her obligations under this section will subject him/her to discipline, up to and including discharge.

12.1.3 The Parties shall adopt the Substance Abuse Policy attached hereto as **Attachment "E,"** which shall be the policy and procedure utilized under this Agreement.

Section 12.2 Suspension of Work for Safety A Contractor may suspend all or a portion of the job to protect the life and safety of employees. In such cases, employees will be compensated only for the actual time worked; provided, however, that where the Contractor requests employees to remain at the site and be available for work, the employees will be compensated for stand-by time at their basic hourly rate of pay.

Section 12.3 Water and Sanitary Facilities The Contractor shall provide adequate supplies of drinking water and sanitary facilities for all employees as required by state law or regulation.

ARTICLE 13
TRAVEL AND SUBSISTENCE

Travel expenses, travel time, subsistence allowances, zone rates and parking reimbursements shall be paid in accordance with the applicable Master Labor Agreement unless superseded by the applicable prevailing wage determination.

ARTICLE 14
APPRENTICES

Section 14.1 Importance of Training The Parties recognize the need to maintain continuing support of the programs designed to develop adequate numbers of competent workers in the construction industry, the obligation to capitalize on the availability of the local work force in the area served by the City, and the opportunities to provide continuing work under the construction program. To these ends, the Parties will facilitate, encourage, and assist local residents

to commence and progress in Labor/Management Apprenticeship and/or training Programs in the construction industry leading to participation in such apprenticeship programs. The City and the Trades Council, will work cooperatively to identify, or establish and maintain, effective programs and procedures for persons interested in entering the construction industry and which will help prepare them for the formal joint labor/management apprenticeship programs maintained by the signatory Unions.

Section 14.2 Use of Apprentices

14.2.1 Apprentices used on Projects under this Agreement shall be registered in Joint Labor Management Apprenticeship Programs approved by the State of California. Apprentices may comprise up to thirty percent (30%) of each craft's work force (calculated by hours worked) at any time, unless the standards of the applicable joint apprenticeship committee confirmed by the Division of Apprenticeship Standards ("DAS"), establish a lower or higher maximum percentage. Where the standards permit a higher percentage, such percentage shall apply on Project Work. Where the applicable standards establish a lower percentage, the applicable Union will use its best efforts with the Joint Labor Management apprenticeship committee and, if necessary, the DAS to permit up to thirty percent (30%) apprentices on the Project.

14.2.2 The Unions agree to cooperate with the Contractor in furnishing apprentices as requested up to the maximum percentage. The apprentice ratio for each craft shall be in compliance, at a minimum, with the applicable provisions of the Labor Code relating to utilization of apprentices. The City shall encourage such utilization, and, both as to apprentices and the overall supply of experienced workers, the CWA Administrator will work with the Trades Council to assure appropriate and maximum utilization of apprentices and the continuing availability of both apprentices and journey persons.

14.2.3 The Parties agree that apprentices will not be dispatched to Contractors working under this Agreement unless there is a journeymen working on the project where the apprentice is to be employed who is qualified to assist and oversee the apprentice's progress through the program in which he is participating.

14.2.4 All apprentices shall work under the direct supervision of a journeyman from the trade in which the apprentice is indentured. A journeyman shall be defined as set forth in the California Code of Regulations, Title 8 [apprenticeship] section 205, which defines a journeyman as a person who has either completed an accredited apprenticeship in his or her craft, or has completed the equivalent of an apprenticeship in length and content of work experience and all other requirements in the craft which has workers classified as journeyman in the apprenticeable occupation. Should a question arise as to a journeyman's qualification under this subsection, the Contractor shall provide adequate proof evidencing the worker's qualification as a journeyman to the Trades Council.

ARTICLE 15
WORKING CONDITIONS

Section 15.1 Meal and Rest Periods There will be no non-working times established during working hours except as may be required by applicable state law or regulations. Meal periods and Rest periods shall be as provided for in Wage Order 16. Individual coffee containers will be permitted at the employees' work location; however, there will be no organized coffee breaks.

Section 15.2 Work Rules The City, the CWA Administrator, and/or relevant Contractor shall establish such reasonable work rules as they deem appropriate and not inconsistent with this Agreement. These rules will be posted at the work sites by the Contractor and may be amended thereafter as necessary. Failure to observe these rules and regulations by employees may be grounds for discipline up to and including discharge.

Section 15.3 Emergency Use of Tools and Equipment There should be no restrictions on the emergency use of any tools by any qualified employee or supervisor, or on the use of any tools or equipment for the performance of work within the jurisdiction, provided the employee can safely use the tools and/or equipment involved and is compliance with applicable governmental rules and regulations.

Section 15.4 Access Restrictions for Cars Recognizing the nature of the work being conducted on the site, employee access by a private automobile may be limited to certain roads and/or parking areas.

ARTICLE 16
PRE-JOB CONFERENCES

Section 16.1 Each Primary Contractor which is awarded a Construction Contract by the City for Project Work shall conduct a Pre-Job conference with the appropriate affected Union(s) prior to commencing work. All Contractors who have been awarded contracts by the Primary Contractor shall attend the Pre-Job conference. The Trades Council and the CWA Administrator shall be advised in advance of all such conferences and may participate if they wish. All work assignments shall be disclosed by the Primary Contractor and all Contractors at the Pre-Job conference in accordance with industry practice. Should there be any formal jurisdictional dispute raised under Article 8, the CWA Administrator shall be promptly notified. Primary Contractor shall have available at the Pre-Job conference the plans and drawing for the work to be performed on the Project. Should additional Project Work not previously included within the scope of the Project Work be added, the Contractors performing such work will conduct a separate pre-job for such newly included work.

ARTICLE 17
LABOR/MANAGEMENT COOPERATION

Section 17.1 Joint Committee The Parties to this Agreement may establish a six (6) person Joint Administrative Committee (JAC). This JAC shall be comprised of three (3) representatives selected by the City and three (3) representatives selected by the Trades Council to monitor

compliance with the terms and conditions of this Agreement and to recommend amendments to this Agreement, with the exception of the dollar threshold specified in Section 2.2(a) and the term of this Agreement under Section 22.1, when doing so would be to the mutual benefit of the Parties. Each representative shall designate an alternate who shall serve in his or her absence for any purpose contemplated by this Agreement. A quorum will consist of at least two (2) representatives selected by the City and at least two (2) representatives selected by the Trades Council. For voting purposes, only an equal number of City and Union representatives present may constitute a voting quorum.

Section 17.2 Functions of Joint Committee The Committee shall meet on a schedule to be determined by the Committee or at the call of the joint chairs, to discuss the administration of the Agreement, the progress of the Project, general labor management problems that may arise, and any other matters consistent with this Agreement. Substantive grievances or disputes arising under Articles 7, 8 or 10 shall not be reviewed or discussed by this Committee, but shall be processed pursuant to the provisions of the appropriate Article. The CWA Administrator shall be responsible for the scheduling of the meetings, the preparation of the agenda topics for the meetings, with input from the Unions the Contractors and the City. Notice of the date, time and place of meetings, shall be given to the Committee members at least three (3) days prior to the meeting. The CWA Administrator shall prepare quarterly reports on apprentice utilization and the training and employment of City residents, and a schedule of Project Work and estimated number of craft workers needed. The Committee or an appropriate subcommittee, may review such reports and make any recommendations for improvement, if necessary, including increasing the availability of skilled trades, and the employment of local residents or other individuals who should be assisted with appropriate training to qualify for apprenticeship programs.

ARTICLE 18
SAVINGS AND SEPARABILITY

Section 18.1 Savings Clause It is not the intention of the City, the CWA Administrator, Contractor or the Union parties to violate any laws governing the subject matter of this Agreement. The Parties hereto agree that in the event any provision of this Agreement is finally held or determined to be illegal or void as being in contravention of any applicable law or regulation, the remainder of the Agreement shall remain in full force and effect unless the part or parts so found to be void are wholly inseparable from the remaining portions of this Agreement. Further, the Parties agree that if and when any provision(s) of this Agreement is finally held or determined to be illegal or void by a court of competent jurisdiction, the Parties will promptly enter into negotiations concerning the substantive effect of such decision for the purposes of achieving conformity with the requirements of any applicable laws and the intent of the Parties hereto. If the legality of this Agreement is challenged and any form of injunctive relief is granted by any court, suspending temporarily or permanently the implementation of this Agreement, then the Parties agree that all Project Work that would otherwise be covered by this Agreement should be continued to be bid and constructed without application of this Agreement so that there is no delay or interference with the ongoing planning, bidding and construction of any Project Work.

Section 18.2 Effect of Injunctions or Other Court Orders The Parties recognize the right of the City to withdraw, at its absolute discretion, the utilization of the Agreement as part of any bid

specification should a Court of competent jurisdiction issue any order, or any applicable statute which could result, temporarily or permanently in delay of the bidding, awarding and/or construction on the Project. Notwithstanding such an action by the City, or such court order or statutory provision, the Parties agree that the Agreement shall remain in full force and the fact on covered Project Work to the maximum extent legally possible.

ARTICLE 19
WAIVER

A waiver of or a failure to assert any provisions of this Agreement by any or all of the Parties hereto shall not constitute a waiver of such provision for the future. Any such waiver shall not constitute a modification of the Agreement or change in the terms and conditions of the Agreement and shall not relieve, excuse or release any of the Parties from any of their rights, duties or obligations hereunder.

ARTICLE 20
AMENDMENTS

The provisions of this Agreement can be renegotiated, supplemented, rescinded or otherwise altered only by mutual agreement in writing, hereafter signed by the negotiating Parties hereto. In the event of any conflict or ambiguity between this Agreement and any Attachment or exhibit, the provisions of this Agreement shall govern.

ARTICLE 21
DURATION OF THE AGREEMENT

Section 21.1 Duration

21.1.1 This Agreement shall be effective from the date signed by all Parties and shall remain in effect for a period of ten (10) years. Any covered Project Work awarded during the term of this Agreement shall continue to be covered hereunder, until completion of the Project Work, notwithstanding the expiration date of this Agreement.

21.1.2 This Agreement may be extended by written mutual consent of the City, as directed by the City Council and the signatory Unions for such further periods as the Parties shall agree to.

Section 22.2 Turnover and Final Acceptance of Completed Work

22.2.1 Construction of any phase, portion, section, or segment of Project Work shall be deemed complete when such phase, portion, section or segment has been turned over to the City by the Contractor and the City has accepted such phase, portion, section, or segment. As areas and systems of the Project are inspected and construction-tested and/or approved and accepted by the City or third parties with the approval of the City, the Agreement shall have no further force or effect on such items or areas, except when the Contractor is directed by the City to engage and repairs or modifications required by its contract(s) with the City.

22.2.2 Notice of each final acceptance received by the Contractor will be provided to the Trades Council with the description of what portion, segment, etc. has been accepted. Final acceptance may be subject to a "punch" list, and in such case, the Agreement will continue to apply to each such item on the list until it is completed to the satisfaction of the City and Notice of Completion is issued by the City or its representative to the Contractor. At the request of the Union, complete information describing any "punch" list work, as well as any additional work required of a Contractor at the direction of the City pursuant to Section 22.2.1 above, involving otherwise turned-over and completed facilities which have been accepted by the City, will be available from the CWA Administrator.

IN WITNESS whereof the Parties have caused this Community Workforce Agreement to be executed as of the date and year above stated.

CITY OF SANTA ANA

By: _____
Kristine Ridge
City Manager

LOS ANGELES/ORANGE COUNTIES
BUILDING & CONSTRUCTION
TRADES COUNCIL

By: _____
Chris Hannan
Executive Secretary

ATTEST:

By: _____
Jennifer L. Hall
City Clerk

APPROVED AS TO FORM:

Jose Montoya
_____
Jose Montoya
Assistant City Attorney

RECOMMENDED BY:

_____
Nabil Saba, P.E.
Executive Director Public Works

LOS ANGELES/ORANGE COUNTIES BUILDING AND CONSTRUCTION
TRADES COUNCIL CRAFT UNIONS AND DISTRICT COUNCILS

Asbestos Heat & Frost Insulators (Local 5) _____

Boilermakers (Local 92) _____

Bricklayers & Allied Craftworkers (Local 4) _____

Cement Masons (Local 500) _____

District Council of Laborers _____

Electricians (Local 441) _____

Elevator Constructors (Local 18) _____

Gunite Workers (Local 345) _____

Iron Workers (Reinforced – Local 416) _____

Iron Workers (Structural – Local 433) _____

Laborers (Local 300) (remediation) _____

Laborers (Local 652) _____

Operating Engineers (Local 12) _____

Operating Engineers (Local 12) _____

Operating Engineers (Local 12) _____

Painters & Allied Trades DC 36 _____

Pipe Trades (Local 250) _____

Pipe Trades (Local 345) _____

Pipe Trades (Plumbers/Fitters Local 582) _____

Pipe Trades (Sprinkler Fitters Local 709) _____

Plasterers (Local 200) _____

Plaster Tenders Local (1414) _____

Roofers & Waterproofers (Local 220) _____

Sheet Metal Workers (Local 105) _____

Teamsters (Local 986) _____

Southwest Mountain States
Regional Council of Carpenters _____

ATTACHMENT A – LETTER OF ASSENT

To be signed by all contractors awarded work covered by the City of Santa Ana Community Workforce Agreement prior to commencing work.

[Contractor's Letterhead]
CWA Administrator
City of Santa Ana
1234 address
City, state, zip code
Attn: _____

Re: Community Workforce Agreement - Letter of Assent

Dear Sir:

This is to confirm that [name of company] agrees to be party to and bound by the City of Santa Ana Community Workforce Agreement effective June 6, 2023, as such Agreement may, from time to time, be amended by the negotiating parties or interpreted pursuant to its terms. Such obligation to be a party and bound by this Agreement shall extend to all work covered by the agreement undertaken by this Company on the project and this Company shall require all of its contractors and subcontractors of whatever tier to be similarly bound for all work within the scope of the Agreement by signing and furnishing to you an identical letter of assent prior to their commencement of work.

Sincerely.

[Name of Construction Company]

By: [_____] Name and Title of Authorized Executive

Contractor State License No.: _____

[Copies of this letter must be submitted to the CWA Administrator and to the Trades Council Consistent with Section 2.6 (b).]

ATTACHMENT B

FIRST TIER ZIP CODES (CITY BOUNDARY)
***Some Zip Codes shared with neighboring cities**

92701
92702
92703
92704
92705
92706
92707
92711
92712
92725
92735
92799
*92866
*92868

SECOND TIER ZIP CODES
REMAINDER OF ORANGE COUNTY,

Zip Code	City
90620	Buena Park
90621	Buena Park
90622	Buena Park
90623	La Palma
90624	Buena Park
90630	Cypress
90631	La Habra
90632	La Habra
90633	La Habra
90680	Stanton
90720	Los Alamitos
90721	Los Alamitos
90740	Seal Beach
90742	Sunset Beach
90743	Surfside
92602	Irvine
92603	Irvine
92604	Irvine
92605	Huntington Beach
92606	Irvine
92607	Laguna Niguel
92609	El Toro
92610	Foothill Ranch
92612	Irvine
92614	Irvine
92615	Huntington Beach
92616	Irvine
92617	Irvine
92618	Irvine
92619	Irvine
92620	Irvine
92623	Irvine
92624	Capistrano Beach
92625	Corona Del Mar
92626	Costa Mesa
92627	Costa Mesa
92628	Costa Mesa
92629	Dana Point
92630	Lake Forest
92637	Laguna Woods
92646	Huntington Beach
92647	Huntington Beach
92648	Huntington Beach
92649	Huntington Beach
92650	East Irvine
92651	Laguna Beach
92652	Laguna Beach
92653	Laguna Hills
92654	Laguna Hills
92655	Midway City
92656	Aliso Viejo
92657	Newport Coast
92658	Newport Beach
92659	Newport Beach
92660	Newport Beach
92661	Newport Beach
92662	Newport Beach
92663	Newport Beach
92672	San Clemente
92673	San Clemente
92674	San Clemente
92675	San Juan Capistrano
92676	Silverado
92677	Laguna Niguel
92678	Trabuco Canyon
92679	Trabuco Canyon

92683	Westminster
92684	Westminster
92685	Westminster
92688	Rancho Santa Margarita
92690	Mission Viejo
92691	Mission Viejo
92692	Mission Viejo
92693	San Juan Capistrano
92694	Ladera Ranch
92697	Irvine
92698	Aliso Viejo
92708	Fountain Valley
92709	Irvine
92710	Irvine
92728	Fountain Valley
92780	Tustin
92781	Tustin
92782	Tustin
92801	Anaheim
92802	Anaheim
92803	Anaheim
92804	Anaheim
92805	Anaheim
92806	Anaheim
92807	Anaheim
92808	Anaheim
92809	Anaheim
92811	Atwood
92812	Anaheim
92814	Anaheim
92815	Anaheim
92816	Anaheim
92817	Anaheim
92821	Brea
92822	Brea
92823	Brea
92825	Anaheim
92831	Fullerton
92832	Fullerton
92833	Fullerton
92834	Fullerton
92835	Fullerton
92836	Fullerton
92837	Fullerton
92838	Fullerton
92840	Garden Grove
92841	Garden Grove
92842	Garden Grove
92843	Garden Grove
92844	Garden Grove
92845	Garden Grove
92846	Garden Grove
92850	Anaheim
92856	Orange
92857	Orange
92859	Orange
92861	Villa Park
92862	Orange
92863	Orange
92864	Orange
92865	Orange
92866	Orange
92867	Orange
92868	Orange
92869	Orange
92870	Placentia
92871	Placentia
92885	Yorba Linda
92886	Yorba Linda
92887	Yorba Linda
92899	Anaheim

ATTACHMENT C

CITY OF SANTA ANA
CRAFT REQUEST FORM

TO THE CONTRACTOR: Please complete and fax this form to the applicable union to request craft workers that fulfill the hiring requirements for this project. After faxing your request, please call the Local to verify receipt and substantiate their capacity to furnish workers as specified below. Please print your Fax Transmission Verification Reports and keep copies for your records.

The City of Santa Ana Community Workforce Agreement establishes a goal that 30% of the total work hours shall be:

First, from qualified workers residing in those in those U. S. Postal Service zip codes which overlap all of the City of Santa Ana, as set forth in Attachment B and veterans, regardless of where they reside (Tier 1); and,

Second, qualified workers residing within Orange County and individuals who have successfully completed the Building Trades Multi-Craft Core Curriculum Pre-Apprenticeship Program, regardless of where they reside.

For Dispatch purposes, employees residing within either of these two (2) tiers, as well as Veterans and individuals who have successfully completed the Building Trades Multi-Craft Core Curriculum Pre-Apprenticeship Program, regardless of where they reside, shall be referred to as Local Residents.

TO THE UNION: Please complete the "Union Use Only" section on the next page and fax this form back to the requesting Contractor. Be sure to retain a copy of this form for your records.

CONTRACTOR USE ONLY

To: Union Local # _____ **Fax#** (___) _____ **Date:** _____

Cc: CWA Administrator

From: Company: _____ Issued By: _____

Contact Phone :(___) _____ Contact Fax: (___) _____

PLEASE PROVIDE ME WITH THE FOLLOWING UNION CRAFT WORKERS.

Craft Classification (i.e., plumber, painter, etc.)	Journeyman or Apprentice	Local Resident, Veteran or General Dispatch	Number of workers needed	Report Date	Report Time
TOTAL WORKERS REQUESTED = _____					

Please have worker(s) report to the following work address indicated below:

Project Name: _____ Site: _____ Address: _____

Report to: _____ On-site Tel: _____ On-site Fax: _____

Comment or Special Instructions: _____

UNION USE ONLY

Date dispatch request received:
Dispatch received by:
Classification of worker requested:
Classification of worker dispatched:

WORKER REFERRED

Name:
Date worker was dispatched:
Is the worker referred a: (check all that apply)

JOURNEYMAN	Yes _____	No _____
APPRENTICE	Yes _____	No _____
LOCAL RESIDENT	Yes _____	No _____
VETERAN	Yes _____	No _____
GENERAL DISPATCH FROM OUT OF WORK LIST	Yes _____	No _____

ATTACHMENT D

List of Neutral Arbitrators

Mark Burstein
Fred Horowitz
Najeeb Khoury

ATTACHMENT "E"

SUBSTANCE ABUSE POLICY

The Parties recognize the problems which drug and alcohol abuse have created in the construction industry and the need to develop drug and alcohol abuse prevention programs. Accordingly, the Parties agree that in order to enhance the safety of the work place and to maintain a drug and alcohol free work environment, individual Contractors may require applicants or employees to undergo drug and alcohol testing.

1. It is understood that the use, possession, transfer or sale of illegal drugs, narcotics, or other unlawful substances, as well as being under the influence of alcohol and the possession or consuming alcohol is absolutely prohibited while employees are on the Contractor's job premises or while working on any jobsite in connection with work performed under the Community Workforce Agreement ("CWA").

2. No Contractor may implement a drug testing program which does not conform in all respects to the provisions of this Policy.

3. No Contractor may implement drug testing at any jobsite unless written notice is given to the Union setting forth the location of the jobsite, a description of the project under construction, and the name and telephone number of the Project Work Supervisor. Said notice shall be addressed to the office of each Union signing the CWA. Said notice shall be delivered in person or by registered mail before the implementation of drug testing. Failure to give such notice shall make any drug testing engaged in by the Contractor a violation of the CWA, and the Contractor may not implement any form of drug testing at such jobsite for the following six months.

4. An employer who elects to implement drug testing pursuant to this Agreement shall require all employees on the Project Work to be tested. With respect to individuals who become employed on the Project Work subsequent to the proper implementation of this drug testing program, such test shall be administered upon the commencement of employment on the project, whether by referral from a Union Dispatch Office, transfer from another project, or another method. Individuals who were employed on the project prior to the proper implementation of this drug testing program may only be subjected to testing for the reasons set forth in Paragraph 5(f) (1) through 5(f) (3) of this Policy. Refusal to undergo such testing shall be considered sufficient grounds to deny employment on the project.

5. The following procedure shall apply to all drug testing:

a. The Contractor may request urine samples only. The applicant or employee shall not be observed when the urine specimen is given. An applicant or employee, at his or her sole option, shall, upon request, receive a blood test in lieu of a urine test. No employee of the Contractor shall draw blood from a bargaining unit employee, touch or handle urine specimens, or in any way become involved in the chain of custody of urine or blood specimens. A Union Business Representative, subject to the approval of the individual applicant or employee, shall be permitted

to accompany the applicant or employee to the collection facility to observe the collection, bottling, and sealing of the specimen.

b. The testing shall be done by a laboratory approved by the Substance Abuse & Mental Health Services Administration (SAMHSA), which is chosen by the Contractor and the Union.

c. An initial test shall be performed using the Enzyme Multiplied Immunoassay Technique (EMZT). In the event a question or positive result arises from the initial test, a confirmation test must be utilized before action can be taken against the applicant or employee. The confirmation test will be by Gas Chromatography Mass Spectrometry (GC/MS). Cutoff levels for both the initial test and confirmation test will be those established by the SAMHSA. Should these SAMHSA levels be changed during the course of this agreement or new testing procedures are approved, then these new regulations will be deemed as part of this existing agreement. Confirmed positive samples will be retained by the testing laboratory in secured long-term frozen storage for a minimum of one year. Handling and transportation of each sample must be documented through strict chain of custody procedures.

d. In the event of a confirmed positive test result the applicant or employee may request, within forty-eight (48) hours, a sample of his/her specimen from the testing laboratory for purposes of a second test to be performed at a second laboratory, designated by the Union and approved by SAMHSA. The retest must be performed within ten (10) days of the request. Chain of custody for this sample shall be maintained by the Contractor between the original testing laboratory and the Union's designated laboratory. Retesting shall be performed at the applicant's or employee's expense. In the event of conflicting test results the Contractor may require a third test.

e. If, as a result of the above testing procedure, it is determined that an applicant or employee has tested positive, this shall be considered sufficient grounds to deny the applicant or employee his/her employment on the Project Work.

f. No individual who tests negative for drugs or alcohol pursuant to the above procedure and becomes employed on the Project Work shall again be subjected to drug testing with the following exceptions:

1. Employees who are involved in industrial accidents resulting in damage to plant, property or equipment or injury to him/herself or others may be tested pursuant to the procedures stated hereinabove.

2. The Contractor may test employees following thirty (30) days advance written notice to the employee(s) to be tested and to the applicable Union. Notice to the applicable Union shall be as set forth in Paragraph 3 above and such testing shall be pursuant to the procedures stated hereinabove.

3. The Contractor may test an employee where the Contractor has reasonable cause to believe that the employee is impaired from performing his/her job. Reasonable

cause shall be defined as exhibiting aberrant or unusual behavior, the type of which is a recognized and accepted symptom of impairment (i.e., slurred speech, unusua1 lack of muscular coordination, etc.). Such behavior must be actually observed by at least two persons, one of whom shall be a Supervisor who has been trained to recognize the symptoms of drug abuse or impairment and the other of whom shall be the job steward. If the job steward is unavailable or there is no job steward on the project the other person shall be a member of the applicable Union's bargaining unit. Testing shall be pursuant to the procedures stated hereinabove. Employees who are tested pursuant to the exceptions set forth in this paragraph and who test positive will be removed from the Contractor's payroll.

g. Applicants or employees who do not test positive shall be paid for all time lost while undergoing drug testing. Payment shall be at the applicable wage and benefit rates set forth in the applicable Union's Master Labor Agreement. Applicants who have been dispatched from the Union and who are not put to work pending the results of a test will be paid waiting time until such time as they are put to work. It is understood that an applicant must pass the test as a condition of employment. Applicants who are put to work pending the results of a test will be considered probationary employees.

6. The employers will be allowed to conduct periodic job site drug testing on the Project under the following conditions:

a. The entire jobsite must be tested, including any employee or subcontractor's employee who worked on that project three (3) working days before or after the date of the test;

b. Jobsite testing cannot commence sooner than thirty (30) days after start of the work on the Project;

c. Prior to start of periodic testing, a business representative will be allowed to conduct an educational period on company time to explain periodic jobsite testing program to affected employees;

d. Testing shall be conducted by a SAMHSA certified laboratory, pursuant to the provisions set forth in Paragraph 5 hereinabove.

e. Only two periodic tests may be performed in a twelve month period.

7. It is understood that the unsafe use of prescribed medication, or where the use of prescribed medication impairs the employee's ability to perform work, is a basis for the Contractor to remove the employee from the jobsite.

8. Any grievance or dispute which may arise out of the application of this Agreement shall be subject to the grievance and arbitration procedures set forth in the CWA.

9. The establishment or operation of this Policy shall not curtail any right of any employee found in any law, rule or regulation. Should any part of this Agreement be found unlawful by a court of competent jurisdiction or a public agency having jurisdiction over the

parties, the remaining portions of the Agreement shall be unaffected and the parties shall enter negotiations to replace the affected provision.

10. Present employees, if tested positive, shall have the prerogative for rehabilitation program at the employee's expense. When such program has been successfully completed the Contractor shall not discriminate in any way against the employee. If work for which the employee is qualified exists he/she shall be reinstated.

11. The Contractor agrees that results of urine and blood tests performed hereunder will be considered medical records held confidential to the extent permitted or required by law. Such records shall not be released to any persons or entities other than designated Contractor representatives and the applicable Union. Such release to the applicable Union shall only be allowed upon the signing of a written release and the information contained therein shall not be used to discourage the employment of the individual applicant or employee on any subsequent occasion.

12. The Contractor shall indemnify and hold the Union harmless against any and all claims, demands, suits, or liabilities that may arise out of the application of this Agreement and/or any program permitted hereunder.

13. Employees who seek voluntary assistance for substance abuse may not be disciplined for seeking such assistance. Requests from employees for such assistance shall remain confidential and shall not be revealed to other employees or management personnel without the employee's consent. Employees enrolled in substance abuse programs shall be subject to all Contractor rules, regulations and job performance standards with the understanding that an employee enrolled in such a program is receiving treatment for an illness.

14. This Memorandum, of Understanding shall constitute the only Agreement in effect between the parties concerning drug and alcohol abuse, prevention and testing. Any modifications thereto must be accomplished pursuant to collective bargaining negotiations between the parties.

DRUG ABUSE PREVENTION AND DETECTION

APPENDIX A

CUTOFF LEVELS

DRUG	SCREENING METHOD	SCREENING LEVEL **	CONFIRMATION METHOD	CONFIRMATION LEVEL
Alcohol	EMIT	0.02%	CG/MS	0.02%
Amphetamines	EMIT	1000 ng/m*	CG/MS	500 ng/ml*
Barbiturates	EMIT	300 ng/ml	CG/MS	200 ng/ml
Benzodiazepines	EMIT	300 ng/ml	CG/MS	300 ng/ml
Cocaine	EMIT	300 ng/ml*	CG/MS	150 ng/ml*
Methadone	EMIT	300 ng/ml	CG/MS	100 ng/ml
Methaqualone	EMIT	300 ng/ml	CG/MS	300 ng/ml
Opiates	EMIT	2000 ng/ml*	CG/MS	2000 ng/ml*
PCP (Phencyclidine)	EMIT	25 ng/ml*	CG/MS	25 ng/ml*
THC (Marijuana)	EMIT	50 ng/ml*	CG/MS	15 ng/ml*
Propoxyphene	EMIT	300 ng/ml	CG/MS	100 ng/ml

* SAMHSA specified threshold

** A sample reported positive contains the Indicated drug at or above the cutoff level for that drug. A negative sample either contains no drug or contains a drug below the cutoff level.

EMIT - Enzyme Immunoassay
CC/MS - Gas Chromatography/Mass Spectrometry

SIDE LETTER OF AGREEMENT
TESTING POLICY FOR DRUG ABUSE

It is hereby agreed between the parties hereto that an Contractor who has otherwise properly implemented drug testing, as set forth in the Testing Policy for Drug Abuse, shall have the right to offer an applicant or employee a "quick" drug screening test. This "quick" screen test shall consist either of the "ICUP" urine screen or similar test or an oral screen test. The applicant or employee shall have the absolute right to select either of the two "quick" screen tests, or to reject both and request a full drug test.

An applicant or employee who selects one of the quick screen tests, and who passes the test, shall be put to work immediately. An applicant or employee who fails the "quick" screen test, or who rejects the quick screen tests, shall be tested pursuant to the procedures set forth in the Testing Policy for Drug Abuse. The sample used for the "quick" screen test shall be discarded immediately upon conclusion of the test. An applicant or employee shall not be deprived of any rights granted to them by the Testing Policy for Drug Abuse as a result of any occurrence related to the "quick" screen test.

CITY OF SANTA ANA
APPENDIX I
PROJECT NO.: 23-2601
SANTA ANA ZOO EDUCATION HUB BUILDING A – PHASE 1

TECHNICAL SPECIFICATIONS

SANTA ANA ZOO EDUCATION HUB

1801 E CHESTNUT AVE,
SANTA ANA, CA 92701

TECHNICAL SPECS

MARCH 24, 2025

LOC

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Work covered by the Contract Documents.
   2. Type of the Contract.
   3. Work phases.
   4. Use of premises.
   5. Owner's occupancy requirements.
   6. Work restrictions.
   7. Specification formats and conventions.
   8. Pollution Control.
   9. Storm Water Pollution Prevention Plan.

B. Related Sections include the following:
   1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Santa Ana Zoo - Education Hub.

B. Project Location: 1801 E Chestnut Ave, Santa Ana, California 92701.

C. Architect: LOC.

D. The Work consists of the following:
   1. The Work to include construction of education hub and site improvements and as indicated on Drawings.

1.3 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.4 WORK PHASES

A. The Work shall be conducted in single phase.

1.5 OWNER'S OCCUPANCY REQUIREMENTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction

operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing building, driveways, and other adjacent occupied or used facilities. Do not close or obstruct building, driveways, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.6 WORK RESTRICTIONS

A. On-Site Work Hours:
   1. Work shall be generally performed during normal business working hours as specified.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify the Owner not less than two working days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without the Owner's written permission.

1.7 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 49-division format and CSI's MasterFormat 2004 numbering system.
   1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Technical Specifications are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Technical Specifications to determine numbers and names of Sections in the Contract Documents.
   2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
   2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
      a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.8 POLLUTION CONTROL

A. Provide positive methods, means and facilities required to prevent contamination of the soil, water or atmosphere by the discharge of noxious substances from the construction operations.

1.9 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. The contractor shall submit a Storm Water Pollution Prevention Plan for approval by the City's Utility Department (OMUC). The plan shall show erosion control measures and indicate locations of staging, fueling, equipment and employee parking, and storage/stockpile locations. Locations for concrete washout shall be shown, as well as gravel site entrances and/or metal grates to keep soil from being deposited on City streets. The plan shall note that street sweeping shall occur as often as necessary, to ensure that no dirt or dust will remain on City streets. Drip pans shall be used under parked equipment and visqueen shall be shown on the plan to protect the soil in the fueling area. Only minor vehicle maintenance shall occur on-site. Maintenance shall occur in the fueling area and soil shall be protected by drip pans and visqueen.

B. Prepare a Storm Water Pollution Prevention Plan (SWPPP) and file a Notice of Intent with the State Water Resources Control Board for this project. The SWPPP will provide Best Management Practice (BMP) methods and controls for wet weather grading activities and erosion control for both onsite and offsite improvements, in accordance with the requirements of the NPDES General Permit for Storm Water Discharges Associated with Construction Activity. The SWPPP shall include an erosion control plan.

1.10 MISCELLANEOUS PROVISIONS

A. Noise Control:
   1. The Contractor shall install noise reducing devices on construction equipment. Contractor shall comply with the requirements of the city and county having jurisdiction with regard to noise ordinances governing construction sites and activities. Construction Equipment noise at the Site shall be limited and only as permitted by applicable law, rule or regulation.

B. Dust Control.
   1. The Contractor shall be fully and solely responsible for maintaining and upkeeping all areas of the Site and adjoining areas, outdoors and indoors, free from flying debris, grinding powder, sawdust, dirt and dust as well as any other product, product waste or work waste, that by becoming airborne may cause respiratory inconveniences to persons and Owner's personnel.
   2. Additionally, the Contractor shall take specific care to avoid deposits of airborne dust or airborne elements. Such protection devices, systems or methods shall be in accordance with the regulations set forth by the EPA and OSHA, and other applicable law, rule or regulation.
   3. Additionally, the Contractor shall be the sole party responsible to regularly and routinely clean up and remove any and all deposits of dust and other elements. Damage and/or any liability derived from the Contractor's failure to comply with these requirements shall be exclusively at the cost of the Contractor, including, without limitation, any and all penalties that may be incurred for violations of applicable law, rule or regulation, and any amounts expended by the Owner to pay such damages shall be due and payable to the Owner on demand.

4. Contractor shall replace any damages property or part thereof and professionally clean any and all items that become covered or partially covered to any degree by dust or other airborne elements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

A. Related Sections include the following:
   1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.2 MINOR CHANGES IN THE WORK

A. The Owner’s Representative may issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, or Changes not affecting the Structural Safety, Access Compliance or Fire & Life Safety portions of the work, on AIA Document G710, "Architect's Supplemental Instructions" or an equivalent form acceptable to Owner.

1.3 PROPOSAL REQUESTS (BULLETIN)

A. Owner-Initiated Proposal Requests: The Owner’s Representative may issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Proposal Requests issued are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
   2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Owner’s Representative may issue a Change Order for signatures of Owner and Contractor.

1.5 CONSTRUCTION (FIELD) CHANGE DIRECTIVE

A. Construction Change Directive: The Owner's Representative may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:
   1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.2 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with Continuation Sheets.
      b. Submittals Schedule.
      c. Contractor's Construction Schedule.
   2. Submit the Schedule of Values to the Owner's Representative no later that 21 days of City Council's approval of project award.
   3. No payment applications will be signed by the Owner’s Representative prior to the Contractor submitting, and the Owner’s Representative reviewing, a schedule of values.

B. Format and Content: Use the Technical Specifications table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location.
      b. Name of Owner’s Representative.
      c. The Owner’s Representative’s project number.
      d. Contractor's name and address.
      e. Date of submittal.
   2. Submit draft of AIA Document G703 Continuation Sheets or an equivalent form acceptable to Owner.
   3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division.
      b. Description of the Work.
      c. Name of subcontractor.

d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value.
1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Technical Specifications table of contents. Provide several line items for principal subcontract amounts, where appropriate.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Owner’s Representative and paid for by Owner.
1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times:
1. The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment or an equivalent form acceptable to Owner.

D. Application Preparation: Complete every entry on form. Execute by a person authorized to sign legal documents on behalf of Contractor. Owner’s Representative will return incomplete applications without action.
1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit one signed original copy of each Application for Payment to Owner's Representative by a method ensuring receipt within 24 hours. The copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of Values.
   3. Contractor's Construction Schedule (preliminary if not final).
   4. Products list.
   5. Schedule of unit prices.
   6. Submittals Schedule (preliminary if not final).
   7. List of Contractor's staff assignments.
   8. List of Contractor's principal consultants.
   9. Copies of building permits.
   10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
   11. Initial progress report.
   12. Report of preconstruction conference.
   13. Certificates of insurance and insurance policies.
   14. Data needed to acquire Owner's insurance.
   15. Initial settlement survey and damage report if required.

G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following (AIA Documents may be substituted with an equivalent form acceptable to Owner):
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   3. Updated final statement, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
   6. AIA Document G707, "Consent of Surety to Final Payment."
   7. Evidence that claims have been settled.
   8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
   9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Project meetings.
   2. Requests for Interpretation (RFIs) by Procore Project Management.

B. Related Sections include the following:
   1. Division 1 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
   2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Division 1 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.2 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's Construction Schedule.
   2. Preparation of the Schedule of Values.
   3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.3 SUBMITTALS

A. Submit electronic submittals directly to extranet specifically established for Project.
   1. Product: Procore Project Management System.

1.4 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Owner’s Representative of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Owner’s Representative, within three days of the meeting.
   4. Frequency of Attendance by Owner’s Representative: Limited by Owner’s Representative /Owner Contract.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Owner’s Representative, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
   1. Attendees: Authorized representatives of Owner, Owner’s Representative, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing, if any.
      c. Critical work sequencing and long-lead items.
      d. Designation of key personnel and their duties.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for RFIs.
      g. Procedures for testing and inspecting.
      h. Procedures for processing Applications for Payment.

i. Distribution of the Contract Documents.
j. Submittal procedures.
k. Preparation of Record Documents.
l. Use of the premises and existing site.
m. Work restrictions.
n. Owner's occupancy requirements.
o. Responsibility for temporary facilities and controls.
p. Construction waste management and recycling.
q. Parking availability.
r. Office, work, and storage areas.
s. Equipment deliveries and priorities.
t. First aid.
u. Security.
v. Progress cleaning.
w. Working hours.

3. Minutes: Record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Owner's Representative of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. The Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Review of mockups.
   i. Possible conflicts.
   j. Compatibility problems.
   k. Time schedules.
   l. Weather limitations.
   m. Manufacturer's written recommendations.
   n. Warranty requirements.
   o. Compatibility of materials.
   p. Acceptability of substrates.
   q. Temporary facilities and controls.
   r. Space and access limitations.
   s. Regulations of authorities having jurisdiction.
   t. Testing and inspecting requirements.
   u. Installation procedures.
   v. Coordination with other work.
   w. Required performance results.
   x. Protection of adjacent work.
   y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Owner's Representative, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
        1) Review schedule for next period.
    b. Review present and future needs of each entity present, including the following:
        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of correction of deficient items.
        14) Field observations.
        15) RFIs.
        16) Status of proposal requests.
        17) Pending changes.
        18) Status of Change Orders.
        19) Pending claims and disputes.
        20) Documentation of information for payment requests.
3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.5 RFIs:

A. General:
1. Contractor may submit a RFI to the Owner's Representative seeking clarification or interpretation of the contract documents. If in the Contractor's opinion the nature of the RFI requires a discussion, rather than simply an answer, the Contractor shall call the Owner's Representative to have such a discussion. The results of that discussion as well as all other RFI's must be presented in writing on a form approved in advanced by the Owner's Representative along with any supporting information or data, as well as the Contractor's recommended resolution. An oral RFI or a RFI presented on an unapproved form, or without adequate supporting information and Contractor's recommended solution, will be attributed solely to the contractor. The Owner's Representative's review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction means, methods, techniques, sequences, or procedures of the Contractor.
2. The Owner's Representative's review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction site safety precautions, procedures, or methodology of the Contractor.
3. The use of a RFI is limited to clarification of the contract documents. Contractor will limit each RFI to a single issue. Information which is discernable from the contract documents; construction means and methods; product substitution submittals; product submittals; and construction site safety will not be addressed by the Owner's Representative in responding to a RFI.
4. The Owner's Representative's response to a RFI is not a change order or directive authorizing an increase in construction cost or time.

B. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

C. Frivolous or Unnecessary RFIs: Cost of design professional's time will be billed or deducted from progress payment.

D. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
1. Project name.
2. Date.
3. Name of Contractor.
4. Name of Owner's Representative.
5. RFI number, numbered sequentially.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.

9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
    a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

E. Hard-Copy RFIs: Form at end of this Section.
1. Identify each page of attachments with the RFI number and sequential page number.

F. The Owner's Representative Action: Owner's Representative will review each RFI, determine action required, and return it. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for coordination information already indicated in the Contract Documents.
    d. Requests for adjustments in the Contract Time or the Contract Sum.
    e. Requests for interpretation of Owner's Representative actions on submittals.
    f. Incomplete RFIs or RFIs with numerous errors.
2. The Owner's Representative action may include a request for additional information, in which case Owner's Representative time for response will start again.
3. The Owner's Representative action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
2. Name and address of Contractor.
3. Name and address of Owner's Representative.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Owner's Representative response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 FORMS

A. Electronic versions of attached forms will be provided upon request or may be scanned and submitted.

1. RFI Form.
2. RFI Log.

END OF SECTION 013100

RFI FORM

Project:		RFI No:
Project No:		
To:		Date:
From:		
Subject:		
Discipline:		Category
Specification Section Title:		
Section Number:	Page:	Article/Paragraph:
Sheet Number:		Detail:

Question:

Suggestion:

☐Attachment:

Undersigned certifies:

- Both drawings and specification sections were thoroughly reviewed.
- Processing time for frivolous RFIs will be charged back to Contractors at A/E billable rates.

Desired Response Date:	(However, A/E still have specified days to respond.)
Cost Impact: $	Schedule Impact: days
Drawing Impact:	Submitted by:
Signed:	Date:

Answer:

Answered by:

Signed: Date:

Copies: ☐ Owner ☐Consultants ☐ ☐ ☐ File

1. A/E review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction site safety precautions, procedures, or methodology of the Contractor.
2. The use of a RFI is limited to clarification of the contract documents. Contractor will limit each RFI to a single issue. Information that is discernable from the contract documents; construction means and methods; product substitution submittals; product submittals; and construction site safety will not be addressed by the A/E in responding to a RFI.
3. A/E response to a RFI is not a change order or directive authorizing an increase in construction cost or time.

End of RFI Form

RFI LOG

Project:	Project Number:
Contractor:	Updated Date:

RFI Number	Submit Date	Subject of RFI	Response Date	Proposal Request No.

Submitted by: _____

Signed: _____ Date: _____

End of RFI Log

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following in Procore Project Management System:
   1. Contractor's Construction Schedule.
   2. Submittals Schedule.
   3. Three Week Look-Ahead Schedule.
   4. Daily construction reports.

B. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
   2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
   3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
   4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.2 SUBMITTALS

A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
   1. Scheduled date for first submittal.
   2. Specification Section number and title.
   3. Submittal category (action or informational).
   4. Name of subcontractor.
   5. Description of the Work covered.
   6. Scheduled date for Owner’s Representative final release or review.

B. Contractor's Construction Schedule: Submit three opaque copies of schedule, large enough (minimum 11”x 17”) to show entire schedule for entire construction period.

C. Daily Construction Reports: Submit two copies at weekly intervals.

1.3 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Concurrent with the development of the Contractor's construction schedule, prepare a complete schedule of submittals. Submit the submittal schedule with the Contractor's construction schedule described above.
   1. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
   2. The Owner’s Representative will review the schedule and indicate which submittals may be deleted from the submission requirement. The deletion of the submittal requirement for an item does not release the Contractor from any requirements of the Construction Contract, General Conditions or Plans and Specifications.

B. Prepare the schedule in chronological order; include submittals required during the first 90 days of construction. Provide the following information:
   1. Scheduled date for the first submittal.
   2. Related Section number.
   3. Submittal category.
   4. Name of subcontractor.
   5. Description of the part of the Work covered.
   6. Scheduled date for resubmittal.
   7. Scheduled date the Owner’s Representative final release or review.

C. Distribution: Following response to initial submittal, print and distribute copies to the Owner’s Representative, Owner, subcontractors, and other parties required to comply with submittal dates indicated.
   1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

D. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule.
   1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as identified in the "Schedule of Values".
   2. Within each time bar indicate estimated completion percentage in 10 percent increments. As work progresses, place a contrasting mark in each bar to indicate Actual Completion.

3. Prepare the schedule on a sheet, or series of sheets, of stable reproducible media, of sufficient width to show data for the entire construction period.
4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
5. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Owner's Representative procedures necessary for certification of Substantial Completion.

B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by requirements for phased completion to permit work by separate Contractors and partial occupancy by the Owner prior to Substantial Completion.

C. Work Stages: Indicate important stages of construction for each major portion of the Work, including testing and installation.

D. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.

E. Cost Correlation: At the head of the schedule, provide a two item cost correlation line, indicating "pre-calculated" and "actual" costs. On the line show dollar-volume of work performed as of the dates used for preparation of payment requests.
1. Refer to Section "Payment Procedures" for cost reporting and payment procedures.

2.3 THREE WEEK LOOK-AHEAD SCHEDULE

A. Prepare weekly (or as determined by scheduled meeting times), prior to Project meetings, a computer-generated 3-week look-ahead schedule (bar chart) which is consistent with the Contractors schedule and depicts daily labor activities. The schedule will consist of the prior week, current week and the following 3 weeks.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).

10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial Completions and occupancies.
19. Substantial Completions authorized.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates changes, including, but not limited to, changes in durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of reviewed schedule to The Owner, Owner’s Representative, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.2 FORMS

A. Electronic versions of attached forms will be provided upon request or may be scanned and submitted.
   1. Submittals Schedule Form.

END OF SECTION 013200

SUBMITTAL SCHEDULE FORM

☐ Preliminary Submittal Schedule: Include submittals required during the first 60 days of construction.
☐ Complete Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

Project: From:

To: Date:

Scheduled Initial Submittal Date	Spec Section No.	Spec Section Title	Type: ☐ Action ☐ Info Only	Name of Subcontractor	Description	Scheduled Date of Approval

End of Submittal Schedule Form

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals using Procore Project Management System.

B. Consult individual sections of specifications for specific submittals required under those sections and for further details and descriptions of requirements.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Owner's Representative responsive action.

B. Informational Submittals: Written information that does not require Owner's Representative responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

A. Processing: All costs for printing, preparing, packaging, submitting, mailing, or delivering submittals for initial submittals and all costs for re-printing, re-drawing, re-drafting, re-packaging, re-submitting, and re-mailing or re-delivering as required for all re-submittals shall be included in Contract Sum.

B. Sequence: Transmit each submittal in sequence which will not result in Owner's Representative approval having to be later modified or rescinded by reason of subsequent submittals which should have been processed earlier or concurrently for coordination.

C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. The Owner's Representative reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

D. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

E. Multiple Reviews: The Contractor shall also be responsible for all costs to Owner's Representative or Project consultants for reviews requiring more than 2 reviews for same specification section.

F. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Owner's Representative receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Review: Allow 21 days for review of each submittal. The Owner's Representative will request for more time if needed.

G. Identification: Place a permanent label or title block on each submittal for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Owner's Representative.
   3. Include the following information on label for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Name and address of Owner's Representative.
      d. Name and address of Contractor.
      e. Name and address of subcontractor.
      f. Name and address of supplier.
      g. Name of manufacturer.
      h. Each submittal number shall be unique as follows:
         1) Format shall be as follows:
            a) Sequential Number - Revision Number - Project Specification Section Number (e.g., 1-1-09910). Do not use letters.
         2) Submittal number shall be sequential starting with 1 (e.g., 1-#-#####).
         3) First submittal for each section shall have number 1 as the "revision" number. (e.g., #-1-#####)
         4) Resubmittal for same specification section shall have same first digit as the original submittal and sequential second digit revision number (e.g., #-2-##### as in second submittal).
         5) Sample submittal log would look like the following in the submittal number column: Note that 1-2-09910 is second submittal.

Submittal Number
1-1-099100
1-2-099100 (revised submittal: shown for clarity)
2-1-055000
3-1-077200

      i. Number and title of appropriate Specification Section.
      j. Drawing number and detail references, as appropriate.
      k. Location(s) where product is to be installed, as appropriate.
      l. Other necessary identification.

H. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

I. Additional Copies: Unless additional copies are required for final submittal, and unless Owner's Representative observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Owner's Representative.
2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

J. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. The Owner's Representative will return submittals, without review, received from sources other than Contractor.
1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Owner's Representative on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

K. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Approved" or "Furnish as Noted".

L. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

M. Use for Construction: Use only final submittals with mark indicating approval by Owner's Representative.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General:
1. Submittal shall be electronic.
2. Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
   a. Circle items applicable.
   b. Cross-out items not applicable.
   c. Select item number if required.
3. Submittal data must include complete documentation relating to all the specified features
4. Include the following information, as applicable:
   a. Manufacturer's Submittal Form with all the options selected when available.
   b. Manufacturer's written recommendations.
   c. Manufacturer's product specifications.
   d. Manufacturer's installation instructions.

e. Standard color charts.
f. Manufacturer's catalog cuts.
g. Wiring diagrams showing factory-installed wiring.
h. Printed performance curves.
i. Operational range diagrams.
j. Mill reports.
k. Standard product operation and maintenance manuals.
l. Compliance with specified referenced standards.
m. Testing by recognized testing agency.
n. Application of testing agency labels and seals.
o. Notation of coordination requirements.

5. Submit Product Data before or concurrent with Samples.
6. Number of Copies: Submit 4 copies of Product Data, unless otherwise indicated. The Owner’s Representative will return 2 copies. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
a. Dimensions.
b. Do not use words "by others." Use words which depict exactly who is responsible for the work.
c. Identification of products.
d. Fabrication and installation drawings.
e. Roughing-in and setting diagrams.
f. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
g. Shopwork manufacturing instructions.
h. Templates and patterns.
i. Schedules.
j. Design calculations.
k. Compliance with specified standards.
l. Notation of coordination requirements.
m. Notation of dimensions established by field measurement.
n. Relationship to adjoining construction clearly indicated.
o. Seal and signature of professional engineer if specified.
p. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.

d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit 1 full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. The Owner’s Representative will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. The Owner’s Representative will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product.
   2. Number and name of room or space.
   3. Location within room or space.
   4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. The Owner’s Representative will return two copies.
      a. Mark up and retain one returned copy as a Project Record Document.

F. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

G. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."

H. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
   1. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   2. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of Owner’s Representative, and other information specified.

D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   1. Name of evaluation organization.
   2. Date of evaluation.
   3. Time period when report is in effect.
   4. Product and manufacturers' names.

5. Description of product.
6. Test procedures and results.
7. Limitations of use.

L. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."

M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment.

Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.

6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Owner's Representative.
1. Coordinate the work; do not delegate responsibility for coordination to any subcontractor.
2. Anticipate the interrelationship of all subcontractors and their relationship with the total work.
3. Resolve differences or disputes between subcontractors and materials suppliers concerning coordination, interference, or extent of work between sections.
4. Trade submittals with "By Others", "By General Contractor", or similar coordination and work scope are not allowed. Identify, acknowledge, and resolve scope of work prior to submittal by Contractor. No extras will be allowed. Provide complete and coordinated submittals.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 THE OWNER'S REPRESENTATIVE'S ACTION

A. General: The Owner's Representative will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: The Owner's Representative will review each submittal, make marks to indicate corrections or modifications required, and return it. The Owner's Representative will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

C. Informational Submittals: The Owner's Representative will review each submittal and will not return it, or will return it if it does not comply with requirements. The Owner's Representative will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

F. The Owner's Representative's and Project Consultant's review shall neither be construed as complete check nor relieve the Contractor, Subcontractor, manufacturer, fabricator, or supplier from responsibility for any deficiency that may exist or from any departures or deviations from the requirements of the Contract unless the Contractor has, in writing, called the Owner's Representative attention to the deviations at the time of submission as specified.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and quality-control services required by Owner’s Representative, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:
   1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
   2. Other Sections for specific test and inspection requirements.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Owner’s Representative.

C. Product Testing: Tests and inspections that are performed by a Nationally Recognized Testing Laboratory (NRTL), a National Voluntary Laboratory Accreditation Program (NVLAP), or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

D. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

E. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

F. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

G. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

H. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of 5 previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Owner’s Representative for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Owner’s Representative for a decision before proceeding.

1.4 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Description of test and inspection.
   3. Identification of applicable standards.
   4. Identification of test and inspection methods.
   5. Number of tests and inspections required.
   6. Time schedule or time span for tests and inspections.
   7. Entity responsible for performing tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A licensed professional engineer who is legally qualified to practice in California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6 QUALITY CONTROL

A. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

C. Testing Agency Responsibilities: Cooperate with Owner’s Representative and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Owner’s Representative and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform any duties of Contractor.

D. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   5. Delivery of samples to testing agencies.
   6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspecting equipment at Project site.

E. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

F. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.
   1. Distribution: Distribute schedule to Owner, Owner's Representative, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Owner's Representative.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Owner's Representative's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes list of references.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. Architect: Owner’s Representative.

C. “AHJ”: Agency having jurisdiction.

D. "Approved": When used to convey Owner’s Representative’s action on Contractor's submittals, applications, and requests, "approved" is limited to Owner’s Representative’s duties and responsibilities as stated in the Conditions of the Contract.

E. “Compatible”: When used for products, it shall comply with requirements including products recommended/ required by the manufacturer for warrantee acceptance.

F. "Directed": A command or instruction by Owner’s Representative. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

G. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

H. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

I. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

J. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

K. “Or equal” or “Or Approve equal”: Shall be as approved by Architect.

L. “Owner”: As defined in Division 1 section “Summary”.

M. "Provide": Furnish and install, complete and ready for the intended use.

N. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
   2. Copies of standards and applicable building codes (Title 24 Parts 1-5) shall be kept on-site during construction.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations.

E. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.

F. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.

G. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014339 - MOCKUPS

1.1 SUMMARY

A. Section Includes:
   1. Integrated exterior mockups.

B. Related Requirements:
   1. Division 1 Section "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior mockups.
   2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
   3. Review locations and extent of mockups.
   4. Review testing procedures to be performed on mockups.
   5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and maintain schedule for the Work.

1.4 SUBMITTALS

A. Shop Drawings: For integrated exterior mockups.
   1. Include plans, elevations, sections, and attachment and support details.
   2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
   3. Include site location drawing indicating orientation of mockup.
   4. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

1.5 QUALITY ASSURANCE

A. Build mockups to do the following:
   1. Verify selections made under Sample submittals.
   2. Demonstrate aesthetic effects.
   3. Demonstrate the qualities of products and workmanship.
   4. Demonstrate acceptable coordination between components and systems.

5. Perform preconstruction testing, such as window air- and water-infiltration testing.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.
1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Remove mockups when directed unless otherwise indicated.

C. Notifications:
1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
2. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's and Construction Manager's approval of mockups before starting fabrication or construction of corresponding Work.
1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.6 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups according to approved mockup Shop Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.

C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

D. Use specified products that have been approved by the Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

E. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.

F. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION

3.1 EXTERIOR MOCKUPS

A. Transition from exterior tile to Kebony siding rainscreen.

B. Transition from architectural cast in place to other materials.

END OF SECTION 014339

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:
   1. Division 1 Section "Summary" for limitations on utility interruptions and other work restrictions.
   2. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
   3. Division 1 Section "Execution Requirements" for progress cleaning requirements.

1.2 USE CHARGES

A. General: Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Owner’s Representative, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service:
   1. Pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service:
   1. Pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service:
   1. Pay electric power service use charges for electricity used by all entities for construction operations.

E. Sanitary Facilities:
   1. Pay sanitary service use charge for temporary toilets, wash facilities, and drinking water for use of construction personnel.

1.3 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized steel bases for supporting posts.

B. Wind Screen Fabric: Green.

2.2 TEMPORARY FIELD OFFICES - Not Required.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures. Minimum rated at Class 2A-10B:C.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Install temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Electric Power Service: Install electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

F. Lighting: Install temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

A. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

B. Parking: Provide temporary or use designated areas of Owner's existing parking areas if approved for construction personnel.

C. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
   2. Remove snow and ice as required to minimize accumulations.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Division 1 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

E. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

G. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses.
1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been

delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 015723 - TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 PERFORMANCE

A. Minimum Water Quality Protection Requirements

1. The Contractor is required to meet the following minimum standards of good housekeeping:

   a. Eroded sediments and other pollutants must be retained on site and may not be transported from the site via sheetflow, swales, area drains, natural drainage, or wind.
   b. Stockpiles of earth and other construction-related materials must be protected from being transported from the site by wind or water.
   c. Fuels, oils, solvents, and other toxic materials must be stored in accordance with their listing and are not to contaminate the soil nor the surface waters. All approved toxic storage containers are to be protected from the weather. Spills must be cleaned up immediately and disposed of in a proper manner. Spills may not be washed into the drainage system.
   d. Excess or waste concrete may not be washed into the public way or any drainage system. Provisions shall be made to retain concrete wastes on-site until they can be appropriately disposed of or recycled.
   e. Trash and construction-related solid wastes must be deposited into a covered receptacle to prevent contamination of rainwater and dispersal by wind.
   f. Sediments and other materials may not be tracked from the site by vehicle traffic. The construction entrance roadways must be stabilized so as to inhibit sediments from being deposited into the public ways. Accidental depositions must be swept up immediately and may not be washed down by rain or by any other means.

B. Erosion Control Plan (ECP)

1. The Contractor shall refer to the prepared Erosion Control Plan (ECP) and implement Best Management Practices (BMPs) necessary to control stormwater pollution from sediments, erosion and construction materials leaving the construction site.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 015723

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and product substitutions using Procore Project Management System.

B. Related Sections include the following:
   1. Division 1 Section "References" for applicable industry standards for products specified.
   2. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
   3. Other Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Proposed products by manufacturers not listed in Manufacturers list.

C. Basis-of-Design: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating “or equal” products of other named manufacturers.

1.3 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
   1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.

2. Form: Tabulate information for each product under the following column headings:
    a. Specification Section number and title.
    b. Generic name used in the Contract Documents.
    c. Proprietary name, model number, and similar designations.
    d. Manufacturer's name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date or time span of delivery period.
    h. Identification of items that require early submittal approval for scheduled delivery date.

B. Substitution Requests: Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use form provided at end of Section.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, environmental, and specific features and requirements indicated.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
    j. Cost information, including a proposal of change, if any, in the Contract Sum.
    k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. The Owner’s Representative’s Action: The Owner’s Representative will notify Contractor of acceptance or rejection of proposed substitution.
    a. Form of Acceptance: Change Order.
    b. Use product specified if Owner’s Representative cannot make a decision on use of a proposed substitution within time allocated.

C. Named Product and Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
   1. If a dispute arises between contractors over concurrently selectable but incompatible products, Owner's Representative will determine which products shall be used.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Store cementitious products and materials on elevated platforms.
   5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   7. Protect stored products from damage and liquids from freezing.
   8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to other sections for specific content requirements and particular requirements for submitting special warranties.

C. Warranty Period: Warranty period specified in each sections are minimum requirements. Do not modify manufacturer’s standard warranty period if the manufacturer’s warranty has longer warranty period.

D. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Owner’s Representative will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Owner’s Representative’s.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:
1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or an equal product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with “or equal”.
6. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Product Substitutions" Article to obtain approval by Owner’s Representative for use of an unnamed product.
7. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Owner’s Representative’s sample. The Owner’s Representative’s decision will be final on whether a proposed product matches.
    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
8. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Owner’s Representative will select color, pattern, density, or texture from manufacturer's product line that does not include custom or premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Owner’s Representative will select color, pattern, density, or texture from manufacturer's product line that includes standard, custom, and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Owner’s Representative will consider requests for substitution if received within days after the Notice to Proceed as specfied**.** Requests received after that time may be considered or rejected at discretion of Owner’s Representative.

B. Conditions: The Owner’s Representative will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Owner’s Representative will return requests without action, except to record noncompliance with these requirements:
    1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Owner’s Representative for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    2. Requested substitution does not require extensive revisions to the Contract Documents.
    3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    4. Substitution request is fully documented and properly submitted.
    5. Requested substitution will not adversely affect Contractor's Construction Schedule.

6. Requested substitution has received necessary approvals of authorities having jurisdiction and has paid any fees.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
11. Furnish samples upon requested by Owner's Representative.
12. Attached Request for Substitution Form shall used for substitution requests.

PART 3 - EXECUTION

3.1 FORMS

A. Electronic versions of attached forms will be provided upon request or may be scanned and submitted.
   1. Product List Form.
   2. Similar Installation List Form.
   3. Substitution Request Form.

END OF SECTION 016000

SUBSTITUTION REQUEST FORM

Substitutions are only allowed within number of days specified. Use this form for requesting "or equal" products and materials.

Project:	Substitution Request Number:
	From:
To:	Date:
	Project Number:

Specification Section Title:		
Section Number:	Page:	Article/Paragraph:
Specified Item:		

Proposed Substitution:	
Manufacturer:	Address:
Contact Name:	Phone Number:
☐ Comparison between proposed substitution and specified product is attached. Note all differences.	

Reason for not using specified item:
☐ Specified product is no longer available.
☐ Substitution will improve lead time by _____ days
☐ Substitution will save Owner $ _____
☐ Other:

☐ List 3 similar installations including project name, address, owner, and date installed is attached.
Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explanation attached.

Supporting Data Attached:
☐ Product Data (indicate any options to be included)
☐ Drawings ☐ Test Reports ☐ Samples ☐ Color Chart ☐ Other:

Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable is available.
- Proposed substitution will not affect or delay Construction Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including architectural or engineering design, detailing, and construction costs caused by the requested substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

- Substitutions for products or systems involving structural, fire/life safety and access compliance will require AHJ approval. This will add time required to review those substitutions requiring AHJ approval. Contractor is solely responsible for all documentation, cost, and time required to obtain AHJ approval.

Submitted by:	Firm:
Signature:	Date:
Comments:	

A/E Review:
☐ Approve Substitution.
☐ Approve Substitution as Noted.
☐ Reject Substitution. Use specified product.
☐ Reject Substitution. Use specified product. Substitution request received too late.

Signed by:	Date:
Comments:	

Owner's Review and Action (Approval of substitution is not valid without Owner's signature)
☐ Substitution approved.
☐ Substitution approved as Noted.
☐ Substitution rejected. Use specified product.

Signed by:	Date:

Comments:

End of Substitution Request Form

PRODUCT LIST FORM

☐ Preliminary Product List.
☐ Complete Product List.
Include a written explanation for omissions of data and for variations from Contract requirements.

Project: _____ From: _____

To: _____ Date: _____

Spec Section		Early approval? ☐ Yes ☐ No	Product	Model No.	Manufacturer	Supplier	Installer	Delivery Date
No.	Title							

SIMILAR INSTALLATION LIST FORM

Provide minimum 5 similar installations within last 3 years.

Project: _____ From: _____

To: _____ Date: _____

	Date of Installation	Project Name	Owner Info	GC Info	Architect info
1					
2					
3					
4					
5					
6					
7					
8					

End of Previous Project List Form

SECTION 017300 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. General installation of products.
   2. Progress cleaning.
   3. Protection of installed construction.
   4. Correction of the Work.

B. Related Sections include the following:
   1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
   2. Division 1 Section "Submittal Procedures" for submitting surveys.
   3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 SUBMITTALS

A. Qualification Data: For professional engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
   1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of underground gas, water-service piping; and electrical services.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   2. Examine site for suitable conditions where products and systems are to be installed.
   3. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Owner's Representative. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes and wiring as indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Owner's Representative.
   2. Allow for material movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Provide protection against weather, rain, wind, storms, frost and heat so as to maintain all work and materials free from injury or damage.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.6 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:
   1. Division 1 Section "Temporary Facilities and Controls" for environmental-protection measures during construction.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 75 percent by weight of total waste generated by the Work.

1.4 SUBMITTALS

A. Waste Management Plan: Submit 3 copies of plan within 30 days of date established for the Notice to Proceed.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste in tons.
   4. Quantity of waste salvaged, both estimated and actual in tons.
   5. Quantity of waste recycled, both estimated and actual in tons.
   6. Total quantity of waste recovered (salvaged plus recycled) in tons.
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Qualification Data: For Waste Management Coordinator.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Warranties.
   3. Extra Materials.
   4. Final cleaning.

B. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
   2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
   3. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   6. Other Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBMITTALS

A. Submit a copy of Title 24 Certificate of Acceptance forms submitted to enforcement agency.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Owner’s Representative will either proceed with inspection process or notify Contractor of unfulfilled requirements. The Owner’s Representative will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Owner’s Representative, that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
   2. Submit certified copy of Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Owner’s Representative. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report and warranty.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection process for acceptance. On receipt of request, Owner’s Representative will either proceed with inspection process or notify Contractor of unfulfilled requirements. The Owner’s Representative will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use form attached.
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Owner's Representative.
      d. Name of Contractor.
      e. Page number.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Owner's Representative for designated portions of the Work where commencement of warranties other than date specified in General Conditions.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Technical Specifications.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Include Table of Contents.
   3. Identify content with specification section number and title.
   4. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   5. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

1.7 EXTRA MATERIALS

A. Deliver to Owner's facility manager extra materials specified in each section.

B. Organize submitted materials in orderly sequence based on the table of contents of the Technical Specifications.
   1. Itemize each material and quantity in 8-1/2 by 11-inch paper.

C. Label each items for easy identification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    g. Remove debris and surface dust from limited access spaces, including trenches, equipment vaults, manholes, and similar spaces.
    h. Remove labels that are not permanent.
    i. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
        1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    k. Replace parts subject to unusual operating conditions.
    l. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and

defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

m. Leave Project clean and ready for occupancy.

3.2 FORMS

A. Electronic versions of attached forms will be provided upon request.
   1. Punch-List Form.

END OF SECTION 017700

PUNCH-LIST FORM

☐ Preliminary Punch-List.
☐ Final Punch-List.

Project:	From:
To:	Date:

Item No.	Room No.	Area	Description	Completion Date	A/E Verification

End of Punch-List Form

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.

B. Related Sections include the following:
   1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
   3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
   4. Other Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. The Owner’s Representative will return 1 copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit 1 copy of each manual in final form at least 15 days before final inspection. The Owner’s Representative will return copy with comments within 15 days after final inspection.
   1. Correct or modify each manual to comply with Owner’s Representative’s comments. Submit 3 copies of each corrected manual within 15 days of receipt of Owner’s Representative’s comments.

1.4 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.
   3. List of equipment.
   4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Owner’s Representative.
   7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Technical Specifications.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Technical Specifications.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
   4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
   5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   3. Gas leak.
   4. Power failure.
   5. System, subsystem, or equipment failure.

6. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

2.4 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Technical Specifications.

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to maintenance manuals.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Sections include the following:
   1. Division 1 Section "Closeout Procedures" for general closeout procedures.
   2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Other Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit 1 set of marked-up Record Prints.

B. Record Specifications: Submit 1 copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit 1 copy of each Product Data submittal.
   1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an understandable drawing technique.

c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Changes made by Change Order or Construction Change Directive.
   i. Changes made following Owner's Representative's written orders.
   j. Details not on the original Contract Drawings.
   k. Field records for variable and concealed conditions.
   l. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Owner's Representative.
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
   4. Assemble in single binder with table of contents.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Owner’s Representative’s reference during normal working hours.

3.2 FORMS

A. Electronic versions of attached forms will be provided upon request or may be scanned and submitted.
   1. Record Product Data Form.

END OF SECTION 017839

RECORD PRODUCT DATA FORM

Record Product Data is due no later than 10 calendar days after the date of Substantial Completion. Photocopy for continuation sheets. List products in order by specification section numbers.

Project Name:	From:
To:	Date:

Spec Section		**Originally Specified**		**Actually Installed**	
No.	**Title**	**Model**	**Manufacturer**	**Model**	**Manufacturer**

End of Record Product Data Form

SECTION 024116 – STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes demolition and removal of the following:

1. Buildings and structures complete demolition only – for partial demolition, see architectural demolition section.
2. Site improvements including site utilities.
3. Protecting existing trees, shrubs, groundcovers, plants, and grass to remain.
4. Removing existing trees, shrubs, groundcovers, plants, and grass.
5. Clearing and grubbing.
6. Stripping and stockpiling topsoil.
7. Removing above- and below-grade site improvements.
8. Disconnecting and capping or sealing site utilities.
9. Temporary erosion and sedimentation control measures.

B. See Division 23 Sections for demolishing or relocating site mechanical items.

C. See Division 26 Sections for demolishing or relocating site electrical items.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

1.3 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, Antiques, and other items of interest or value to Owner that may be encountered during demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS (Not Applicable)

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI A10.6 and NFPA 241.

C. Predemolition Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of Work.

B. Owner assumes no responsibility for buildings and structures to be demolished, until contract NTP.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
2. Before building demolition, Owner will remove the following items:

    a. Existing trees, as noted on C1.20.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

F. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

G. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

H. Do not commence site-clearing operations until temporary erosion and sedimentation control measures are in place.

1.7 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Survey existing conditions and correlate with requirements indicated to determine extent of building and site demolition required.

B. Review Project Record Documents of existing construction provided by [**Owner**] [**Architect**]. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Inventory and record the condition of items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to Architect.

3.2 PREPARATION

A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.

1. Arrange to shut off indicated utilities with utility companies.
2. If utility services are required to be removed, relocated, or abandoned, before proceeding with building demolition provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

B. Existing Utilities: Refer to Division 23 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping mechanical or electrical utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

D. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

E. Protect and maintain benchmarks and survey control points from disturbance during construction.

F. Locate and clearly flag trees and vegetation to remain or to be relocated.

G. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.3 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, sediment and erosion control Drawings, or a sediment and erosion control plan, specific to the site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.4 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.5 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.

C. Existing Utilities: Maintain utility services indicated to remain and protect them against damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

    a. Provide at least 72 hours notice to Owner if shutdown of service is required during changeover.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 1 Section "Temporary Facilities and Controls."

1. Protect existing site improvements, appurtenances, and landscaping to remain.
2. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
3. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
4. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

3.6 DEMOLITION, GENERAL

A. General: Demolish indicated existing buildings, structures, and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
2. Maintain adequate ventilation when using cutting torches.
3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Engineering Surveys: Perform surveys as the Work progresses to detect hazards that may result from building demolition activities.

C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.7 MECHANICAL DEMOLITION

A. Remove buildings, structures, and site improvements intact when permitted by authorities having jurisdiction.

B. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on next lower level.

C. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact or dust generation.

D. Concrete: Cut concrete full depth at junctures with construction indicated to remain.

E. Masonry: Cut masonry cleanly at junctures with construction indicated to remain.

F. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.

G. Below-Grade Construction: Demolish foundation walls and other below-grade construction.

1. Remove below-grade construction, including basements, foundation walls, and footings, completely.

H. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet outside of footprint indicated for new construction. Abandon utilities outside this area.

1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 2 Section "Earthwork."

I. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

3.8 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

3.9 CLEARING AND GRUBBING

A. Clearing and Grubbing shall be performed in conformance with the provisions of Section 300-1 of the Standard Specifications and these Special Provisions.

B. The following is added to Section 300-1.2 Preservation of Property:
Modify and/or repair existing sprinklers in project area that are damaged due to the Contractor's operation within 24 hours.

3.10 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.11 EXPLOSIVE DEMOLITION

A. Explosives: Use of explosives is not permitted.

3.12 SITE RESTORATION

A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 31 Section "Earthwork."

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.13 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

3.14 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

3.15 REPAIRS

A. General: Promptly repair damage to adjacent construction caused by building demolition operations.

B. Where repairs to existing surfaces are required, patch to restore surface to original or better condition.

C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.16 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be [**recycled,**] reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.17 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Form-facing material for cast-in-place concrete.
   2. Form liners.
   3. Insulating concrete forms.
   4. Shoring, bracing, and anchoring.

B. Related Requirements:
   1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.
   2. Section 321316 "Decorative Concrete Paving" for formwork related to decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:
   1. Exposed surface form-facing material.
   2. Concealed surface form-facing material.
   3. Forms for cylindrical columns.
   4. Pan-type forms.
   5. Void forms.
   6. Form liners.
   7. Insulating concrete forms.
   8. Form ties.
   9. Waterstops.
   10. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
   1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
   2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
   3. Location of construction joints is subject to approval of the Architect.
   4. Indicate location of waterstops.
   5. Indicate form liner layout and form line termination details.
   6. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
   7. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

C. Samples:
   1. For waterstops.
   2. For Form Liners: 12-inch by 12-inch sample, indicating texture.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Form Liners: Store form liners under cover to protect from sunlight.

B. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
   1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
   2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
      a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
   1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:
      a. Wind Loads: As indicated on Drawings.
         1) Horizontal Deflection Limit: Not more than 1/600 of the wall height.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:
   1. Provide continuous, true, and smooth concrete surfaces.
   2. Furnish in largest practicable sizes to minimize number of joints.
   3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
      a. Plywood, metal, or other approved panel materials.
      b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
         1) APA Plyform or equal Class I, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
   1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Sonoco “Seamless Sonotubes,” or equal, type leaving no marks in concrete, 1-piece lengths for full required heights.
   1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

E. Form Liners:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Spec Formliners, Inc.; Block Patterns or comparable product by one of the following:
      a. Architectural Polymers, Inc.
      b. Sika Corporation
      c. Or equal
   2. Size: As required.
   3. Face Pattern: Smooth.

2.3 WATERSTOPS

A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Williams Products, Inc; Neoprene Hi-Tensile Rubber Waterstop or equal
   2. Profile: As indicated.
   3. Dimensions: As indicated on Drawings; nontapered.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.
   1. Basis-of-Design Product: provide GCP Applied Technologies, Inc, Swellseal WA Gungrade Polyurethane Waterstop, or equal.
   2. Profile: As indicated.
   3. Dimensions: As indicated; nontapered.

C. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BoMetals, Inc.
      b. Sika Corporation.
      c. Vinylex Waterstop & Accessories.
      d. Or equal
   2. Profile: As indicated.
   3. Dimensions: As indicated; nontapered.

D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CETCO is a subsidiary of Minerals Technologies Inc.
      b. Carlisle Coatings & Waterproofing Inc.
      c. Concrete Sealants Inc.
      d. Henry Company.
      e. J P Specialties, Inc.

f. Sika Corporation.
g. Or equal

E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CETCO is a subsidiary of Minerals Technologies Inc.
b. GCP Applied Technologies Inc.
c. Kryton International, Inc.
d. OCM, Inc.
e. Sika Corporation.
f. Or equal

2.4 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1-3/4 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:
   1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
   2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
   3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.
   1. Minimize joints.
   2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
   1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
   2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
   1. Provide and secure units to support screed strips
   2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
   1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
   2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
   1. Determine sizes and locations from trades providing such items.
   2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:
   1. Construct joints true to line with faces perpendicular to surface plane of concrete.

2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
   a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings.
7. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.

3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
4. Secure waterstops in correct position at 12 inches on center.
5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
   a. Miter corners, intersections, and directional changes in waterstops.
   b. Align center bulbs.
6. Clean waterstops immediately prior to placement of concrete.
7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.4 INSTALLATION OF INSULATING CONCRETE FORMS

A. Comply with ACI 301 and manufacturer's instructions.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Install forms in running bond pattern.
1. Align joints.
2. Align furring strips.

D. Construct forms tight to prevent loss of concrete mortar.

E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.5 REMOVING AND REUSING FORMS

A. Comply with requirements of ACI 318, Section 26.11.

B. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work.
   1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
   2. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
   1. Align and secure joints to avoid offsets.
   2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:
1. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.
2. Section 321316 "Decorative Concrete Paving" for reinforcing related to decorative concrete pavement and walks.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
1. Each type of steel reinforcement.
2. Epoxy repair coating.
3. Zinc repair material.
4. Bar supports.
5. Mechanical splice couplers.
6. Structural thermal break insulated connection system.

B. Shop Drawings: Comply with ACI SP-66:
1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
1. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For testing and inspection agency.

B. Welding certificates.
   1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

C. Material Test Reports: For the following, from a qualified testing agency:
   1. Steel Reinforcement:
      a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706.
   2. Mechanical splice couplers.

D. Field quality-control reports.

E. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

C. Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.
   1. Build panel approximately 100 sq. ft. for formed surface in the location indicated on Drawings or, if not indicated, as directed by Architect.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. and to avoid damaging coatings on steel reinforcement.
   1. Store reinforcement to avoid contact with earth.
   2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
   3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
   4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, deformed, unless otherwise indicated on drawings

B. Low-Alloy Steel Reinforcing Bars for welding: ASTM A706, Grade 60, deformed.

C. Headed-Steel Reinforcing Bars: ASTM A970.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, ASTM A775/A775M epoxy coated.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
   1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
      a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
      b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
      c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
      d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
      e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

D. Mechanical Splice Couplers: Type and manufacturer, noted on drawings and subject to approval by LADBS. If substitution is requested, Design Builder to supply manufacturer calculations and supporting data showing proposed substitution conforms to requirements indicated and supplied.

E. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, 16 ga minimum
   1. Finish: Plain.

F. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:
   1. Do not cut or puncture vapor retarder.
   2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.
   1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
   2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.
   1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, or as indicated on Drawings, whichever is greater.
   2. Stagger splices in accordance with ACI 318.
   3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
   4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install structural thermal break insulated connection system in accordance with manufacturer's instructions.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement.
   2. Continue reinforcement across construction joints unless otherwise indicated.
   3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 032000 “Concrete Reinforcing” for steel reinforcing bars.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

D. Samples: For vapor retarder.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For all products and product manufacturers, installers, testing and inspection personnel and testing agency as required by LADBS and CBC requirements.

B. Welding operator's certificates.

C. Steel Reinforcement Shop Drawings: Submit shop drawings which should include complete layouts, sections, and details for congested conditions, typical bending diagrams and offsets, splice lengths and locations, proposed layout where vertical and horizontal bars intersect, and wherever welding is proposed, detailed to conform to AWS D1.4 and 2022 CBC requirements.

D. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Curing compounds.
   6. Floor and slab treatments.
   7. Bonding agents.
   8. Adhesives.
   9. Vapor retarders.
   10. Semi rigid joint filler.
   11. Joint-filler strips.
   12. Repair materials.

E. Material test and sampling reports.

F. Form Removal Reports: Submit record copies of bi-weekly form removal reports as work progresses.

G. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

   1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

H. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

I. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency with certifications acceptable to LADBS.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Regulatory Requirements: Conform to 2022 CBC, Chapter 19.

E. Source Quality Control of Portland Cement: Furnish Certificate of Compliance in accordance with 2022 CBC 1910.2, and acceptable to Structural Engineer of Record and LADBS, showing conformance with requirements specified. Cementitious materials without Certificate of Compliance shall not be used.

F. Source Quality Control of Aggregate for Normal Weight Concrete: Aggregate materials which, by previous tests or actual service, have shown conformance may be used without testing when so approved by the SEOR and LADBS. Otherwise, test the aggregate before and after concrete mix is designed and whenever character of aggregate varies, or source of material is changed. Include a sieve analysis. Obtain samples of aggregates at the dry batching or ready-mix concrete plant in accordance with ASTM D 75 and perform tests for the properties listed in the following table:

PHYSICAL PROPERTIES		
Physical Properties, units	Test Method	Minimum values
Sieve analysis	ASTM C136	Per ASTM C33 Section 6 for fine aggregate, and Table 2 for coarse aggregate
Organic impurities	ASTM C40	Fine aggregate not darker than reference standard color
Soundness	ASTM C88	Loss after 5 cycles not more than 8 percent of coarse aggregate, nor more than 10 percent of fine aggregate
Abrasion	ASTM C131	For coarse aggregate, weight loss not more than 50 percent after 500 revolutions
Deleterious materials	ASTM C33	Per ASTM C33 Table 1 for Fine Aggregate, and Table 3, Class 1N, for Coarse Aggregate.
Materials finer than No. 200 sieve	ASTM C117	Not over 1 percent for gravel, 1.5 percent for crushed aggregate
Reactivity potential	ASTM C289	Ratio of silica released to reduction in alkalinity not to exceed 1.0. See 2022 CBC Section 1903.5.
Sand equivalent	ASTM D2419	California sand equivalent values operating range not below 71 percent

G. Source Quality Control of Aggregate for Lightweight Aggregates: Aggregate materials which, by previous tests or actual service, have shown conformance may be used without testing when so approved by the SEOR and LADBS. Otherwise, test the lightweight aggregates before mix is designed and whenever the character of aggregate varies, or source is changed in accordance ASTM C330 and C332 and 2022 CBC Section 1903.5. Include sieve analyses, report on unit weights, report on deleterious substances, unburned or underburned lumps, loss on ignition,

soundness, staining materials, and crushed particles in coarse aggregate. Splitting tensile strength (FSP); 5.5 minimum. The use of pumice aggregate is prohibited.

H. Concrete Batch Plant Inspections: Conform to 2022 CBC 1705.3.3. Continuous batch plant inspection is required for structural concrete, performed by a specially qualified inspector approved by LADBS. As allowed by 2022 CBC, 1705.3.3.1, batch plant inspection may be waived provided all the requirements in section 1705.3.3 are satisfied. Structural Engineer of Record and LADBS approval will be required prior to the waiving batch plant inspection.

I. Source Quality Control of Reinforcing Steel: Testing Laboratory shall select test samples of bars, ties, and stirrups from the material at the site or from place of distribution, each sampling including at least two 18" long pieces, and perform the following tests in accordance with 2022 CBC Section 1910.2.2 and ASTM A706.
   1. Identified Bars: If samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with Identification Certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when samples are selected.
   2. Unidentified Bars: When positive identification of reinforcing bars cannot be made and when random samples are obtained, perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.

J. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4.
   1. Chemical Composition and Procedures Requirements for Welded Bars: Comply with 2022 CBC Section 1903.8.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures as required by code.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Formwork: Store materials in area protected from weather, above ground on framework or blocking, and cover with protective waterproof covering providing for adequate air circulation and ventilation. Handle materials to prevent damage.

B. Steel Reinforcement: Deliver reinforcement to the Project Site, bundled, tagged, and marked. Indicate on tags, the bar size, lengths, and other information corresponding to markings shown on placement diagrams, store, and handle steel reinforcement to prevent bending, accumulation of dirt and excessive rust, and damage.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Design Builder's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 – PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301
2. ACI 117

2.2 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:
1. Portland Cement: ASTM C 150 Type II, low alkali.
2. Fly Ash: ASTM C 618, Class F or N Fly Ash.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: 1-1/2 inches for foundations, and 3/4 inch for the remainder of the structure. Comply with 2022 CBC Section 1903.5 and ACI 318, Section 26.4.2.1 (a)(4).
   a. For Pumping: Limit design to use up to 3/4-inch maximum aggregate.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
   a. For Pumping: 15 percent sand to pass 50 mesh screen; 3-1/2 percent to pass 100 mesh screen.

D. Lightweight Aggregate: ASTM C 330, approved kiln expanded shale having fire sealed surface, coarse aggregate, not produced by crushing, dry loose weight maximum 38 pounds per cubic foot, maximum 9/16 inch size; all aggregate vacuum or thermally fully saturated for pumped concrete. Control mix in accordance with ACI 213R-14. Guide for Structural Lightweight-Aggregate Concrete. The absolute volume of coarse aggregate in concrete mix shall not exceeding 8.8 cubic feet. Design for air-dry density of 110 ± 3 pounds per cubic foot per U.L. Rating maximum. With each mix design submit test reports showing concretes covered by the mix designs meet shrinkage test requirements specified under article "Field Quality Control" hereinafter or include certified test reports showing conformance as furnished by the ready-mix concrete manufacturer.

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride. Admixtures to be used in concrete shall be subject to prior approval by LADBS.
   1. A crystalline permeability reducing admixture (PRAH) may be used in roof top equipment pads in accordance with ACI 212.3R. Trial batches shall be performed to ensure that the plastic and hardened properties of concrete meet expectations.
   2. A crystalline waterproofing admixture may be used in sewage/sump/elevator pits in accordance with ACI 212.3R. Admixture to be 1-3% dosage by weight of cement content for enhanced chemical protection per manufacturer's recommendation. Trial batches shall be performed to ensure that the plastic and hardened properties of concrete meet expectations.

G. Color Pigment: ASTM C 979 synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
   1. Color: As selected by Architect.

H. Water: ASTM C 94 and potable.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A and have a water vapor transmission rate (WVTR) of less than or equal to 0.012 Perms as tested by ASTM E96. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   1. Products: Subject to compliance with requirements, provide products by available manufacturers offering products that may be incorporated into the work, including, but are not limited to, the following:
      a. Zero-Perm by Alumiseal (15-mil).
      b. W.R. Meadows Premoulded Membrane with Plasmatic Core (15-mil).
      c. Stego Industries, LLC; Stego Wrap 15 mil Class A.
      d. Or equal

2.4 CURING MATERIALS

A. Liquid Curing compound: ASTM C 309, fugitive dye dissipating type, complying with Local Air Quality Management District and Federal Air Quality Regulation 40 CFR 52.254e.

B. Moisture-Retaining Cover: ASTM C 171, non-staining white types.

C. Water: Potable.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

E. Types II, non-load bearing for bonding freshly mixed concrete to hardened concrete.

F. Reglets: As indicated in Section 031000.

G. Dovetail Anchor Slots: As indicated in Section 031000.

H. Non-shrink Grout: Premixed, nonmetallic, noncorrosive product, complying with ASTM C 1107, Class B or C, at flowable consistency for 30 minutes for temperature extremes of 45 degrees F to 90 degrees F. Provide for setting bolts and dowels in new and existing concrete, and leveling baseplates and bearing plates. Minimum compressive strength of non-shrink grout shall be 6000 psi.
   1. Products: Subject to compliance with code requirements, provide one of the following:
      a. BASF "Masterflow 928," or Atlas “Ultimate HP Grout” or equal.

I. Drypack: Contractor may use factory mixed drypack material such as Atlas “Tech Grout” or approved equal & shall follow all manufacturer’s instructions.

J. For grouting around embedded handrails use an expanding cement such as CRL KWIXSET EXTERIOR CEMENT or equal.

K. For concrete repairs: SikaTop-123 Plus, SikaGrout 328, Sikacrete 421 or approved equal. Follow all manufacturer instructions.

2.6 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. All concrete shall conform to 2022 CBC Section 1905 and ACI 318, Chapter 19 and Chapter 26 for strength design, and have the minimum 28 day compressive strengths in pounds per square inch indicated on the Structural Drawings.

B. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures. Mix proportions shall be established by a registered Civil Engineer.

C. Cementitious Materials: Use 100 pounds maximum per cubic yard of Fly Ash. Fly Ash shall not be used in excess of 15 percent by weight of total cement quantity.

D. Aggregates: Provide quantity of fine and coarse aggregate as determined by Testing Laboratory designing the mix.

E. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

F. Admixtures: Use admixtures according to manufacturer's written instructions. Use no admixture in concrete below grade. Admixtures used shall meet approval of LADBS and be acceptable to the Architect.
   1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.7 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Minimum Compressive Strength: As indicated on the drawings.

B. Maximum W/C Ratio: As indicated on the drawings.

C. Slump Limit: As indicated on the drawings.

D. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size, and 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size. Do not allow air content of trowel-finished floors to exceed 3 percent.

2.8 FABRICATING REINFORCEMENT

A. As indicated in Section 032000.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2.10 SOURCE QUALITY CONTROL

A. Inspection and Testing will be performed under provisions of Division 01 and 2022 CBC Chapter 17.

B. Testing Laboratory will:
1. Review Design Builder's Quality Assurance procedures for maintaining identification of steel reinforcement.
2. Collect certificates of compliance for steel reinforcement for record purposes.
3. Collect available test reports for record purposes.
4. Randomly sample and test reinforcement for tensile and bend tests in accordance with 2022 CBC Section 1910.2.2.
5. Review mix designs and certificates of compliance for concrete materials Design Builder proposes to use.

C. Provide batch plant inspection at the location where materials used in transit-mixed concrete and batched aggregates are measured in accordance with 2022 CBC Section 1705.3.3. Inspection may be waived, subject to requirements of 2022 CBC Section 1705.3.3.1.

PART 3 – EXECUTION

3.1 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Place vapor retarder over compacted smooth subgrade surface.
2. Lap joints 6 inches and seal with manufacturer's recommended tape.
3. Protect, and repair vapor retarder according to manufacturer's written instructions.

3.2 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect. Comply with ACI 318, Section 26.5.6 and details shown on the structural drawings.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Walls: Provide either a vertical contraction joint, or construction joint in walls at a maximum spacing of 30x the wall thickness or 30'-0" maximum, whichever is smaller. Provide protection of contraction joints at watertight and below grade joints. Submit contraction joint proposal: type & location to SEOR/AOR for approval prior to placement of concrete.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.3 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
1. Pumped Concrete: Do not use aluminum or aluminum lined pipe. Prevent concrete from contacting aluminum fittings.
a. Minimum Diameter of Hose for 1 inch Aggregate: 3 inches with 3 workers at hose.
b. Minimum Diameter of Hose for 1-1/2 inch Aggregate: 4 inches with 4 workers at hose.
c. For hoses greater than 4 inches in diameter, use mechanically supported and operated hose.

d. Pumps: Use only piston type pumps. Ensure that they are reversible. Make standby pump available of no less capacity than that in use for operation at the Project Site within one hour's notice.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect, Structural Engineer (SEOR) and Inspector of Record (IOR).

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Surface Preparation: Before concrete is deposited upon or against concrete that has taken its initial set or has hardened, remove all encrustations from the forms and reinforcement, and mechanically roughen hardened concrete to minimum 1/4 inch coarseness amplitude.
1. Remove all laitance, oil, and loose particles from concrete; clean concrete surfaces and forms thoroughly by washing with water under stiff pressure, or sandblasting, if necessary, to obtain the specified condition.
2. Remove laitance after concrete has partially hardened (not less than two nor more than four hours after placing) by brushing with stiff bristles or by directing a stream of water from a 1/4 inch nozzle, or other acceptable method, to expose clean top surface of aggregate.
3. Where cleaning is not satisfactory to the Architect, sandblast surface and then wash again.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
a. Place concrete containing retarding admixture, if approved, by a schedule that allows layers of concrete to be in place and compacted for at least 30 minutes before next layer of concrete is placed. Remove bleed water on the concrete surface and from forms and re-vibrate the concrete down as far as the concrete is plastic before placing the next layer.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations. Continuously monitor concrete placing operation to maintain level floors by use of an instrument level, transit, or laser.
4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

G. Vertical Elements: Stop placement of concrete in walls and columns 1-1/2 inches below bottom of beams or supported slabs. Stop placement at sills and heads of wall openings in same manner. Allow concrete in vertical element to be in place at least 2 hours and until vertical shrinkage has ceased before placing concrete for floor framing.

3.4 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view and as indicated on the drawings.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view, and to surfaces covered with a coating or covering material applied directly to concrete.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.5 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven float. Restraighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

   1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces indicated, exposed to view, to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 25; and of levelness, F(L) 20.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.6 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 6 inches high unless otherwise indicated, and extend base not less than 12 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: As indicated on drawings.
4. Install dowel rods to connect concrete base to concrete floor as indicated.
5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

D. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

E. Nonshrink Grout: Provide nonshrink grout for setting bolts and dowels in new and existing concrete, and leveling baseplates and bearing plates. Clean existing concrete surfaces of foreign materials prior to grouting operations. Add water to premixed grout only at Project site in accordance with manufacturer's instructions. Coordinate grouting operations with Division 05 steel sections.

F. Miscellaneous Items: Provide areaways, cast-in-place valve boxes, pits, splash blocks, bases, and other miscellaneous concrete as indicated on the Drawings and required to complete the Work.

3.7 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
1. Protect exposed concrete finish such as bases, curbs, and similar work as necessary to prevent damage resulting from impact or from subsequent work or rubbish.

2. Protect work of other Sections from damage by Work of this Section with heavy kraft paper.
    a. Maintain protection in effective condition for as long as need for protection exists.
    b. Control use of water within the building so that no damage to previously installed work or existing structure and finish is permitted to occur.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.8 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days' old unless approved by the manufacturer.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
   1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
   2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
   3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
   4. Control and dispose of waste products produced by grinding and polishing operations.
   5. Neutralize and clean polished floor surfaces.

C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.9 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least six month(s) or as approved by the manufacturer. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.11 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.
   3. Headed bolts and studs.
   4. Verification of use of required design mixture.
   5. Concrete placement, including conveying and depositing.
   6. Curing procedures and maintenance of curing temperature.

D. Obtain inspection and approval of reinforcing per 2022 CBC Section 1705.3 before concrete is placed.

E. Whether welding is done in the shop or at the site, perform welding of reinforcing bars under inspection of the Testing Laboratory Welding Inspector who is specially qualified and approved by LADBS in accordance with 2022 CBC Section 1705.3.1 and Table 1705.3 Item 2.

F. Verification of concrete strength before removal of shores and forms from beams and slabs.

G. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 and in accordance with 2022 CBC Section 1903.1 shall be performed according to the following requirements:
   1. Testing Frequency: Conform to testing frequency of ACI-318 Section 26.12.2.1(a) as modified by 2022 CBC Section 1909.3.7.
   2. Obtain at least one composite sample for each 50 cu. yd. or fraction thereof of each concrete mixture placed each day, or not less than once for each 2,000 square feet of surface area for slabs and walls, of each strength of structural concrete.
   3. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are use.
   4. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   5. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   6. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
   7. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   8. Compression Test Specimens: ASTM C 31.
      a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

9. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
10. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Design Builder shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
11. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
12. Test results shall be reported in writing to Architect, concrete manufacturer, and Design Builder within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
13. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
14. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
15. Additional testing and inspecting, at Design Builder's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
16. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

H. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing. Floor flatness requirements per Architect.

I. Concrete Piles: All pile drilling and concrete placement operations shall be performed under the observation of a representative of the Geotechnical Engineering firm and an approved special concrete inspector as follows:
   1. The Geotechnical Engineering firm shall issue periodic field reports regarding the progress of the excavation and pile drilling operations and observations. Copies shall be distributed to Structural Engineer of Record and LADBS.
   2. The Geotechnical Engineering firm shall issue a final as-built Geotechnical Report which shall include observations and tests performed during grading, excavation and installing the piles, and submit verification reports of pile lengths and pile locations.
   3. The Special Inspector shall perform testing and inspection required by 2022 CBC, and as indicated.

3.12 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 033500 – ARCHITECTURAL CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Finishing of Cast-in-Place Architectural Concrete, including form facings, reinforcement accessories, concrete materials, concrete mixtures, concrete placement, and concrete finishes.

B. Related Sections:
   1. Division 3 Section "Cast-in-Place Concrete" apply to this Section.

1.2 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Concrete that is exposed to view, is designated as architectural concrete, and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Cast-in-place architectural concrete Subcontractor.
   2. Review the following:
      a. Construction joints, control joints, isolation joints, and joint-filler strips.
      b. Reinforcement accessory installation.
      c. Concrete finishes and finishing.
      d. Curing procedures.
      e. Forms and form-removal limitations.
      f. Shoring and reshoring procedures.
      g. Concrete repair procedures.
      h. Protection of cast-in-place architectural concrete.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Formwork: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

a. Show formwork construction, including form-liner layout, form-liner termination details, dimensioned locations of form-facing material joints, rustications, construction and contraction joints, form joint-sealant details, form-tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
   1) Included separate layout for formwork used in field sample panels and mockups.
   2) Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
   3) Location of construction joints is subject to approval of Architect.

B. Samples: For each of the following materials:
   1. Form-facing panels.
   2. Form ties.
   3. Form liners, 12-by-12-inch Sample, indicating texture.
   4. Manufacturer's standard colors for color pigment.
   5. Exposed aggregates.
   6. Chamfers and rustications.
   7. Design Reference Sample.

C. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18 by 18 by 2 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.5 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
   1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Installer Qualifications: An experienced cast-in-place architectural concrete installer, as evidenced by not less than five consecutive years' experience, specializing in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
   1. Provide written evidence of qualifications and experience.
   2. Include locations, descriptions, and photographs of completed projects, including name of architect, substantiating the quality of the installer's experience.

C. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.
   1. Locate panels as indicated or, if not indicated, as directed by Architect.
   2. Demonstrate methods of curing, aggregate exposure, wood sealers, and coatings, as applicable.

3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
5. Demolish and remove field sample panels when directed.

D. Mockups: Before casting architectural concrete, build mockups, using the same procedures, equipment, materials, finishing procedures, and curing procedures that will be used for producing architectural concrete, to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, color, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups of typical wall of cast-in-place architectural concrete as shown on Drawings, including vertical and horizontal rustication joints, and any sculptured features.
3. Construct mockups to include at least two lifts having heights equal to those anticipated for construction.
4. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
5. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair to match adjacent undamaged surfaces.
6. In presence of Architect, demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
7. Obtain Architect's approval of mockups before casting architectural concrete.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Comply with Division 3 Section "Concrete Forming and Accessories" for formwork and other form-facing material requirements, and as specified in this Section.

B. Form-Facing Panels for As-Cast Finishes:
1. Steel- and glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

C. Form Liners: Units of face design, texture, arrangement, and configuration to match design reference sample. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments and finishes of concrete.

D. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch, minimum; nonstaining; in longest practicable lengths.

E. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch thick.

F. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or Type S, Grade NS, that adheres to form joint substrates, does not stain, does not adversely affect concrete surfaces, and does not impair subsequent treatments and finishes of concrete surfaces.

G. Form-Release Agent: Commercially formulated, colorless form-release agent that does not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments and finishes of architectural concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
   2. Form-release agent for form liners to be acceptable to form-liner manufacturer.

H. Form Ties: Factory-fabricated, designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

PART 3 - EXECUTION

3.1 FINISHING EXPOSED FORMED CONCRETE

A. Formed finish: Match Architect’s sample.

3.2 CLEANUP AND PROTECTION

A. Construction Waste Management:
   1. At end of each work day, recycle or dispose of unused materials, debris, and containers.

B. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION 033500

SECTION 033517 – POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes polishing of concrete flooring.

1.2 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's product data sheets and tested physical and performance properties on products to be used for the work.

B. VOC Certification: Submit certification that products furnished comply with regulations controlling use of volatile organic compounds (VOC).

C. Certificates:
   1. Certificates by manufacturer stating that installer is listed applicator of special concrete finishes, and has completed the necessary training programs.

D. Floor Protection Plan.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Applicator to be familiar with the specified requirements and the methods needed for proper performance of work of this section. Applicator must have availability of proper equipment to perform work within scope of this project on a timely basis. Applicator should have successfully performed a minimum of 5 projects of similar scope and complexity.

B. Mock-up: On site, prior to the start of the polished concrete finishing process.
   1. Require attendance of parties directly affecting work of this Section, including the Contractor, Architect, applicator, and Owner's Representative.
   2. Notify the above parties one week in advance of date and time when mock-up will be completed.
   3. Demonstrate the materials, equipment and application methods to be used for work specified herein in pre-approved location approximately 50 sq. ft. in area or as directed by Architect.
   4. Retain approved mock-up during construction as a standard for judging the completed work. Areas may remain as part of the completed work.

C. Pre-Installation Meeting: Convene before the start of work on new concrete slabs, patching of existing concrete slabs and start of application of concrete finish system.
   1. Require attendance of parties directly affecting work of this Section, including the Owner's Representative, Contractor, Architect, concrete installer, and applicator. Meeting should only convene when required parties are present.
   2. Review the following:

a. Physical requirements of completed concrete slab and slab finish.
b. Locations and time of test areas.
c. Protection of surfaces not scheduled for finish application.
d. Surface preparation.
e. Application procedure.
f. Quality control.
g. Cleaning.
h. Protection of finish system.
i. Coordination with other work.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original containers, with seals unbroken, bearing manufacturer labels indicating brand name and directions for storage.

B. Store concrete hardener/densifier and surface protectant treatment in environment recommended on published manufacturer's product data sheets.
1. Store containers upright in a cool, dry, well-ventilated place, out of the sun with temperature between 40 and 100 degrees F (4 and 38 degrees C).
2. Protect from freezing.
3. Store away from other chemicals and potential sources of contamination.
4. Keep lights, fire, sparks and heat away from containers.
5. Do not drop containers or slide across sharp objects.
6. Do not stack pallets more than three high.
7. Keep containers tightly closed when not in use.

1.5 FIELD CONDITIONS

A. Environmental limitations:
1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting performance and finishing requirements.

B. Close areas to traffic during floor application and after application for time period recommended in writing by manufacturer.

C. Protect the completed slab to prevent damage by the other trades during floor completion.

D. Temperature Limitations:
1. Apply when surface and air temperature are between 40 degrees F (4 degrees C) and 95 degrees F (35 degrees C) unless otherwise indicated by manufacturer's written instructions.
2. Apply when surface and air temperatures are expected to remain above 40 degrees F (4 degrees C) for a minimum of 8 hours after application, unless otherwise indicated by manufacturer's written instructions.

E. Apply when air conditions are calm to minimize surface treatment contacting surface not intended to be finished.

F. Do not apply to frozen substrate. Allow adequate time for substrate to thaw if freezing conditions exist before application.

G. Apply a minimum of 24 hours after rain event. Suspend application when rain is anticipated for a period of 8 hours after application, unless otherwise indicated by manufacturer's written instructions.

H. Temporary Heat: Ambient temperature of 50 degrees F (10 degrees C) minimum.

I. Ventilation: Provide adequate ventilation in confined or enclosed areas in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Concrete Polish:
1. Consolideck Cleaner/Degreaser manufactured by PROSOCO, Inc. (Basis of Design)
2. Advanced Floor Products, Inc
3. Floor Seal Technology, Inc.
4. L & M Construction Chemicals.
5. Scofield.
6. Or equal.

2.2 MATERIALS

A. Pre-Densifier Concrete Cleaner: Cleaner to remove dirt, oil, grease, and other stains from existing slab surface.
1. Product: Consolideck Cleaner/Degreaser manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.

B. Penetrating Concrete Hardener/Densifier: Lithium silicate hardener/densifier.
1. Product: Consolideck LS, manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
2. Subject to compliance with the following requirements:
    a. Living Building Challenge 2.0/2.1 Red List Compliant.
    b. Recipient of Scientific Certification System (SCS) Indoor Air Quality Gold Certification.
    c. Comply with national, state and district AIM VOC regulations and contain 50 g/L or less.
    d. Registered as an approved NSF International/Nonfood Compound Registration.
    e. Abrasion Resistance: Greater than 50 percent improvement over untreated samples when tested in accordance with ASTM C1353.
    f. Achieve 'High Traction Range' readings when tested in accordance with ANSI B101.1.
    g. Coefficient of Friction: Greater than 0.60 dry, Greater than 0.60 wet when tested in accordance with ASTM C1028.

h. Adhesion: Greater than10 percent increase in pull-off strength when compared to an untreated sample when tested in accordance with ASTM D4541.
i. Water Vapor Transmission: 100 percent retained when compared to untreated samples when tested in accordance with ASTM E96/96M Method B (Water Method).
j. UV Stability: No degradation or yellowing of material when tested in accordance with ASTM G154.

C. Interior Concrete Protective Treatments:
1. General Purpose medium gloss, film forming sealer.
a. Product: Consolideck PolishGuard, manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
b. Subject to compliance with the following requirements:
1) Living Building Challenge 2.0/2.1 Red List Compliant.
2) Recipient of Scientific Certification System (SCS) Indoor Air Quality Gold Certification.
3) Comply with national, state and district AIM VOC regulations.
4) Achieve 'High Traction Range' readings when tested in accordance with ANSI B101.1.
5) Coefficient of Friction: Greater than 0.60 dry, Greater than 0.60 wet when tested in accordance with ASTM C1028.
6) Stain Resistance: Achieve limited or no adverse effects when tested in accordance with ASTM D1038.
7) UV Stability: No degradation or yellowing of material when tested in accordance with ASTM G154.

2.3 EQUIPMENT

A. Auto Scrubber Machine: For cleaning operations.

B. Hand Grinder or stand-up edger for edge grinding/polishing.

C. Polishing Equipment:
1. Dry grinding/polishing machines shall include a dust extraction system, including HEPA filtration vacuum.

D. Diamond Segments:
1. Use heads from the same manufacturers throughout the entirety of the project.

E. Diamond Heads Types:
1. Metal Diamonds: 80 or 150.
2. Hybrid Style Diamonds: 50 or 100.
3. Resin Bonded, Phenolic Diamonds: 100, 200, 400, 800, 1500, and 3000 (if necessary).

F. Burnishing Machine and Burnishing Pads to produce specified results.
1. Burnishing Machine: High speed burnisher, generating pad speeds of 1,500 RPM or higher, as recommended by protective treatment manufacturer. Dust skirt must be installed at time of work.
2. Burnishing Pads: as recommended by protective treatment manufacturer.
a. White Burnishing Pad, non-abrasive

b. Consolideck Heat Pad manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate with installer present for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Notify Architect in writing of conditions detrimental to the proper and timely completion of the work.

B. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

3.2 PREPARATION

A. Clean dirt, dust, oil, grease and other contaminants that interfere with penetration or performance of specified product from surfaces. Use appropriate concrete cleaners approved by the concrete surface treatment manufacturer where necessary. Rinse thoroughly using pressure water spray to remove cleaner residues. Allow surfaces to dry completely before application of product.

B. Repair, patch and fill cracks, voids, defects and damaged areas in surface as approved by the Architect. Allow repair materials to cure completely before application of product.

C. Variations in substrate texture and color will affect final appearance and should be corrected prior to application of sealer/hardener system and the polishing steps.

D. Protect surrounding areas prior to application. If product is accidentally misapplied to adjacent surfaces, flush with water immediately before material dries.

E. Avoid contact in areas not to be treated. Avoid contact with metal, glass and painted surfaces.

F. Seal open joints.

G. Apply specified sealants and caulking and allow complete curing before application of penetrating concrete hardener/densifier.

H. Do not proceed until unsatisfactory conditions have been corrected.

3.3 CONCRETE POLISHING

A. Adhere to industry standard polishing procedures for dry and wet grinding/polishing.

B. Scrub and rinse slab surface with clean water and vacuum with auto-scrubber between and after final polishing passes.

C. Sequential progression of diamond polishing steps shall be required and limited to no more than double the grit value of the previous diamonds used.

D. Overlap adjacent polishing passes by 25 percent.

E. Perform each pass perpendicular to the other pass north/south then east/west; multiple passes may be needed.

F. Progressively grind and polish the slab surface utilizing approved diamond segments as necessary to produce Finishing requirements.

3.4 APPLICATION OF PENETRATING CONCRETE HARDENER/DENSIFIER

A. Apply hardener/densifier at the rate of 500 to 700 square feet per gallon with a low pressure sprayer fitted with a 0.5 gpm spray tip. (Typically after 200-grit and no later than 400 grit)

B. Apply sufficient material to keep concrete surface wet for 5 to 10 minute period, without producing puddles.

C. Allow treated surface to dry.

D. Continue progressively polishing floor with required resin diamonds as necessary to produce desired final finish.

3.5 APPLICATION OF INTERIOR CONCRETE PROTECTIVE TREATMENT

A. Application of general purpose, medium gloss protective treatment:
   1. Apply per manufacturer's published recommendations to clean, dry slab at the completion of mechanically polishing the slab surface.
   2. Lightly wet a clean microfiber pad with PolishGuard and wring out excess, leaving the pad damp.
   3. Spray-apply protective treatment using a clean, pump-up sprayer fitted with a 0.5 gpm conical or fan spray tip at an estimated coverage rate of 400 to 800 square feet per gallon. Work from one control joint to another.
   4. Spread with the damp microfiber pad. Maintain a thin, even coating and wet edge. Stop spreading once drying begins. Do not overlap. Repeat steps 1 through 4. Two coats are recommended for maximum protection.
   5. To increase gloss, wait at least 60 minutes after the final coat is applied, then use a high-speed burnisher fitted with a white polishing pad. Burnish at a fast walking pace.

3.6 SLAB PROTECTION

A. Protect finished floors to prevent damage including staining, gouges and scratching by construction traffic and activities until possession.

B. Do not drag or drop equipment or material across the slab which will scratch or chip it.

C. Inspect tires for debris prior to use on slab. Remove embedded items which may cause damage to floor slab.

D. Clean up spills on slab immediately. Provide cleaning chemicals and absorptive materials.

E. Develop a concrete protection procedure which addresses the following procedures:
   1. Communication of protection plan to subcontractors and vendors.
   2. Procedures for cleaning up slab spills, including use of and availability of cleaning chemicals and absorptive materials at Site.

F. Provide a clean slab surface using concrete maintenance cleaner within an auto scrubber, equipped with soft nylon brushes, in accordance with manufacturer's recommendations.

3.7 FINISHING REQUIREMENTS

A. Appearance:
   1. Interior exposed finished slab areas must consist of the following:
      a. Slab surface must meet the desired sheen, as discussed in Pre-Installation meeting and be consistent with approved Mock-up.

END OF SECTION 033517

SECTION 050650 - WELDED STUD CONNECTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers the technical requirements for welded stud connectors and forms a part of all other Sections which require stud connectors, anchor studs, stud shear connectors, and similar items to be provided in accordance with this Section.

1.2 SUBMITTALS

A. Comply with all pertinent provisions of Division 01.

B. Product Data: Submit following items for information only if requested; however, maintain copies of the following readily available at the site whenever welded stud connectors are being installed:
   1. Certified evidence stud bases are qualified in accordance with 2022 CBC.
   2. Stud manufacturer's installation instructions with a complete listing, by manufacturer and model, of stud welding equipment approved by stud manufacturer.

C. Samples: Submit samples as may be requested.

D. Stud Connector Mill Certificates.

E. Weld Procedure Specification (WPS): Submit WPS' for review and approval by SEOR. WPS's shall be submitted for both stud welding and repair fillet welds (see Section 3.3).

1.3 QUALITY ASSURANCE

A. Comply with all pertinent provisions of Division 01.

B. General: Furnish studs and stud bases currently qualified in accordance with 2022 CBC, AWS D1.1-15, and install in accordance with the procedures and quality control requirements of AWS D1.1-15. Employ welding mechanics that are skilled and experienced in installing required studs and currently qualified in accordance with AWS D1.1-15.

C. Source Quality Control: Furnished laboratory shall test end welded studs furnished for either shop or field installation according to 2022 CBC 1705.2 and 2213.2.

1.4 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Comply with all pertinent provisions of Division 01.

B. Protect materials from damage during shipping, handling, and storage at the site. Deliver studs to site in unbroken sealed packages bearing manufacturer's name and label identifying the contents.

PART 2 - PRODUCTS

2.1 STUD CONNECTORS

A. Standard product steel stud units intended for welding by automatically timed stud-welding equipment, furnished complete with an arc shield (ferrule) of heat-resistant ceramic or equivalent for all studs and, for studs 5/16" diameter or larger, a deoxidizing and arc stabilizing flux; no studs painted, galvanized, or cadmium plated prior to welding and all finished by cold heading, cold rolling, or machining; all of uniform quality and condition, free of injurious laps, fins, seams, cracks, twists, bends not indicated, rust, rust pits, scale, oil, or other injurious defects or substances.

B. Stud Steel: Furnish end-welding studs manufactured of steel conforming to ASTM A108, Grade 1010 through 1020 cold-drawn steel of minimum 60,000 psi tensile strength with 20% elongation in 2".

C. Manufacturer: As specified on the Construction Documents.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that galvanizing on steel deck does not exceed the zinc coating approved for stud installation. Report in writing all conditions that prevent or interfere with the proper installation of studs including loose steel decking or improper fitting.

3.2 PREPARATION: CONFORM TO AWS D1.1.

A. Cleaning: Clean surfaces to receive the studs of paint, scale, rust, and other injurious substances by wire brushing, peening, prick-punching, grinding, or other method as required to produce clean bare substrates.

B. Preparation for Replacement Studs and Repairs: Repair steel surfaces as follows wherever a defective stud is removed. Make area where a stud is removed flush and smooth if the surface remains exposed in the Work. Complete repairs before installing a replacement stud on a defect area.
   1. Areas Subject To Tensile Stress (Studs occurring at Frame Beams, Chord/Drag/Collector Beams, and at Bottom Half of Gravity Beams): Make the area flush and smooth. If the base metal is pulled out by stud removal, fill pocket by shielded metal-arc welding conforming to AWS D1.1 using low-hydrogen electrodes, and grind the weld surfaces flush.
   2. Areas Subject To Compression (Studs occurring at Top Flange of Gravity Beams): Where any stud failures are confined to shanks or fusion zones of the studs, a new stud may be

installed adjacent to the defective area in lieu of repairing defective area and installing a replacement stud, subject to approval. If metal is pulled out of base metal, fill pocket as specified above for tensile stress areas except, if the defect depth is not more than the lesser of 1/8" or 7% of base metal thickness, the defect may be faired by grinding in lieu of weld filling.

3.3 STUD WELDING

A. Conform to AWS D1.1, approved submittals, and requirements herein.

B. Welding Equipment: Furnish automatically timed stud-welding equipment and a suitable power source, of type and manufacturer listed as approved by the stud manufacturer. Interlock the welding equipment supplying current to two or more stud-welding guns so that only one gun can operate at a time and so power source has fully recovered from making one weld before another weld is started.

C. Installation: Do not install studs on wet surfaces, nor any studs showing defects, rust, rust pits, scale, oil, or other deleterious substance. Hold the steel decking tight to the supports prior to stud installation. Install studs promptly after cleaning and preparation. Hold welding gun in correct position and without movement until the weld metal has solidified. Break and remove arc shields after welding. Produce welded studs free from any defect or substance that interferes with intended functions.

1. Placing Locations: Singly space shear stud connectors along the beam with excess double studs spaced symmetrically from each end of the beam. Place adjacent studs on centers not closer than 3" transversely and not closer than 4-1/2" longitudinally, on centers. Provide minimum distance between edges of the shear stud bases and flange edges equal to the stud diameter plus 1/8", but minimum 1-1/2" clearance wherever possible. Location accuracy of other types of studs shall permit the assembly of attachments without alterations or reaming.
2. Stud Lengths: Stud lengths indicated or noted are minimum acceptable net lengths after welding. If reduction in length of a stud as it is welded is such that length of the stud is more than 1/16" greater than that specified by stud manufacturer, discontinue stud installation until the cause is determined and eliminated and pre-production testing is satisfactorily repeated.
3. Defective Fillets: Any stud not showing a full 360° weld fillet after welding may be repaired by welding a fillet weld with size per AWS D1.1 Section 7.7.3 in lieu of missing weld fillet in accordance with AWS D1.1 using low-hydrogen electrodes.

D. Studs On Metal Decking: Exercise extreme care to prevent defective welds or damage to or excessive burning of decking when welding through metal decking.

3.4 FIELD QUALITY CONTROL

A. Comply with all pertinent provisions of Division 01.

B. Inspection: In accordance with 2022 CBC 1705.2 and 2213.2.

C. Perform shop and field welded stud installation and testing under continuous inspection of a qualified welding inspector approved by LADBS. In addition to the verified report, welding

inspector's reports shall detail the location of all defective studs with the repair or replacement action taken.

D. Inspection Procedure: In accordance with 2022 CBC 1705.2. Welding equipment type and capacity shall be in accordance with manufacturer's recommendations and shall be checked and approved by the welding inspector.

E. Pre-Production Testing: Per AWS D1.1 – Section 7.7.1 – Start of Shift - Before production welding with a particular setup and with a given size and type of stud, and at the beginning of each day's or shifts production, testing shall be performed on the first two studs that are welded. The stud technique may be developed on a piece of material similar to the production member in thickness and properties. If actual production thickness is not available, the thickness may vary +/- 25%. All test studs shall be welded in the same general position as required on the production member (flat, vertical, or overhead). Per AWS 7.7.1.2 – Production member option – Instead of being welded to the separate material, the test studs may be welded on the production member, except when separate plates are required per AWS D1.1 section 7.7.1.5

1. Pre-Production Tests - After cooling, test the first two studs on a member by hammer bending to a 30 degree angle per AWS D1.1 section 7.7.1.4. Studs shall exhibit full 360° flash with no evidence of undercut into the stud base per AWS D1.1 section 7.7.1.3. If failure occurs in the weld zone of either stud or test studs do not exhibit 360° flash ,per AWS D1.1 section 7.7.1.5 correct the procedure, and weld and bend test two more studs to separate materials or on the production member. If either of the second two studs fails, additional welding shall be continued on separate plates until two consecutive studs are tested and found to be satisfactory before any more production studs are welded to the member.

F. Production Inspection and Testing: Per AWS D1.1 Section 7.7.2

1. Once production welding has begun, any changes to the welding setup (size, type of stud, or weld procedure) shall require pre-production testing be performed prior to resuming production welding. In production, studs on which a 360 degree full flash is not obtained may be repaired per AWS D1.1 section 7.7.3 or a replacement stud located. In such cases begin pre-production tests again on a separate plate until successful installation is achieved before any more production studs are welded to the member.

G. Straightening: Leave in a bent condition those stud shear connectors and shear transfer devices that are bent less than 15 degrees and are free of any failure provided no part of studs is within 1" of an exposed concrete surface. Perform stud bending and straightening without heating and before the completion of each day's welding operations. Obtain inspection and approval of straightened studs before covering.

H. Load Testing: Design Builder furnished laboratory shall load test studs to the extent and by the methods directed.

END OF SECTION 050650

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Shear stud connectors, shop and field welded.
   3. Shrinkage-resistant grout.

B. Related Requirements:
   1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
   2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
   3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
   4. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for painting requirements.

C. Refer to drawings for governing code. Standards referenced in this section are the editions associated with that governing code.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:
   1. Shapes included in ASTM A6 with flanges thicker than 1-1/2 inches.
   2. Welded built-up members with plates thicker than 2 inches.
   3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:
   1. Structural-steel materials.
   2. High-strength, bolt-nut-washer assemblies.
   3. Shear stud connectors.
   4. Anchor rods.
   5. Threaded rods.
   6. Forged-steel hardware.
   7. Slide bearings.
   8. Prefabricated building columns.
   9. Shop primer.
   10. Galvanized-steel primer.
   11. Etching cleaner.
   12. Galvanized repair paint.
   13. Shrinkage-resistant grout.

B. Sustainable Design Submittals: For all permanently installed products and materials related to the work of this Section, submit product and material documentation to comply with and contribute to the Project’s LEED and low embodied carbon requirements, as outlined in the Submittals article of Section 018113 - Sustainable Design Requirements.
   1. A Sustainable Product Data Reporting Form shall be submitted for each product, including accessory materials to be used on the Project.
   2. Refer to Part 2 of this Section for specific sustainable product performance requirements.
   3. Edit LEED Credits list down to only those that apply to one or more products in this Section.
   4. The following LEED Credits may apply to one or more products covered by the work of this Section:
   5. Credit MRc2 - Building product disclosure and optimization - Environmental Product Declarations.
   6. Credit MRc3 - Building product disclosure and optimization – Responsible Sourcing of Raw Materials.
   7. Credit MRc4 - Building product disclosure and optimization - Material Ingredients.
   8. Credit EQc2 - Low Emitting Materials.

9. Include only when low embodied carbon goals apply to one or more products in this Section.
10. Low embodied carbon materials requirements apply to one or more products covered by the work of this Section.

C. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand-critical welds.
8. Identify members not to be shop primed.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

E. Welding Procedure Specifications (WPSs):
1. Submit all WPS in writing (both prequalified and qualify by test) in accordance with AWS D1.1. Welding shall not proceed until WPS have be reviewed and approved by the Architect / Structural Engineer of Record (SEOR). Only WPS’s specifically relevant to this project shall be submitted for review and approval.
2. All WPS's shall be prepared by qualified individuals and the same individual responsible for the suitability of the WPS.
3. The written WPS shall be available to the welder, welding supervisor.
4. WPS's for SMAW, SAW and FCAW-G may be pre-qualified providing they meet all the requirements of AWS D1.1, section 3.2.1. Any deviation from the pre-qualified WPS requirements shall necessitate qualifications by test.
5. WPS's that are not prequalified shall be subject to the qualification testing specified in AWS D1.1, section 4. For WPS's that have not been qualified by test, the supporting procedure qualification record (PQR) shall be submitted with the WPS for approval by SEOR.
6. The written WPS shall contain all the necessary information required by the code, this specification, and any other information necessary to produce the welds that are in compliance with these requirements.
7. The WPS shall list the applicable base metal types and thicknesses.
8. The WPS shall contain a sketch of the joint and shall list the welding joint details, including type, weld type, joint geometry, and applicable dimensions. Individual weld passes shall be identified in the sketch and numbered to identify the maximum layer thickness and bead widths. Layer thickness shall conform to AWS D1.1 table 3.7 or as qualified by the PQR.
9. The WPS shall list the applicable welding processes.
10. The WPS shall indicate the minimum preheat requirements. The preheat and interpass temperatures shall be determined in accordance with AWS D1.1 Table 3.3. Maximum inter-pass temperature shall be 550F.

11. The WPS shall list all applicable electrical characteristics for the process employed and shall include, as a reference, the electrode manufacturer's cutsheet. The product data sheets or catalog data for SMAW FCAW and the WPS shall clearly indicate the acceptable values required for each welding pass. These electrical characteristics shall include at a minimum the following:
    a. Type of current, and acceptable ranges of current measures in amperage. For wire feed process both wire feed and amperage should be listed.
    b. Voltage.
    c. Travel speed (range).
    d. Electrode extension for wire feed processes.
    e. Amperage, voltage and electrode extension (as applicable) shall be within the filler metal manufacturer's recommendation.
12. The diameter of the electrodes. SMAW – Maximum diameter (d) 3/16 inch and maximum widths shall be
    a. 4d for 3/32 inch electrodes.
    b. 3d for 1/8 inch electrodes.
    c. 2 ½ d for 5/32 inch electrodes.
    d. 2 d for 3/16 inch electrodes limited to flat and horizontal positions.
    e. These weave widths shall be strictly adhered to except final (cover) pass(s) may be a maximum of 5/8 inches.
13. Manufacturer's product data sheets or catalog data for SMAW, FCAW and GMAW composite (cored) filler metals to be used. The data sheets shall describe the product, limitations of use, recommended or typical welding parameters, and storage and exposure requirements, including baking, if applicable.
14. Copies of the manufacturer's typical certificate of conformance for all electrodes, fluxes and shielding gases to be used. Certificates of conformance shall satisfy the applicable AWS A5 requirements. For demand critical welds, submit applicable manufacturer's certifications that the filler metal meets the supplemental notch toughness requirements.
15. Included shall be WPS for repair welds.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, shop-painting applicators, professional engineer, and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:
    1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
    2. Direct-tension indicators.
    3. Tension-control, high-strength, bolt-nut-washer assemblies.
    4. Shear stud connectors.
    5. Welding electrodes.
    6. Shop primers.
    7. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant.

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE, in the same category of the scope of this project.

C. Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint Endorsement Program, appropriate for the scope included in this project

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
   2. All welders, welding operators, and tack welders shall be qualified by test with the largest diameter electrodes to be used on the work and hold a current valid certificate issued by an independent testing agency, to perform the type of welds required by the work; including the process, position, and thickness of materials used per AWS D1.1 section 4.
   3. All Welders on the project shall be capable of understanding and following the requirements of the written WPS.
   4. Each welder employed on the project shall understand all the requirements of this welding specification before welding on the project.
   5. Copies of the Welder Performance Qualification Records (WPQR), including supplemental testing requirements shall be made available for the SEOR and IOR.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.

3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.
4. Welding Electrodes: Deliver to the site in unbroken packages bearing the manufacturer’s name and label identifying the contents.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS - SUSTAINABILITY

A. Embodied Carbon – Structural Steel:
1. Embodied Carbon (GWP) Baseline: “Baseline (High)” as set in the document “2021 CLF Material Baselines” by the Carbon Leadership Forum.
   a. Structural Steel, Plate: 3.0 kg CO2 eq per kg.
   b. Structural Steel, Hollow Sections: 3.0 kg CO2 eq per kg.
   c. Structural Steel, Hot-Rolled Sections: 1.7 kg CO2 eq per kg.
   d. Cold Formed Steel Framing: 3.0 kg CO2 eq per kg.
   e. Open Web Steel Joists: 2.5 kg CO2 eq per kg.
2. Provide a Product-Specific Type III Environmental Product Declaration (EPD), that meets the following parameters, and documents that each structural steel product's Global Warming Potential (GWP) is better than the baseline.
   a. System Boundary: Product Stage, A1-A3.
   b. Declared Units: kg.
   c. Product Category Rule: Any of the following:
      1) SCS Global Services PCR for Designated Steel Construction Products, v.1.0, 2015-05-05.
      2) Institut Bauen und Umwelt e.V. PCR for Structural Steels, v1.0/1.3/1.0, 2014-07-04.
      3) Comparable listed in EC3.

2.2 STRUCTURAL STEEL MATERIALS

A. W-Shapes: ASTM A992

B. Channels, Angles: ASTM A36

C. Plate and Bar: ASTM A36 or ASTM A572, Grade 50, as indicated on the drawings

D. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588, 50 ksi.

E. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B structural tubing.

F. Steel Pipe: ASTM A53, Type E or Type S, Grade B.
1. Weight Class: As indicated on the drawings.
2. Finish: Black except where indicated to be galvanized.

G. Steel Castings: ASTM A216, Grade WCB, with supplementary requirement S11.

H. Steel Forgings: ASTM A668.

I. Welding Electrodes: Comply with AWS requirements.
   1. Filler metals shall conform to the requirements of the latest edition of ANSI/AWS Specifications for Electrodes as listed herein and shall meet Charpy V-Notch Impact Energy of 20 ft-lbs. at 0 degrees F. Filler metals for demand critical welds shall meet Charpy V-Notch Impact Energy of 20 ft-lbs. at 0 degrees F and 40 ft-lbs at 70 degrees F as per AISC 341 Section A3.4.
      a. SMAW A5.1 or A5.5 E70XX Low Hydrogen.
      b. SAW A5.17 or A5.23 F7XX-EXXX or F7XX-EXXX-XX.
      c. GMAW A5.18 or A5.28 ER70S-X.
      d. FCAW A5.20 or A5.29 E7XT-X except T8-K6

      The Charpy V-Notch requirement above does not apply to welds used in the construction of stairs, elevator guiderail supports, steel supports for partitions or exterior walls, steel supports for exterior architectural appendages, steel supports for MEP equipment, rooftop screen walls, and light gage metal stud framing
   2. The use of E70-T4 Electrode is not allowed for any welding application.
   3. The manufacturer shall certify that consumables used in the Work conform with AISC 341 Section A3.4.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F959, Type 490-1, compressible-washer type with plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip zinc coating
   2. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.
   1. Finish: Plain.

E. Bolts: ASTM 307 Grade A, or as indicated on the drawings.

F. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, ASTM A354, ASTM A449, ASTM A572, or ASTM A36, grade as indicated on the drawings. Provide weldable grade where welding is indicated on drawings.
   1. Configuration: Straight
   2. Nuts: ASTM A563 heavy-hex carbon steel.
   3. Plate Washers: ASTM A36 carbon steel.
   4. Washers: ASTM F436, Type 1, hardened carbon steel.
   5. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C, or as indicated on drawings

B. Headed Anchor Rods: ASTM F1554, ASTM A354, ASTM A449, ASTM A572, or ASTM A36, grade as indicated on the drawings. Provide weldable grade where welding is indicated on drawings.
   1. Configuration: Straight
   2. Nuts: ASTM A563 heavy-hex carbon steel.
   3. Plate Washers: ASTM A36 carbon steel.
   4. Washers: ASTM F436, Type 1, hardened carbon steel.
   5. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C

C. Threaded Rods: ASTM F1554, ASTM A36, ASTM A572 Grade 50.
   1. Nuts: ASTM A63 heavy-hex carbon steel.
   2. Washers: ASTM F436, Type 1, hardened
   3. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C

2.5 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.

C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 SLIDE BEARINGS

A. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide GRM Custom Products, Fluorogold FC-1010-CS Slide Plate, or comparable product by one of the following:
      a. Fluorocarbon Company Limited
      b. Or approved equal
   2. Mating Surfaces: PTFE

3. Coefficient of Friction: Not more than 0.10.
4. Design Load: Not less than 5,000 psi.
5. Total Movement Capability: As indicated on drawings.

2.7 PRIMER

A. Steel Primer:
   1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings.".
   2. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Galvanized-Steel Primer:
   1. Etching Cleaner: MPI#25, for galvanized steel.
   2. Galvanizing Repair Paint: ASTM A780

2.8 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.9 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.Thermal cutting of anchor bolt holes in base plates shall follow AISC 360, Section M2.2
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.10 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened, Pretensioned, or Slip critical (as indicated on drawings).

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, as applicable, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.11 GALVANIZING.

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.
   1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Refer to drawings for areas where galvanizing is required.

2.12 SHOP PRIMING

A. Shop prime steel surfaces, except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces of high-strength bolted, slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces unless indicated to be painted.
   6. Corrosion-resisting (weathering) steel surfaces.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications , standards and manufacturer’s instructions:
   1. SSPC-SP 2.

2. SSPC-SP 3.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.13 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspection agency to perform shop tests and inspections in accordance with 2022 CBC Chapter 17 and Division 01 Section “Structural Test and Inspections”.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
   a. Liquid Penetrant Inspection: ASTM E165.
   b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   c. Ultrasonic Inspection: ASTM E164.
   d. Radiographic Inspection: ASTM E94.
4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1 for stud welding and as follows:
   a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
   b. Conduct tests in accordance with requirements in AWS D1.1 on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
5. Prepare test and inspection reports.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
   1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Structural Engineer of Record. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
   1. Joint Type: Refer to drawings.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, as applicable, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.

B. Touchup Painting:
   1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
      a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
   1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
   2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
    1) Liquid Penetrant Inspection: ASTM E165.
    2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    3) Ultrasonic Inspection: ASTM E164.
    4) Radiographic Inspection: ASTM E94.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel roof deck with accessories.
2. Composite steel floor deck with accessories.
3. Bent plate and sheet metal closures at decking edges and openings.
4. Holes and openings through decking, with reinforcing.
5. All accessories for a complete installation.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Submit drawings fully detailing and dimensioning all steel decking including layout and types of deck panels, closure plates, and accessories. Provide type and layout of jointing, and fastenings and attachments to other construction including welding and shear stud connectors. Show holes with reinforcing, flashings, and closures. Show dimensioned layouts for openings and reinforcing details. Indicate welding according to AWS Standard Welding Symbols.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates: Copies of certificates for welding procedures and personnel.

B. Product Certificates: For each type of steel deck, signed by steel deck manufacturers certifying that products furnished comply with requirements.

C. Evaluation Reports: For steel deck, from ICC-ES.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Sheet Steel Identification: Identify sheet steel in accordance with 2022 CBC 2202 and the specified ASTM Standard.

D. Requirements of Regulatory Agencies: Provide steel floor and roof deck system that, with structural concrete fill or nonstructural insulating concrete fill, meets UL and code requirements for 2 hour fire-rated deck systems.

E. Source Quality Control: Conform to 2022 CBC, Section 2202; unidentified decking is not acceptable. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having Fy of 38 Ksi or less. In addition, for decking having Fy greater than 33 Ksi, Owner’s Representative shall perform one tension and elongation test and one bend or flattening test for each gage.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling. Schedule deliveries to maintain progress of work.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Metal Decking Shall be in conformance with the following:
   1. AISI “Specification for Design of Light Gauge Steel Members”.
   2. AISI “Specification for Design of Cold Formed Steel Members”.
   3. Steel Deck Institute Publication No. 29 “Design Manual for Composite Decking, Form Decks and Roof Decks.
   4. 2022 California Building Code.

B. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members.” See drawings for mechanical properties requirements.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

B. ASC Profiles, Inc.; a Blue Scope Steel company.

C. Verco Decking, Inc., a Nucor company.

D. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), G90, unless noted otherwise.
   2. Deck Profile: As indicated on drawings.
   3. Profile Depth: As indicated.
   4. Design Uncoated-Steel Thickness: As indicated on drawings.
   5. Span Condition: Triple span or more.
   6. Side Laps: Interlocking seam.
   7. Venting: Each panel shall be factory slotted or have rolled-in moisture venting provisions when filled with concrete or insulating non-structural concrete.

2.3 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers or approved equal:
   1. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Verco Decking, Inc., a Nucor company.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Galvanized-Steel Sheet: ASTM A653, G60, SS, Grade 33 steel, with minimum yield strength of 38,000 psi, unless noted otherwise
   2. Profile Depth: As indicated on drawings.
   3. Design Uncoated-Steel Thickness: As indicated on drawings.
   4. Span Condition: Triple span or more.
   5. Venting: Each panel shall be factory slotted or have rolled-in moisture venting provisions when filled with insulating non-structural concrete

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated, or as indicated on the drawings.

B. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

C. Pour Stops and Girder Fillers: As indicated on drawings.

D. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

E. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

F. Flat Sump Plates: As indicated on drawings.

G. Recessed Sump Pans: As indicated on drawings.

H. Galvanizing Repair Paint: Zinc rich paint conforming to Mil Spec MIL-P 21035 (SHIPS).

2.5 SOURCE QUALITY CONTROL

A. Conform to 2022 CBC, Section 2202; unidentified decking is not acceptable. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having Fy of 38 Ksi or less. In addition, for decking having Fy greater than 33 Ksi, Owner’s Representative shall perform one tension and elongation test and one bend or flattening test for each gage.
   1. Provide inspecting agency with access to places where steel deck Work is being fabricated to perform inspections.

B. Correct deficiencies in Work that inspections indicate do not comply with AWS D1.3.and the Contract Documents.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated on the drawings. Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: As indicated on drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2”. End joints shall be butted with a maximum 1/8" gap between ends of units.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 6 inches apart with at least one weld at each corner.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by welded shear studs or arc spot (puddle) welds as indicated on the drawings. Install weld washers at each weld location puddle welds are used.

B. Side-Lap and Perimeter Edge Fastening: As indicated on drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2”. End joints shall be butted with a maximum 1/8" gap between ends of units.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports in accordance with 2022 CBC 1705.2.5.and 2204.1.

B. Inspection: Install steel decking under periodic inspection according to 2022 CBC, Section 1705.2.2. Deck installation and welding to be observed and approved prior to covering.

C. Inspection and testing of welded shear studs: In accordance with Section 050650 including pre-production testing and production inspection and testing.

D. Testing agency will report inspection results promptly and in writing to Owner.

E. Remove and replace work that does not comply with specified requirements.

3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION 053100

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Elevator machine beams, hoist beams, and divider beams.
4. Steel shapes for supporting elevator door sills.
5. Slotted channel framing.

B. Related Requirements:
1. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
2. Section 055113 "Metal Pan Stairs."
3. Section 057313 "Glazed Decorative Metal Railings."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
1. Fasteners.
2. Shop primers.
3. Shrinkage-resisting grout.
4. Slotted channel framing.

B. Sustainable Design Submittals: For all permanently installed products and materials related to the work of this Section, submit product and material documentation to comply with and contribute to the Project's LEED and low embodied carbon requirements, as outlined in the Submittals article of Section 018113 - Sustainable Design Requirements.
   1. A Sustainable Product Data Reporting Form shall be submitted for each product, including accessory materials to be used on the Project.
   2. Refer to Part 2 of this Section for specific sustainable product performance requirements.
   3. Edit LEED Credits list down to only those that apply to one or more products in this Section.
   4. The following LEED Credits may apply to one or more products covered by the work of this Section:
   5. Credit MRc2 - Building product disclosure and optimization - Environmental Product Declarations.
   6. Credit MRc3 - Building product disclosure and optimization – Responsible Sourcing of Raw Materials.
   7. Credit MRc4 - Building product disclosure and optimization - Material Ingredients.
   8. Credit EQc2 - Low Emitting Materials.
   9. Include only when low embodied carbon goals apply to one or more products in this Section.
   10. Low embodied carbon materials requirements apply to one or more products covered by the work of this Section.

C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections. Provide Shop Drawings for the following:
   1. Steel framing and supports for mechanical and electrical equipment.
   2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   3. Elevator machine beams, hoist beams, and divider beams.
   4. Steel shapes for supporting elevator door sills.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State of California.

B. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Research Reports: For post-installed anchors.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.2 PERFORMANCE REQUIREMENTS - SUSTAINABILITY

A. Embodied Carbon – Structural Steel:
   1. Embodied Carbon (GWP) Baseline: “Baseline (High)” as set in the document “2021 CLF Material Baselines” by the Carbon Leadership Forum.
      a. Structural Steel, Plate: 3.0 kg CO2 eq per kg.
      b. Structural Steel, Hollow Sections: 3.0 kg CO2 eq per kg.
      c. Structural Steel, Hot-Rolled Sections: 1.7 kg CO2 eq per kg.
      d. Cold Formed Steel Framing: 3.0 kg CO2 eq per kg.
      e. Open Web Steel Joists: 2.5 kg CO2 eq per kg.
   2. Provide a Product-Specific Type III Environmental Product Declaration (EPD), that meets the following parameters, and documents that each structural steel product's Global Warming Potential (GWP) is better than the baseline.
      a. System Boundary: Product Stage, A1-A3.
      b. Declared Units: kg.
      c. Product Category Rule: Any of the following:
         1) SCS Global Services PCR for Designated Steel Construction Products, v.1.0, 2015-05-05.
         2) Institut Bauen und Umwelt e.V. PCR for Structural Steels, v1.0/1.3/1.0, 2014-07-04.
         3) Comparable listed in EC3.

2.3 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

F. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

G. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   1. Size of Channels: As indicated.
   2. Material: Cold-rolled steel, ASTM A1008/A1008M, structural steel, Grade 33 (Grade 230); 0.0677-inch (1.7-mm) minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

I. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

J. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

K. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

L. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless steel fasteners for fastening aluminum stainless steel or nickel silver.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
   1. Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
   2. Slotted type; carbon steel, Grade C, ASTM A 283; hot-dip galvanized per ASTM A 123/A 123M.

H. Post-Installed Anchors: Torque-controlled expansion anchors.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting."

B. Epoxy Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
   1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Basis-of-Design Product: Tnemec Company, Inc.; Tneme-Zinc 90-97.

C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

F. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-

mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.
   3. Fabricate units with minimum number of joints for field connections.

C. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with primers specified in Section 099113 "Exterior Painting" unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications to attain a uniform dry film thickness of 1.0 mil for each coat, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Apply

shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply one coat of shop primer, except apply two coats to surfaces that will be inaccessible after assembly or installation.

2.10 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.11 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions where metal fabrications will be installed.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.3 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions, overhead doors, and overhead grilles securely to, and rigidly brace from building structure.

3.4 REPAIRS

A. Touchup Painting:
1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055134 - ALUMINUM LADDERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Vertical ladders.

B. Related Sections include the following:
   1. Division 7 Section “Roof Accessories” for roof hatch and ladder safety post.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product.

B. Shop Drawings:
   1. Detail fabrication and erection of each ladder indicated. Include plans, elevations, sections, and details of metal fabrications and their connections.
   2. Provide templates for anchors and bolts specified for installation under other Sections.
   3. Provide reaction loads for each hanger and bracket.

C. Qualification Data: Refer to Quality Assurance provisions for submittal requirements evidencing experience, certifications and resources.

D. Samples for Initial Selection: Color showing the full range of colors available.

E. Verification Samples: For each finish specified, two samples, minimum size 6 inches square, represent actual product color.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in producing aluminum metal ladders similar to those indicated for this Project.

B. Record of successful in-service performance.

C. Sufficient production capacity to produce required units.

D. Installer Qualifications: Competent and experienced firm capable of selecting fasteners and installing ladders to attain designed operational and structural performance.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum ladders that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 2 years.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Ladders: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Alaco. (Basis of Design)
2. O'Keeffe's Inc.
3. Royalite.
4. Cotterman.
5. ACL.
6. Or equal.

2.2 MATERIALS

A. Aluminum Sheet: Alloy 5005-H34 to comply with ASTM B209.

B. Aluminum Extrusions: Alloy 6063-T6 to comply with ASTM B221.

C. Fasteners: As recommended by ladder manufacturer.

2.3 VERTICAL LADDERS

A. Product: Model 561 by Alaco or equal.
1. Fixed Wall Ladders: Extruded aluminum; serrated rungs 1-1/8 inches in diameter, connected to 2-7/8 inch side rail channels with cast aluminum rung connectors, each secured to rails by means of four solid aircraft rivets.

2.4 ALUMINUM FINISHES

A. Mill finish. As extruded.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor securely using fasteners specified by manufacturer or others of equivalent or greater strength and corrosion resistance.

END OF SECTION 055134

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel pipe and tube railings.

B. Related Sections include the following:
   1. Division 9 Section “Painting” for field painting.

1.2 DEFINITIONS

A. Exterior: Defined as the following:
   1. Areas, locations, and surfaces that are unprotected, or exposed to environmental elements.
   2. Areas, locations and surfaces within uncontrolled environments.
   3. Areas, locations and surfaces of unconditioned spaces, including belowgrade/underground, partially-exposed, or “covered” parking areas.

1.3 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Steel: 72 percent of minimum yield strength.

B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails:
      a. Uniform load of 50 lbf/ ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Top Rails of Guards:
      a. Uniform load of 50 lbf/ ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   3. Infill of Guards:
      a. Uniform load of 25 lbf/sq. ft. applied horizontally.
      b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."

C. Appearance: Galvanized articles shall be free from uncoated areas, blisters, flux deposits, acid and black spots, and dross inclusions. Lumps, projections, globules, or heavy deposits of zinc which will interfere with the intended use of the material will not be permitted.

1.6 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of pipe and tube railings that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Pipe and Tube Railings:
   1. Local iron fabricators.

B. Nonshrink, Nonmetallic Grout:
   1. 1107 Advantage Grout by Dayton Superior Chemical & Cement Products.
   2. Conset Grout by ChemMasters Specialty Construction Products.
   3. General-Purpose Grout by Symons.
   4. Or equal.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).

B. Pipe: ASTM A 53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
   1. Provide galvanized finish for exterior installations and where indicated.

2.4 FASTENERS

A. General: Provide the following:
   1. Steel Railings: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

C. Anchors: Provide cast-in-place anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections, unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form changes in direction as detailed.

J. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:
   1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
   2. Comply with ASTM A 123 for hot-dip galvanized railings.
   3. Comply with ASTM A 153 for hot-dip galvanized hardware.

B. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

F. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed railings:
   1. Exterior Railings (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interior Railings (SSPC Zone 1A): SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

G. Apply shop primer to prepared surfaces of railings, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Do not apply primer to galvanized surfaces.
2. Stripe paint corners, crevices, bolts, welds, and sharp edges.

H. Field Finish: Comply with Division 9 Section “Painting” for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch buildup, sloped away from post.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ADJUSTING AND CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Framing with dimension lumber.
   2. Equipment bases and support curbs.
   3. Wood blocking, cants and nailers.
   4. Sheathing.
   5. Subflooring and underlayment.
   6. Plywood backing panels.
   7. Building wrap.
   8. Related framing anchors and connectors

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

B. Exposed Framing: Dimension lumber not concealed by other construction.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NELMA - Northeastern Lumber Manufacturers Association.
   2. RIS - Redwood Inspection Service.
   3. APA – American Plywood Association.
   4. WCLIB - West Coast Lumber Inspection Bureau.
   5. WWPA - Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data:
   1. For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   2. Custom and heavy metal framing connectors.

1.5 QUALITY ASSURANCE

A. Inspection Agencies: Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:
   1. WCLIB - West Coast Lumber Inspection Bureau.
   2. WWPA - Western Wood Products Association.

B. Industry Standards:
   1. Lumber Grading Agency: Certified by WCLIB or WWPA as pertinent to product.
      a. Do not apply inspection service grade mark on timber shown as exposed in the work and with transparent finish.
      b. Submit certificate of grade compliance, obtained from grading agency with each shipment.
   2. Plywood Grading Agency: Certified by APA.

C. Regulatory Requirements: Conform to California Building Code (2022 CBC) Chapter 23 for member and fastener sizes and type of fasteners, unless otherwise indicated on Drawings.

D. Single-Source Responsibility for Engineered Wood Products: Obtain each type of engineered wood products from one source from a single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Lumber Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces.
   1. Stack lumber as well as plywood and other panels.
   2. Provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
   3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   4. Provide dressed lumber, S4S, unless otherwise indicated on structural drawings.
   5. Concealed Lumber: provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.
   6. Exposed Lumber: provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.
   7. Sill Plates: Pressure preservative treated, No. 1 or better, douglas fir.

8. Structural Framing, Posts: 4-inches thick, 4-inches and wider, No. 1 and Better grade, douglas fir, unless otherwise indicated on Drawings.
9. Miscellaneous Framing: For site structures and other exposed conditions, provide No. 1 grade douglas fir-larch or better, selected for appearance, unless noted otherwise on drawings. At site structures, provide light sandblast finish on exposed wood framing.
10. Wane: Limit wane to 5 percent of members in accordance with WWPA standards. Do not locate members with wane at plywood sheathing joints, at solid blocking or at double plates.

2.2 WOOD STRUCTURAL PANELS:

A. Plywood Materials, General: APA Performance-Rated Panels, Group 1 Series, PS 1-95, species and thickness as indicated on Drawings and as specified herein.

B. Plywood Panels for Roof Sheathing: Douglas fir, Structural I, APA RATED SHEATHING.
1. Exposure Durability Classification: EXTERIOR.
2. Thickness: As indicated on the Drawings.
3. Edge detail, low slope roofs: Square if all edges supported on framing or tongue-and-groove (T&G) if edges are unsupported. Plyclips will not be acceptable.
4. Span Rating = Not less than 24".

C. Plywood for Floor Sheathing: Douglas fir, Sturd-I-Floor, APA RATED SHEATHING.
1. Exposure Durability Classification: EXTERIOR.
2. Thickness: As indicated on the Drawings. Thickness of plywood indicated on Drawings is minimum thickness.
3. Edge detail: Provide either tongue and groove (T&G) plywood edges or square edges with full support of edges on framing and blocking. Plyclips will not be acceptable.
4. Span Rating – Not less than 24".

D. Plywood Panels for Wall Sheathing: Douglas fir, Structural I, APA RATED SHEATHING.
1. Exposure Durability Classification: EXTERIOR.
2. Thickness: As indicated on the Drawings.
3. Edge detail: Square.
4. Span Rating = Not less than 24"

2.3 PRESERVATIVE TREATED WOOD PRODUCTS

A. Wood Treatments, General: Where used for exposed locations, treatment materials shall be types guaranteed to not adversely affect durability and appearance of applied finishes.
1. Treatment materials having a highly persistent, noticeable residual odor will not be permitted.
2. After treatment, kiln or air-dry lumber and plywood to a moisture content of 19 percent or less.

B. Preservative Treatment, Members Intended for Finishing: Water-borne salt preservatives for painted, stained, or exposed natural wood product, AWPB LP-2, above ground application and AWPB LP-22, ground contact application.

C. Preservative Treatment, Members Not Intended for Finishing: Oil-borne preservatives for any construction except when in contact with salt water, AWPB LP-33, ground contact application, light petroleum solvent.

2.4 CONNECTORS

A. Framing Connectors:
   1. Specified Manufacturer: Simpson Strong-Tie Co., Pleasanton, CA (510/460-9912 or 800/999-5099; local representatives, Brea, CA (714/871-8373 or 800/999-5099).
   2. Acceptable Manufacturers: None identified. Equivalent products of other manufacturers will be considered in accordance with the substitution provision specified in Section 01600 - Product Requirements. Substitutions shall have equivalent values according to current ICBO Research Report and shall be used only with prior approval of Architect, based on review by Structural Engineer.
   3. Light framing connectors: Simpson Strong-Tie Connectors, formed of sheet steel, catalog number as indicated on the Drawings and to suit Project conditions.
   4. Heavy framing connectors: Simpson Strong-Tie Connectors, formed of steel plate or heavy gage steel sheet, catalog number as indicated on the Drawings and to suit Project conditions. Provide custom or special-order framing connectors as necessary to suit Project conditions and as indicated on the Drawings.
      a. Stock framing connectors: Simpson - Strong Tie Connectors, catalog number as indicated on the Drawings and to suit Project conditions.
      b. Custom framing connectors: Fabricated as indicated on Drawings and as specified in Section 05 50 00 - Metal Fabrications.
   5. finishes:
      a. Light framing connectors: Provide manufacturer's standard galvanized finish.
      b. Heavy framing connectors, exterior: Hot-dipped galvanized, equivalent to ASTM A525, Coating Designation G90.
      c. Heavy framing connectors, interior: Plain steel with shop primer paint finish, as specified in Section 05 50 00 - Metal Fabrications.
      d. Custom framing connectors: Fabricated as specified in Section 05 50 00 - Metal Fabrications. At interior and concealed locations, provide plain steel with shop primer paint finish. At exterior locations, provide hot-dipped galvanized finish.

2.5 FASTENERS AND ANCHORS

A. Fasteners, General: Size and type as required by 2022 CBC requirements and as indicated on Drawings. Provide electro-galvanized finish at interior high humidity locations and exterior locations not directly exposed to weather. Provide hot-dipped galvanized at exterior locations directly exposed to weather. Plain finish may be provided elsewhere.

B. Anchor Bolts: ASTM A36/A307 or as indicated on Drawings, galvanized steel at exterior locations.
   1. Do not upset threads on bolts.
   2. Anchor bolts for hold-downs shall be headed.

C. Machine Bolts: ASTM A307, hex head and nut, full bearing on unthreaded shank, length for maximum 1-1/2 inch beyond nut, with steel washer under head and nut. Provide hot-dipped galvanized finish at exterior locations.

D. Lag Bolts and Screws: Fed Spec FF-S-588, size as indicated on Drawings.

E. Nails, Typical: Common wire, sizes as indicated on Drawings and as required by California Building Code (CBC) Chapter 23, Table 2304.10.1 and applicable reference standard.
   1. No box nails shall be used.
   2. Machine applied nailing will be subject to approval as specified on the Drawings and as approved by code authority having jurisdiction.

F. Screws: Fed Spec FF-S-85, Fed Spec FF-S-92 and Fed Spec FF-S-111, type and grade best suited for the purpose, size as indicated on Drawings.

G. Construction Adhesive: APA Spec. AFG-01.

H. Grout for Sill Plates: Type S or Type M mortar cement grout in accordance with 2022 CBC Table 2103A.8.

2.6 WOOD PRESERVATIVE TREATMENTS

A. Wood Preservative Treatments, General: Where lumber or plywood is indicated as preservative-treated or is specified to be treated, comply with applicable requirements of AWPA C2 (Lumber) and AWPA C9 (Plywood).
   1. Mark each treated item with the Quality Mark Requirements of an inspection agency approved by American Lumber Standards Committee (ALSC) Board of Review.
   2. Comply with 2022 CBC Section 2303.1.9.

B. Wood Members Located Above Ground: Pressure-treat above ground items with water-borne preservatives to a minimum retention of 0.25 pcf. After treatment, kiln dry lumber and plywood to a maximum moisture content of, respectively, 19 percent and 15 percent. Treat indicated items and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping and similar members related to roofing, flashing, vapor barriers and waterproofing.
   2. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
   3. Wood floor plates installed over concrete slabs directly in contact with ground.

C. Wood Members Located in Contact with Ground: Pressure-treat wood members in contact with ground or fresh water with water-borne preservatives to a minimum retention of 0.40 pcf.

D. Coordination with Fabrication: Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces in compliance with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.7 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch (12.7 mm) thick.

2.8 MISCELLANEOUS MATERIALS

A. Building Paper: Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.

B. Building Wrap: Air-retarder sheeting made from polyolefins; cross-laminated films, woven strands, or spun-bonded fibers; coated or uncoated; with or without perforations; and complying with ASTM E 1677, Type I.
   1. Thickness: Not less than 3 mils (0.08 mm).
   2. Permeance: Not less than 10 perms (575 ng/Pa x s x sq. m).
   3. Flame-Spread Index: 25 or less per ASTM E 84.
   4. Allowable Exposure Time: Not less than three months.

C. Building Wrap Tape: Pressure-sensitive plastic tape recommended by building wrap manufacturer for sealing joints and penetrations in building wrap.

D. Sheathing Tape: Pressure-sensitive plastic tape for sealing joints and penetrations in sheathing and recommended by sheathing manufacturer for use with type of sheathing required.

E. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

F. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

G. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers.

H. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Published requirements of metal framing anchor manufacturer.

2. 2022 CBC Table 2304.10.1.

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

E. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

3.3 WOOD FRAMING INSTALLATION, GENERAL

A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.

B. Do not splice structural members between supports.

C. Where built-up beams or girders of 2-inch nominal- (38-mm actual-) dimension lumber on edge are required, fasten together with 2 rows of 20d (100-mm) nails spaced not less than 32 inches (812 mm) o.c. Locate one row near top edge and other near bottom edge.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Arrange studs so wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs. Anchor or nail plates to supporting construction, unless otherwise indicated.
   1. Provide nominal 3-inch bottom plates where indicated on drawings.
   2. Provide single bottom plate and double top plates, nominal 2-inches thick by width of studs. Provide nominal 3-inch bottom plates where indicated on Drawings.
   3. Overlap double plates minimum of 4 feet or as indicated on Drawings and at corners and intersections. Face nail upper plate to lower top plate as indicated on Drawings.

B. Construct corners and intersections with three or more studs. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.

C. Fire block concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where fire blocking is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal- (38-mm actual-) thick lumber of same width as framing members.

D. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs. See structural drawings for specific details.

E. Provide bracing in exterior walls, at both walls of each external corner, full-story height, unless otherwise indicated. Provide one of the following:

F. Provide bracing in walls, at locations indicated, full-story height, unless otherwise indicated. Provide one of the following:
   1. Diagonal bracing at 45-degree angle using let-in 1-by-4-inch nominal- (19-by-89-mm actual-) size boards.
   2. Diagonal bracing at 45-degree angle using metal bracing.
   3. Plywood panels not less than 48 by 96 inches (1219 by 2438 mm) applied vertically.
   4. Particleboard sheathing panels not less than 48 by 96 inches (1219 by 2438 mm) applied vertically.

3.5 FLOOR JOIST FRAMING INSTALLATION

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches (38 mm) of bearing on wood or metal, ry. Attach floor joists as follows:
   1. Where supported on wood members, by toe nailing or by using metal framing anchors.
   2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches (1200 mm).

C. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches (50 mm) from top or bottom.

D. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist at ends of joists unless nailed to header or band.

E. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches (102 mm) or securely tie opposing members together. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist over supports.

F. Provide solid blocking between joists under jamb studs for openings.

G. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
   1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

H. Provide bridging of type indicated below, at intervals of 96 inches (2438 mm) o.c., between joists.
   1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal- (19-by-64-mm actual-) size lumber, double-crossed and nailed at both ends to joists.
   2. Steel bridging installed to comply with bridging manufacturer's written instructions.
   3. Bridging may be omitted where joist depth is 12-inch nominal (286-mm actual) size or less and where indicated live load is 40 lbf/sq. ft. (1915 Pa) or less.

3.6 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
   1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- (19-by-184-mm actual-) size or 2-by-4-inch nominal- (38-by-89-mm actual-) size stringers spaced 48 inches (1200 mm) o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
   1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against valley rafters.
   2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal- (19-by-140-mm actual-) size boards between every third pair of rafters, but not more than 48 inches (1219 mm) o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions, if any.

3.7 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
   1. Comply with "Code Plus" provisions in above-referenced guide.

B. Fastening Methods: Fasten panels as indicated below:
   1. Combination Subfloor-Underlayment:
      a. Glue and nail to wood framing.
      b. Space panels 1/8 inch (3 mm) apart at edges and ends.
   2. Subflooring:
      a. Glue and nail to wood framing.
      b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3. Sheathing:
   a. Nail to wood framing.
   b. Space panels 1/8 inch (3 mm) apart at edges and ends.
4. Underlayment:
   a. Nail to subflooring.
   b. Space panels 1/32 inch (0.8 mm) apart at edges and ends.
   c. Fill and sand edge joints of underlayment receiving resilient flooring just before installing flooring.
5. Plywood Backing Panels: Nail or screw to supports.

3.8 BUILDING PAPER APPLICATION

A. Apply building paper horizontally with 2-inch (50-mm) overlap and 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails. Cover upstanding flashing with 4-inch (102-mm) overlap.

3.9 BUILDING WRAP APPLICATION

A. Cover wall sheathing with building wrap as indicated.
   1. Comply with manufacturer's written instructions.
   2. Cover upstanding flashing with 4-inch (102-mm) overlap.
   3. Seal seams, edges, and penetrations with tape.
   4. Extend into jambs of openings and seal corners with tape.

3.10 SHEATHING TAPE APPLICATION

A. Apply sheathing tape to joints between sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Wall sheathing.
   2. Roof sheathing.
   3. Floor sheathing.

B. Related Sections include the following:
   1. Section 06 10 00: Rough Carpentry for plywood backing panels.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
   3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
   6. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

B. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
   1. Plywood.
   2. Oriented strand board.
   3. Fiberboard wall sheathing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

B. Oriented Strand Board: DOC PS 2.

C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

D. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA C9.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 WALL SHEATHING

A. Plywood Wall Sheathing: [Exterior, Structural I] sheathing.
   1. Span Rating: Not less than [24/0]
   2. Nominal Thickness: Not less than [15/32 inch].

2.4 ROOF SHEATHING (Sloped)

A. Plywood Roof Sheathing: [Exterior, Structural I] sheathing.
   1. Span Rating: Not less than [32/16]

2. Nominal Thickness: Not less than [15/32 inch].

2.5 ROOF SHEATHING (Flat Roof)

A. Plywood Roof Sheathing: [Exterior, Structural I] sheathing.
1. Span Rating: Not less than [32/16]
2. Nominal Thickness: Not less than [15/32 inch].

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
1. For roof [and wall] sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
1. For steel framing less than 0.0329 inch (0.835 mm) thick, attach sheathing to comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, attach sheathing to comply with ASTM C 954.

G. Screws for Fastening Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
   3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's "Uniform Building Code."
   4. Table 2305.2, "Fastening Schedule," in BOCA's "BOCA National Building Code."
   5. Table 2306.1, "Fastening Schedule," in SBCCI's "Standard Building Code."
   6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
   7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's "International One- and Two-Family Dwelling Code."

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail to wood framing.
      b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 FIBERBOARD SHEATHING INSTALLATION

A. Comply with ASTM C 846 and with manufacturer's written instructions.

B. Fasten fiberboard sheathing panels to intermediate supports and then at edges and ends. Use galvanized roofing nails]; comply with manufacturer's recommended spacing and referenced fastening schedule. Drive fasteners flush with surface of sheathing and locate perimeter fasteners at least 3/8 inch (9.5 mm) from edges and ends.

C. Install sheathing vertically with long edges parallel to, and centered over, studs. Install solid wood blocking where end joints do not occur over framing. Allow 1/8-inch (3-mm) open space between edges and ends of adjacent units. Stagger horizontal joints if any.

D. Cover sheathing as soon as practical after installation to prevent deterioration from wetting.

END OF SECTION 061600

SECTION 06 16 13 DOUGLAS FIR ROTARY CUT MARINE PLYWOOD

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes Douglas Fir rotary cut marine plywood for use as an interior finish material.

B. Related Sections:

1. Section 06 10 00 – Rough Carpentry.
2. Section 09 90 00 – Painting.

1.2 REFERENCES

A. APA – The Engineered Wood Association, Product Standard PS 1-19. B. ANSI/HPVA HP-1 – American National Standard for Hardwood and Decorative Plywood. C. AWI (Architectural Woodwork Institute) Standards.

1.3 SUBMITTALS

A. Product Data: Manufacturer’s specifications and installation instructions.

B. Samples: 12-inch by 12-inch plywood samples showing wood grain, finish, and color.

C. Certificates: Manufacturer’s certification of compliance with applicable standards.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store plywood in a dry, climate-controlled environment, off the ground, and protected from moisture.

B. Handle materials to prevent damage to edges, surfaces, and finish.

PART 2 – PRODUCTS

2.1 MATERIALS A. Douglas Fir Rotary Cut Marine Plywood:

1. Thickness: 3/4 inch mininum.
2. Grade: APA Marine Grade, A-A or A-B.
3. Face Veneer: Rotary cut Douglas Fir, clear and uniform grain with veneer matching for grain consistency. No putty marks allowed.
4. Core Construction: Fully waterproof bonded plies.
5. Formaldehyde Emissions: Compliance with CARB Phase 2 / TSCA Title VI.

2.2 FINISH

A. Prefinished UV-cured clear finish with satin sheen.

B. Sanding: Factory-sanded to a smooth, even surface before finishing.

C. Fire Rating: Class B per ASTM E84, or treated to meet Class A.

D. Edge Treatment: Sanded smooth, no voids, sealed with compatible finish to match face veneer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify substrate conditions are suitable for installation.

B. Ensure that framing or substrate supports panels adequately.

C. Contractor shall inspect all sheets of wood at the lumber yard prior to purchasing to ensure consistency and quality.

3.2 INSTALLATION

A. Install plywood per manufacturer’s instructions and AWI Standards.

B. Secure panels with concealed fasteners or carefully aligned exposed fasteners to maintain a uniform appearance.

C. Align panels to ensure grain continuity across adjacent surfaces.

D. Allow for expansion gaps as necessary to prevent warping.

E. Seal all cut edges with finish coat to prevent moisture absorption.

3.3 ADJUSTMENT AND CLEANING

A. Remove dust and debris upon completion of installation.

B. Touch up minor scratches with manufacturer-approved finish.

C. Protect installed panels from damage until project completion.

END OF SECTION

SECTION 061800 - STRUCTURAL GLUED LAMINATED MEMBERS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install structural glued laminated wood members as indicated on the drawings and specified.

1.2 SYSTEM DESCRIPTION

A. Regulatory Requirements: Manufacture and fabrication of structural glued laminated timber shall be in accordance with 2022 CBC Chapter 23.

1.3 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings for glued laminated members. Indicate areas requiring 6 inch spacing.

1.4 QUALITY ASSURANCE

A. As a minimum comply with the following requirements:
   1. AITC - Product Standard PS 56.
   2. AITC 117 - Structural Glued laminated Timber of Softwood Species.
   3. ASTM D 3737 - Design and Manufacture of Structural Glued Laminated Timber.
   4. NSI/ATC A 190.1 - Standard Specifications for Glued Laminated Timber.

B. Inspection of structural-glued laminated members shall be performed during fabrication by an inspector approved by owner. Inspection shall be performed in accordance with 2022 CBC Sections 1705 and 2303.

1.5 DELIVERY, STORAGE AND HANDLING

A. After fabrication and prior to shipping, seal surfaces of each member, including ends, with 2 coats of sealer primer, installed in accordance with manufacturer's written recommendations.

B. Each member, which will be exposed in completed structure, shall be separately wrapped in heavy waterproof paper for protection against weather and damage in shipping and handling. Do not remove wrapping until after members have been installed. Protect all members from damage, whether concealed or exposed in the finished Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber for Laminating: Conforming to the structural requirements and laminating specifications of PS 56, of stress grades and combination indicated that provides glued laminated members with allowable stress values in bending as indicated.

B. Glue: Exterior type; waterproof.

2.2 FABRICATION

A. Appearance grade of members shall be Industrial Grade where concealed and Architectural Grade where exposed to public view.

B. Weather exposed surfaces of members as defined in 2022 CBC shall be protected to prevent decay. When member is protected with pressure treatment, treatment process shall not impair structural integrity of member. When member is protected by flashing or is encased, provide ventilation and prevent moisture entrapment on member.
   1. Preservative treatment shall meet Standards U1 and M4, use category UC3B, as defined by the American Wood Protection Association. Use copper naphthenate preservative and follow with a stain blocker and oil-based, semi-transparent earthtone stain.

C. Joints: End joints in adjacent laminations shall be separated in accordance with 2022 CBC requirements. Joints in adjacent laminations of arched members shall be separated as required for bending members.

D. Maximum moisture content of the wood at time of gluing shall not exceed 16 percent for Projects located in coastal areas, 12 percent for Projects located in interior valleys or 10 percent for Projects located in desert areas. Moisture content of wood for members that will be exposed to direct sunlight in finished structure shall not exceed 10 percent at time of gluing. Range of moisture content of laminations assembled into a single member shall not exceed 5 percent at time of gluing.

E. Reinforcement for Radial Tension: Where mechanical reinforcement is required to resist radial tension, reinforcement shall be as described in the Timber Construction Manual. Maximum spacing of mechanical reinforcement shall not exceed half effective depth of member at location of reinforcement.

F. Notches: Notched glued laminated members shall be designed as required for sawn lumber using allowable stress of a combination, with outer lamination being grade of laminations exposed by notch. Where a notch is located on tension face of a member, at least one fully-threaded lag bolt, or equal, shall be provided on each side of notch to prevent splitting.

G. Fabricate and assemble components for laminations in combinations in accordance with requirements of AITC 117 and ASTM D 3737.

H. Radius of Curvature: Where curved glue-laminated members are specified, fabrication shall conform to Section 6.3 of AITC 117. Laminations thinner than the overall member width may be required to meet these provisions.

PART 3 - EXECUTION

3.1 ERECTION

A. Provide erection bracing in addition to required lateral bridging. Avoid temporary construction loads in excess of design limits. Maintain members straight and plumb. Provide adequate lateral support for individual members and entire system until permanent bridging and sheathing is installed. Deliver and erect each member in one piece. Field splicing is not permitted unless reviewed by the Architect.

END OF SECTION 061800

SECTION 061900 - MANUFACTURERED LUMBER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Documents affecting work of this section shall include, but are not necessarily limited to, the agreement, general conditions, supplementary conditions, sections in division 1 of these specifications, and the drawings

1.2 SUBMITTALS

A. Comply with pertinent provisions of section 01 30 00.

B. Design: submit complete calculations signed by a licensed California civil engineer for verification.

C. Shop drawings: drawings shall be furnished by the manufacturer showing all critical dimensions for determining manufactured lumber fit and placement in the building as well as the loads the manufactured lumber is designed to support. These drawings shall be approved prior to fabrication.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Design: the manufactured lumber shall be sized and detailed to fit the dimensions and loads indicated on the plans. All designs shall be in accordance with allowable values assigned by the building code approval.

C. Manufactured lumber shall be manufactured in a plant approved for fabrication by the building official.

D. Manufactured lumber shall be identified with a stamp or stamps noting the name and plant number of the manufacturer, the grade, the national research board report number and the quality control agency.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of section 01 60 00.

B. Handle manufactured lumber with care, and in accordance with manufacturer's instructions.

C. Stock pile or store manufactured lumber in a vertical position and protected from the weather.

D. Protect manufactured lumber from construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Joists: TJI series by Truss Joist Macmillan conforming to ner-200. Any substitutions shall be submitted to SEOR and AOR for review and approval with documentation and applicable calculations to demonstrate compatibility. Each piece shall be stamped with name of the manufacturer and size and type designation. Top chord shall be Microlam unless otherwise noted. Refer to structural drawings for additional types of joists.

B. Beams: LVL or Parallam, by Trus Joist Macmillan. Any substitutions shall be submitted to SEOR and AOR for review and approval with documentation and applicable calculations to demonstrate compatibility.

C. Sill PL: LSL by Weyeraeuser

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the architect.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

B. Commencement of installation of any products of this section shall be considered as acceptance of the substrate and conditions as being satisfactory for proper installation of products of this section.

3.2 INSTALLATION

A. Coordinate as required with other work to assure proper and adequate provision in other work for interface with the work of this section.

B. Install the work of this section in strict accordance with the original design, the approved shop drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures

C. The manufactured lumber is to be erected and installed in accordance with the plans, drawings, and installation suggestions.

D. Temporary construction loads that cause member stresses beyond design limits are not permitted.

E. Drilling or notching of manufactured lumber is not permitted unless specifically detailed or noted on the drawings

END OF SECTION 061900

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SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Plastic-laminate countertops.
   2. Solid surfacing-material countertops.
   3. Stainless steel counter.
   4. Upholstery.

1.2 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   2. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
   3. Apply WI-certified compliance label to first page of Shop Drawings and follow Section 1, “Guidelines for Architectural Millwork Shop Drawing”.

C. Samples for Initial Selection: For each type of product indicated requiring product selection.

D. Samples for Verification:
   1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
   2. Solid-surfacing materials, 6 inches square.
   3. Corner pieces as follows:
      a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
      b. Miter joints for standing trim.
   4. Exposed cabinet hardware and accessories, one unit for each type and finish.
      a. Hardware samples will be returned up on approval.

E. Product Certificates: For each type of product, signed by product manufacturer.

F. Woodwork Quality Standard Compliance Certificates for Product and Installation: WI-certified compliance certificates confirming conformance with Certified Compliance Program (CCP).

G. Qualification Data: For Installer and fabricator.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.

B. Installer Qualifications: Licensee of WI's Certified Compliance Program.

C. Quality Standard: Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
   1. Before delivery to job-site, Millwork supplier:
      a. Licensees of WI shall issue a certified compliance certificate indicating millwork products being furnished for this project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
      b. Non-Licensees of WI shall provide evidence that they have arranged for inspection by WI inspector after completion of fabrication and installation. If conditions are found to be compliant, inspector will issue Compliance Certificate indicating millwork products being furnished for this project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
   2. Each elevation of casework and each countertop shall bear certified compliance label.
   3. Cabinet Design Series (CDS): CDS numbers on Drawings indicate typical designs.

D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of interior architectural woodwork that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. High-Pressure Decorative Laminate:
   1. Wilsonart International; Div. of Premark International, Inc. (Basis of Design)
   2. Formica Corporation.
   3. Lamin Art.
   4. Nevamar Company, LLC; Decorative Products Div.
   5. Arpa.
   6. Abet Laminati.
   7. Or equal.

B. Solid Surfacing Materials:

1. Corian by E. I. du Pont de Nemours and Company. (Basis of Design)
2. Formica Corporation.
3. Nevamar Company, LLC; Decorative Products Div.
4. Wilsonart International; Div. of Premark International, Inc.
5. Hi-Macs by LG Hausys.
6. Or equal.

C. Medium-Density Fiberboard:
1. Medex, Medex NC, Medite II, or Arreis SDF by SierraPine Ltd.
2. Weyerhaeuser Company; Premier Plus by Weyerhaeuser.
3. Or equal.

D. Particleboard:
1. Rodman Industries, Inc.
2. Acadia Board Company.
3. PrimeBoard, Inc.
4. Or equal.

E. Cabinet hardware:
1. Accuride.
2. Hafele.
3. Rockfokrd Process Control, Inc.
4. Or equal.

2.2 MATERIALS

A. General: Provide materials that comply with requirements of WI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Core and Substrates: Comply with the following:
1. Backs of cabinets, book cases, etc.
a. Hardboard: AHA A135.4.
2. Plastic-laminates:
a. Medium-Density Fiberboard: ANSI A208.2, Grade MD.

C. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.

D. High-Pressure Decorative Laminate (HPDL): NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
1. Type: Standard type, unless Special Purpose type is indicated.

2.3 CABINET HARDWARE AND ACCESSORIES

A. Adjustable Shelf Pilaster Standards: Side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
   1. Product: 255/256 Mortise-Mount Pilaster Shelving System by Knape & Vogt or equal.
      a. Holds up to 500 lbs. per shelf.
      b. 23 gauge high strength steel.
      c. 39/64" wide x 11/64" deep.
      d. BHMA Grade 1 approved.
      e. Self supports: KV #256.
      f. Mortise-Mount system.
      g. 1/2" vertical slot adjustment.
      h. Numbered slots for fast, accurate clip insertion.
      i. Punched nail/screw holes.
      j. Limited LIfetime Warranty.
      k. Made in USA.

B. Shelf Support Pins:
   1. Product: KV #330 by Knape & Vogt or equal.
      a. Stainless steel.
      b. Pin diameter for 5 mm hole (approx 13/64 inch).

C. Grommets: Plastic, 2 inch diameter, locations as indicated. If locations are not indicated, as selected by Architect during shop drawing review.
   1. Doug Mockett, Sugatsune, Wood Technology, or equal.

D. Drawer and Door Pulls: For all, including accessible casework.
   1. "U" shaped wire pull, aluminum with satin finish, 4 inch centers.

E. Cabinet Locks: Casework shall lock. Casework in a room shall be keyed alike and each room shall be keyed differently. All locks shall be master keyed with one master key for all casework.

F. Hinges: Model 376 by Rockford Process Control, Inc. or equal.
   1. Heavy duty, .090” cold rolled steel, 5-knuckle institutional hinge; mill ground with hospital tips, 270 degree opening angle.
   2. 2-3/4 inch height, drilled knuckle ID with precision drawn pins.
   3. All mounting holes are countersunk for #8 flat head screws.
   4. Non-removable knurled pin.
   5. Exceed ANSI/BHMA 156.9 Grade 1 requirements.

G. Drawer Slides: Heavy-duty, full extension, ball bearing, soft closing, drawer glides by Blum or equal.

H. Counter Support Brackets:
   1. Model #EH-1824 by Rakks or equal.
   2. Description: Used to support up to 30" deep counters. Manufactured from 2" x 3" “T” to provide maximum stiffness. When the 24" leg is against the wall, this bracket can also be used to support 24" deep counters.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Wood Glues: 30 g/L.
   2. Contact Adhesive: 250 g/L.

E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect 7 days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

E. Drawer bottoms to be fully let-in, glued and blocked. Joinery must be lapped and mitered, no butt joints.

2.6 CABINETS

A. WI Construction Style: Style A, Frameless.

B. WI Construction Type: Type I, multiple self-supporting units rigidly joined together.

C. WI Door and Drawer Front Style: Flush overlay.

D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
   1. Horizontal Surfaces Other Than Tops: Grade HGS, 0.048 inches (1.2 mm) thick.
   2. Postformed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade HGS, 0.048 inches (1.2 mm) thick.
   4. Edges: Self-edge banded.

E. Semi-Exposed Surfaces: Any of one of following.
   1. Low pressure decorative polyester overlay.
   2. Low pressure decorative melamine overlay.
   3. HPL cabinet liner.
   4. Solid Phenolic core (SPC).
   5. Vinyl at cabinet backs and drawer bottoms only.

F. Concealed Surfaces: Any of one of following.
   1. Solid Wood or Plywood: Any hardwood or softwood species, with no defects affecting strength or utility. Hardwood and softwood lumber kiln dried to 7 and 10 percent moisture content, respectively.
   2. Particleboard: ANSI A208.1, Grade M-2.
   3. Medium-Density Fiberboard: ANSI A208.2.
   4. Solid Phenolic core (SPC).

G. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As selected by Architect from laminate manufacturer's full range.

2.7 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Solid-Surfacing-Material Thickness: 3/4 inch.

B. Edge: 1-1/2 inch thick eased edge.

C. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

D. Integral Cove: Provide shop fabricated integrally molded coves at back and ends where against walls or other vertical surfaces, with 3/8” radius between top and splash.

2.8 STAINLESS STEEL COUNTER

A. Custom as indicated on Drwings.

2.9 UPHOLSTERY

A. Bench: As indicated on Drawings.
   1. Cushion: Suitable for bench.
   2. Fabric: Maharam as indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
4. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

07 13 26

PRE-APPLIED SHEET MEMBRANE WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. The work of this section includes, but is not limited to, blindside pre-applied and post applied sheet membrane waterproofing that forms an adhesive and mechanical bond to poured concrete for the following applications:

1. Horizontal Applications: Membrane applied on prepared subbase prior to placement of concrete slabs.
2. Vertical Applications: Membrane applied against formwork, or soil retention system prior to placement of concrete foundation walls.
3. Waterstops for sealing concrete construction joints, pipe penetrations, and knock-outs.

1.02 REFERENCES

A. American Society for Testing and Materials International (ASTM)

1. ASTM C 836 Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
2. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
3. ASTM D570 Standard Test Method for Water Absorption of Plastics
4. ASTM D 903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
5. ASTM D 1876 Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
6. ASTM D1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
7. ASTM D3767 Standard Practice for Rubber - Measurement of Dimensions
8. ASTM D5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
9. ASTM E96 Standard Test Method for Water Vapor Transmission of Materials
10. ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.03 SUBMITTALS

A. Manufacturer's Product Data, installation instructions for waterproofing membrane system, and representative membrane samples for approval.

B. Shop Drawings: Manufacturer to provide shop drawings of the entire sub-grade waterproofing system showing locations and extent of all waterproofing materials, waterstops, and accessories including details of substrate joints, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, integration with air barrier system, and other termination conditions.

C. Mock-up Panels: Mock-up panels as specified herein shall be constructed by the Contractor at locations selected by the Architect, to test all products specified in this Section and arrive at acceptable methods of installation.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Sheet membrane waterproofing system manufacturer shall be ISO 9001 certified and demonstrate a minimum of fifteen (15) years continuous, successful experience in production of waterproofing membranes.
B. Installer Qualifications: Sheet membrane waterproofing system installation shall be performed by one Contractor, approved by the waterproofing manufacturer, and shall have at least three (3) years of experience in work of the type required by this section.
C. Manufacturer Technical Representatives: Membrane manufacturer shall provide trained direct company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conduct a final inspection upon successful completion of the installation.
D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions, to coordinate this work with related and adjacent work, and to review special details.
E. Give a minimum of five (5) days' notice to the owner and manufacturer prior to commencing any work and notify both parties on a daily basis of any change in work schedule.
F. Contractor shall attend necessary job meetings and furnish competent and full-time supervision, experienced mechanics, all materials, tools, and equipment necessary to complete, in an acceptable manner, the membrane installation in accordance with this specification.
G. Materials: Obtain primary sheet membrane waterproofing and all joint sealing and waterstop materials of each type required from a single manufacturer. Manufacturer to provide waterproofing shop drawings.
H. Backup Preparation: The Contractor shall prepare the backup surfaces to accept the approved waterproofing system in the manner necessary to comply with all requirements of the membrane manufacturer and architect. Backup preparation shall be guided by the following:
1. Mock-up areas shall be used to determine required methods and tools to obtain degree of backup preparation required by the membrane manufacturer. Prepare and clean a three (3) foot by three (3) foot areas of each substrate material type.
I. Schedule Coordination: Schedule work such that the membrane will not be left exposed to jobsite conditions for longer than that recommended by the manufacturer. Manufacturer or manufacturer's representative to be on site during waterproofing installation.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original and unopened labeled packages. Store and handle in strict compliance with manufacturer's instructions. Protect from damage from weather, excessive temperature, and construction operations. Remove and dispose of damaged material in accordance with applicable regulations.

1.06 CODE REQUIREMENTS

A. Work shall be performed in accordance with the more stringent requirements of these specifications, the Local Building Code, OSHA, or other governmental authorities including Federal, State, and Local, having jurisdiction.

1.07 FIELD CONDITIONS

A. Perform work only when weather conditions as well as ambient and substrate temperatures are within the limits established by the manufacturer of the sheet membrane waterproofing system. Do not apply waterproofing in snow, rain, or mist.

B. Proceed with installation only when the substrate construction and preparation work is complete and is suitable to support sheet membrane waterproofing.

1.08 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

    a. Warranty Period: Ten years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section

    a. Warranty Period: Two Years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. **Sika Corporation St. Louis**, 3400 Tree Court Industrial Boulevard, St. Louis, MO 63122; Local Contact (562) 676 0459.

B. Source Limitations for Waterproofing System: Obtain primary sheet membrane waterproofing and all joint sealing and waterstop materials of each type required from a single manufacturer.

2.02 MATERIALS

A. Basis of Design: Pre-applied and Post-Applied Integrally Bonded Sheet Waterproofing Membrane: **SikaProof A+** by **Sika Corporation**, a flexible sheet membrane consisting of a flexible polyolefin membrane and a hybrid bonding layer with a cement modified polymer. The membrane shall form a continuous and permanent dual bond (mechanical and adhesive) to poured concrete or existing

concrete to prevent lateral water migration between the membrane and structural concrete

1. Pre-Applied Applications:
    a. Horizontal Applications (Underslab)
        A. Sika; SikaProof A+12
    b. Vertical Applications (Blindside)
        A. Sika; SikaProof A+12
2. Post-Applied Applications:
    a. Horizontal Applications (Post Applied)
        A. Sika; SikaProof A+12 with SikaProof® Adhesive-22
    b. Vertical Applications (Post Applied on walls)
        A. Sika; SikaProof A+12 with SikaProof® Adhesive-22

B. Provide membrane with the following physical properties:

Property	**Test Method**	**Result**
Color		Yellow
Thickness (nominal)	ASTM D 3767	1.70mm (0.07in.)
Lateral Water Migration Resistance	ASTM D 5385 modified	Pass at 71m (231 ft.) of hydrostatic head pressure head pressure
Resistance to Hydrostatic Head	ASTM D 5385 modified	71m (231 ft.) min.
Low Temperature Flexibility	ASTM D 1970	Pass at -29°C (-20°F)
Tensile Strength[1]	ASTM D 412	830 psi (5.7 MPa) min.
Elongation[1]	ASTM D 412	1400% min.
Crack Cycling	ASTM C 836	Pass at -26°C (-15°F)
Peel Adhesion to Concrete	ASTM D 903	20 lbs/in. min.
Lap Peel Adhesion	ASTM D 1876	30 lbs/in. min.
Permeance	ASTM E 96 Method B	3.45ng/Pa x s x m^2 (0.06 perms)
Puncture Resistance	ASTM E 154	200 lbs (670 N) min.
Radon Permeability (SPA-12)	Certificate E-214/2011	(5.3 +/- 0.7) x 10^{-12} m^2/s

2.03 ACCESSORIES

A. SikaProof Tape A+: Self-Adhesive tape for pre-applied internal jointing, detailing, and transitions.

B. SikaProof ExTape-100: Self-Adhesive tape for post-applied SikaProof A+ membrane seams

C. SikaProof Adhesive-22: Cementitious adhesive for application of SikaProof A+ membrane to concrete

D. Sika Drainage Mat 420: Consists of a polypropylene dimpled drainage core bonded with a non-woven geocomposite fabric on the top side, and a membrane protective film bonded to the bottom side.

E. Leakmaster LVZ: Single Component moisture-cure water-swelling sealant used for detailing and penetrations

F. Waterstop: Sika Greenstreak waterstops as required by Section 03 15 13

G. Miscellaneous Accessories: Accessories specified or acceptable to manufacturer of pre-applied waterproofing membrane system.

PART 3 EXECUTION

3.01 GENERAL

A. The Installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the Contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

B. Membrane Placement: Thickness of the sub-grade membrane shall be determined by the following factors and approved by the membrane manufacturer's technical representative and the architect.

1. SikaProof A+ 12: Use on all horizontal surfaces and where rebar cages are placed next to vertical surfaces. Run SikaProof® A+ 12 up vertical wall to a height above the rebar concentration and marry to the SikaProof® A+ 12 membrane. Use for post-applied horizontal applications with SikaProof® Adhesive-22

2. SikaProof A+12: Use on all vertical surfaces where membrane will be pre-applied or for post applied applications with SikaProof® Adhesive-22.

3.02 SUBSTRATE PREPARATION

A. Pre-Applied Applications

1. The substrate shall be of sufficient stability to prevent movement during the concrete placement. Substrates must be regular and smooth with no gaps or voids larger than 0.5 in. Acceptable substrates include concrete, permanent or removable formwork, plywood, fleece, rigid protection board, or drainage composite.

a. Horizontal Surfaces: The substrate must be free of loose aggregate and sharp protrusions. Avoid curved or rounded substrates. When installing over crushed stone or earth, ensure substrate is well compacted to prevent displacement of the substrate due to traffic or concrete placement. Substrate may be damp but standing water must be removed.

b. Vertical Surfaces: Use a suitable substrate such as permanent or temporary formwork, plywood, rigid protection board, or drainage composite to provide membrane support.

B. Post-Applied Applications

1. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

a. Cast In Place Concrete Substrates:

1. Concrete must be cured for minimum 48 hours
2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
3. Repair bug holes over 0.5 in in length and 0.25 in depth and finish flush with surrounding surfaces.
4. Remove scaling to sound, unaffected concrete and repair exposed area
5. Grind irregular construction joints to suitable flush surface

3.03 INSTALLATION

A. General: Strictly comply with installation instructions in manufacturer's published literature, including but not limited to the following:

B. Horizontal Pre-Applied Applications:

1. Install a separation/protection or leveling layer based on existing jobsite conditions.
2. Form the corners with the same SikaProof A+12 sheet adhering internally with SikaProof Tape-A+.
3. Install the SikaProof A+ membrane grey side up, adhering the joints with the SikaProof Tape A+ or the SikaProof® Sandwich Tape.
4. Accurately position succeeding sheets to overlap the previous sheet by a minimum of 50 mm (2 in.).
5. Apply SikaProof® Tape A+ or SikaProof Sandwich Tape at overlap of sheets. Roll with a hand roller to ensure a continuous bond is achieved.
6. Install detail areas, such as pipe penetrations, pits, connections, expansion joints, and any other special details using the appropriate accessory products and in strict accordance with the manufacturer's installation instructions.

C. Vertical Pre-Applied Applications:

1. Install leveling layer or protection based on existing jobsite conditions.
2. Mechanically fasten the membrane using fasteners appropriate to the substrate with the grey side facing towards the concrete placement. The membrane may be installed in either horizontal or vertical orientation in any convenient length.
3. Accurately position succeeding sheets to overlap by a minimum of 50mm (2 in.).
4. Apply SikaProof Tape A+ at overlap of sheets. Roll with hand roller to ensure a continuous bond is achieved.

D. Dual Vertical Formwork Pre-Applied Applications:

1. Mechanically fasten the membrane using fasteners appropriate to the substrate with the grey side facing towards the concrete placement. The membrane may be installed in either horizontal or vertical orientation in any convenient length.

2. Accurately position succeeding sheets to overlap by a minimum of 50mm (2 in.). Ensure the underside of the succeeding sheet is clean, dry, and free from contamination before removing the protective release liner.
3. Apply SikaProof Sandwich Tape between overlapping sheets and roll with hand roller to ensure a continuous bond is achieved.
4. After removing the formwork penetrations, such as form ties, any membrane damage and construction joints can be sealed on the external side of the membrane with SikaProof Patch-200 or the Sika Dilatec system.
5. Protect membrane in accordance with the manufacturer's published literature prior to backfilling operations.

E. Post Applied Applications (Vertical and Horizontal)

1. Apply SikaProof Adhesive-22 at rate recommended by manufacturer using a 1/4in x 3/16in V-notch trowel for vertical and horizontal.
2. Apply membrane directly into adhesive bed during workability time of adhesive.
3. Tape Seams after adhesive has cured and apply protection board and related materials in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 07 14 00

COLD FLUID-APPLIED MEMBRANE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide a cold fluid-applied bitumen-modified polyurethane waterproofing system on structural concrete, plywood sheathing, metal or other substrates.

1. Work includes substrate preparation.
2. Work includes bridging and sealing air leakage and water intrusion pathways and gaps including connections of the walls to the roof air barrier, and penetrations of the building envelope including piping, conduit, ducts and similar items.

1.2 PERFORMANCE REQUIREMENTS

A. Cold fluid applied bitumen-modified polyurethane waterproofing system is intended to perform as a continuous barrier against liquid water and to flash or discharge to the exterior incidental water. Membrane system is not long-term UV resistant and is intended to receive an overburden of concrete, tile in a cementitious setting bed, pavers in a sand setting bed, pavers on supporting pedestals, or soil/growing media, and shall accommodate movements of building materials as required with accessory sealant materials at locations such as: changes in substrate, perimeter conditions and penetrations. Installed waterproofing membrane system shall not permit the passage of water.

B. Manufacturer shall provide all primary waterproofing materials that are physically and chemically compatible when installed in accordance with manufacturers current application requirements.

1.3 SUBMITTALS

A. Submittals: Comply with project requirements for submittals as specified in Division 01.

B. Product Data: For each product.

C. Shop Drawings: Manufacturer’s standard details and shop drawings for the specified system.

D. Installer’s Authorization: Installer shall provide written documentation from the manufacturer of their authorization to install the 10 year system, and eligibility to obtain the warranty specified in this section.

E. Manufacturer’ Certification: Certification showing full time quality control of production facilities and that each batch of material is tested to ensure conformance with the manufacturer's published physical properties.

F. VOC Certification: Manufacturer's certification that all waterproofing system products meet current Volatile Organic Compound (VOC) regulations as established by the State in which they are being installed; and stating total VOC content, in grams per liter, for all system components (i.e. primers, adhesives, coatings, etc.).

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer shall demonstrate qualifications to supply materials of this section by certifying the following:

1. Membrane Manufacturer shall have available an in-house technical staff to assist the contractor when necessary in the application of the products and site review of the assembly.

B. Installer's Qualifications: The Contractor shall demonstrate qualifications to perform the Work of this Section by submitting certification or license by the waterproofing membrane manufacturer as a trained and authorized applicator of the product the installer intends to use.

C. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary waterproofing manufacturer.

D. Materials Compatibility: All materials included in the waterproofing assembly, as well as associated materials adhered to/applied beneath the waterproofing membrane shall have been tested and verified to be compatible. Include written testing documentation and test reports if requested by Architect.

E. Applicable Regulations: Comply with local code and requirements of authorities having jurisdiction. Do not exceed VOC regulations as established by the State in which they are being installed; including total VOC content, in grams per liter, for all system components (i.e. primers, adhesives, coatings, and similar items).

F. Waterproofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for definitions of waterproofing terms related to this section.

1.5 PRE-INSTALLATION CONFERENCE

A. Prior to scheduled commencement of the waterproofing installation and associated work, conduct a meeting at the project site with the installer, architect/consultant, owner, manufacturer's representative and any other persons directly involved with the performance of the Work. The Installer shall record conference discussions and to include decisions and agreements reached (or disagreements), and furnish copies of recorded discussions to each attending party. The main purpose of this meeting is to review foreseeable methods and procedures related to the Work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all waterproofing materials to the site in original containers, with factory seals intact.

B. Store all pail goods in their original undamaged containers in a clean, dry location within their specified temperature range.

C. Do not expose materials to moisture in any form before, during, or after delivery to the site. Reject delivery of materials that show evidence of contact with moisture.

D. Remove manufacturer supplied plastic covers from materials provided with such. Use “breathable” type covers such as canvas tarpaulins to allow venting and protection from weather and moisture. Cover and protect materials at the end of each work day. Do not remove any protective tarpaulins until immediately before the material will be installed.

E. Materials shall be stored above 60-95°F (15-35°C) a minimum of 24 hours prior to application

1.7 PROJECT CONDITIONS

A. Weather: Proceed with waterproofing only when existing and forecasted weather conditions permit. Membrane application should not proceed when precipitation is imminent. Ambient temperatures shall be above 40°F (4°C) to 90 degrees F (32 degrees C) when applying the waterproofing system and remain above 40 degrees F (4 degrees C) for at least 24 hours after application.

B. All surfaces to receive the waterproofing membrane shall be free from visible water, dew, frost, snow and ice. Do not apply coatings if snow, rain, fog, and mist is anticipated within 12 hours after application. Allow surfaces to attain temperature and conditions specified before proceeding with coating application. Application of waterproofing membrane shall be conducted in well ventilated areas.

C. Application on Green Concrete:
Horizontal: 48 hours or walkable conditions
Vertical: 24 hours after forms removed

D. Waterproofing Membrane:

1. Waterproofing membrane is not intended to be exposed or in contact with a constant temperature below -25°F (-31.7°C) or in excess of 200°F (93.3°C). See technical data sheets for limitations, i.e., hot pipes and vents or direct steam venting.
2. Specified waterproofing membrane is VOC compliant. Consult container, packaging labels and Safety Data Sheets (SDS) for specific safety information.
3. Some low molecular weight alcohols can soften. Any exposure to foreign materials or chemical discharges shall be presented to membrane manufacturer for evaluation to determine any impact on the waterproof membrane assembly performance prior to warranty issuance.

E. Contractor shall ensure adequate protection during installation of the waterproofing system.

F. Do not apply over sealant joints, control joints or other materials that will be affected by solvent.

G. Avoid application when inclement weather is present or imminent.

H. Do not apply membrane to reinforcing bars or to wet or contaminated surfaces

1.8 WARRANTY

A. Warranty: Provide manufacturer's standard warranty. Materials warranty shall be for a minimum of one year starting at the date of Substantial Completion. System warranty shall be for the following duration in accordance with specified system.

1. Warranty Length: 5 years 60 mil system.
2. Warranty Length: 10 years 90 mil system with approved project.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Manufacturer: Sika Corporation, 201 Polito Avenue, Lyndhurst NJ 07071. Local Contact: (562) 676 0459. No substitutions without prior written approval by the Architect.

2.2 WATERPROOFING SYSTEM

A. Fluid-Applied Membrane System, 5 Year System: Sikalastic HLM 5000 GC:

a. Sikalastic HLM 5000 GC, 60 mils wet film thickness resulting in 25 SF/gal coverage

2.3 MEMBRANES AND COATINGS

A. Base coat shall be Sikalastic HLM 5000 GC by Sika Corp, a single component, cold fluid applied, moisture cure, bitumen modified, polyurethane base coat membrane.

B. Membranes shall be low in VOC's and be a one component elastomeric polyurethane membrane that may be brush or roller applied. Membrane shall have the following physical properties and conforms to ASTM D7311-07: Standard Specification for a single component, cold fluid applied, moisture cure, bitumen modified, polyurethane membranes.

C. Liquid and Cured Film Property Requirements:

1. Compliances:
   a. ASTM C836
2. Minimum Recovery: 90 percent.
3. Swelling in Water (3 days at room temperature): None.
4. Service Temperature Range:
   a. Minimum: Minus 40 degrees F (Minus 40 degrees C).
   b. Maximum: 120 degrees F (49 degrees C).
5. Hardness, Shore OO: 85, ASTM C836.
6. Tensile Strength: 150 psi (1.0 MPa), ASTM D412.

7. Average Elongation: 600 percent, ASTM D412.
8. 100% Modulus: 80 psi (0.6 MPa), ASTM D412.
9. Moisture-Vapor Permeability (dry perms): < 0.1, ASTM E96.
10. Crack Bridging Test: Passed 1/16 inch (2 mm), ASTM C836.
11. Extensibility After Heat Aging: No cracking, ASTM C836.
12. Weight Loss (20 percent maximum): 16 percent, ASTM C836.

2.4 MEMBRANE REINFORCEMENT

A. Supplemental reinforcement of the waterproofing membrane system shall be Sika Flexitape Heavy by Sika Corp., a nylon mesh specifically designed for local reinforcement of the waterproofing membrane at structural cracks, expansion joints and transitions between dissimilar materials.

2.5 FILLET BEAD AND PENETRATION SEALANT

A. Sealant for fillet bead applications and membrane penetrations shall be any Sikaflex sealant including Sikaflex 1a, 1a+, 2c NS EZ Mix, or 11FC by Sika Corp., one and two part polyurethane sealants suitable for fillet bead transition compound to be applied prior to the installation of the membrane system at changes in substrate direction, sealing reglet terminations, cracks in the substrate and penetrations of the waterproofing system.

2.6 REPAIR AND PATCHING

A. Cementitious repair mortar to repair bug holes, spalled areas, and other non-structural surface defects, to fill uneven areas and birdbaths, or to repitch decks shall be SikaQuick 1000 by Sika Corp., a two component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar.

2.7 DRAINAGE MAT

A. Dimpled core polystyrene drainage mat with a non-woven polypropylene filter fabric bonded to the topside of the mat, and a bonded protection sheet on the underside of the mat. To be installed between the waterproofing membrane and extruded polystyrene insulation. Drainage mat to be Sika Drainage Mat 420.

2.8 FILTER FABRIC

A. Non-woven needle-punched polyester UV-stabilized mat, 3 oz./sq.yd., used between the extruded polystyrene insulation and overburden. Filter fabric shall be Sika 120 Fleece by Sika Corp.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify Architect in writing of any discrepancies. Commencement of the Work in an area shall mean Installer’s acceptance of the substrate.

B. Surfaces shall be sound, clean and free of standing water, oil, grease, dirt, excess mortar or other contaminants. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full flush.

3.2 SURFACE PREPARATION

A. Verify that the deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers or gutters. Verify that all openings or penetrations through the intended substrate are secured back to solid blocking. Ensure all preparatory Work is complete prior to applying membrane.

B. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.

C. All surfaces shall be blown clean using an air compressor to remove any remaining loose debris.

D. All cracks and voids greater than 1/16 inch shall be routed and caulked with a Sikaflex sealant. Allow to cure per waterproofing membrane manufacturer's technical data sheets prior to over-coating with the specified waterproofing membrane system. Green concrete cracks or joints can be sealed with Sikaflex 1a+.

E. At all inside corners, gaps or voids at the juncture of the deck and penetrations apply a minimum 3/4 inch fillet bead of Sikaflex sealant and allow to cure per waterproofing membrane manufacturer's technical data sheets prior to installing the waterproofing membrane system.

F. Sikaflex Sealants used in detailing can be over coated with Sikalastic HLM 5000 once tack free.

G. Membrane is self-terminating but membrane terminations can be established prior to project start-up and documented in shop drawings. Terminations can occur in raked-out mortar joints, saw cut terminations or under installed counter-flashing materials.

H. Use tape lines to achieve a straight edge detail.

3.3 SUBSTRATE PREPARATION

A. Acceptable substrates include concrete, concrete block, solid wood/plywood sheathing, and metal.

B. Structural Concrete:

1. Acceptable concrete substrates are limited to poured in place concrete decks.
2. Minimum deck thickness for structural concrete is 4 inches (10.2 cm).
3. Concrete surface to be light broom finish or equivalent.
4. Curing agents shall be checked for compatibility with specified waterproofing materials. Most curing agents shall be completely removed from the substrate by grinding, scarifying, or other mechanical means.
5. Concrete and masonry surfaces shall be low-pressure (5,000 psi or less) power-washed in accordance with ICRI Guideline No. 03732: Selecting and Specifying

Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays to remove all dirt, debris or surface contamination that would compromise bonding of the specified waterproofing membrane system. Remove oil or grease with solvents, or detergent and water. Rinse surface clean of remaining cleaning agents.

C. Metal Surfaces:

1. Exposed drain bowls, pipes, and other metal surfaces shall be cleaned by power tool cleaning (SSPC SP-3) to remove corrosion deposits back to a clean, bright metal followed by a solvent wipe prior to application of the specified primer.

3.4 PRIMING

A. Metal

1. Apply Sikalastic PF Lo-VOC primer for metal surfaces. To clean and prepared drain bowls and other metal surfaces by brush or roller at the application rate shown on the technical data sheet to achieve an overall wet film thickness of 8 mils. High porosity and roughness of the substrate will decrease coverage rates.
2. Allow to cure and dry in accordance with manufacturer's technical data sheets.

3.5 MEMBRANE REINFORCEMENT

A. Reinforcement of Cracks, Plywood and Cover Board Joints/Seams, and Base/Curb Flashing Transitions:

1. For all locations where the specified membrane system is to be applied directly to the substrate surface, reinforcement of cracks and joints prior to applying the specified membrane system is conditional on the terms agreed to in a given warranty
2. For all horizontal-to-vertical transitions, provide a ¾" x ¾" Sikaflex polyurethane sealant cant.
3. Back roll reinforcement to fully embed reinforcement into the wet liquid polyurethane membrane. Add more liquid membrane as needed to fully embed the reinforcement.
4. Ensure reinforcement is not in tension during embedment.

3.6 COLD FLUID APPLIED MEMBRANE APPLICATION

A. Install waterproofing membrane system in accordance with current technical data sheets and in accordance with warranty guideline requirements.

B. Apply base coat to horizontal deck and vertical wall surfaces by brush or with 1/2 inch – 3/4 inch nap roller to achieve a continuous and uniform minimum wet film thicknesses as specified in warranty guideline requirements.

C. Apply additional liquid material as required to ensure desired millage.

D. Extend membrane reinforcement vertically at adjacent wall surfaces in accordance with project details and specifications.

E. Install all flashings in accordance with manufacturer's construction details.

3.7 PARAPET AND WALL FLASHINGS

A. Clean, prepare and prime if necessary substrate surfaces ready to receive membrane.

B. All parapet, wall, and curb flashings shall be provided with a Sikaflex sealant cant bead membrane application.

C. Terminate waterproofing membrane system at raked-out mortar joints, termination saw cut joint, or under installed counter-flashing materials. Seal all mortar joints and saw cut joints with Sikaflex polyurethane sealant.

D. Install metal counter flashings in accordance with details.

3.8 DRIP EDGES AND OTHER METAL FLANGED FLASHING

A. Clean, prepare and prime metal flange surfaces ready to receive membrane.

B. Metal flanges are typically encapsulated between two membrane layers, usually by providing membrane flashing as a stripping ply over the metal flange, with the field or flashing membrane extending beneath the metal flange. It is also acceptable to install the stripping ply under the metal flange, and extend the field or flashing membrane over the metal flange.

3.9 DRAINS

A. Clean, prepare and prime surfaces ready to receive membrane applications. Block drain bowl opening to avoid waterproofing material from entering the drainage system.

B. Remove strainer baskets and clamping rings from the drain bowl assembly. Temporarily replace the bolts back into assembly to avoid miss-alignment of connections after membrane applications are completed.

C. Extend the liquid waterproofing material and membrane reinforcement directly into the throat of the prepared drain.

D. Remove drain blocks and allow the waterproofing system to fully cure dry prior to re-connecting the drain bowl assembly.

3.10 PENETRATIONS

A. Clean, prepare and prime surfaces ready to receive membrane. Ensure that penetrations are secured to prevent movement.

B. Apply a cant bead of Sikaflex sealant the base of penetrations and apply Sikalastic HLM 5000 membrane vertically up the penetration 6-8 inches.

3.11 APPLICATION OF PENETRATION SEALANT

A. Seal reglet-based membrane terminations, heads of exposed mechanical fasteners, around penetrations, duct work, electrical and other apparatus extending through the waterproofing membrane with specified penetration sealant.

3.12 FLOOD TEST

A. Upon the completion of the waterproofing membrane system and associated terminations the contractor shall flood test the system. Provide temporary stops and plugs for the drains within the test area. Flood test with a minimum 2 inches of water for no less than 24 hours.

B. Repair and retest the system for no less than 24 hours, report all deficiencies to the Architect. Remove temporary stops and plugs. No other Work is to proceed without prior direction from the Architect.

3.13 PROTECTION

A. Protect waterproofing Work from other trades until completion.

B. Stage materials in such a manner that avoids foot traffic over completed waterproofed areas.

C. Provide temporary walkways and platforms to protect completed Work from traffic and point loading during the application process.

D. Provide temporary membrane tie-ins and water-stops at the end of each workday and remove prior to commencement of work the following day.

3.14 PREFABRICATED COMPOSITE DRAINAGE AND PROTECTION MAT

A. Install the drainage mat when it can be followed immediately by the installation of the extruded polystyrene insulation and overburden. If the drainage mat cannot be installed within one week of membrane application, a protection course must be applied over the membrane to protect from other trade work and UV radiation.

B. Install the drainage mat on horizontal and vertical surfaces in accordance with the product data sheet. Lay out and position drainage mat, and allow to lay flat. Cut and closely fit drainage mat to perimeter and penetrations.

C. Overlap filter fabric from adjacent sheets/rolls, and bond all fabric overlaps with Sikaflex sealant. Install supplemental filter fabric as required to ensure filter fabric continuity at flashing locations.

3.15 INSTALLATION OF EXTRUDED POLYSTYRENE INSULATION

A. Before the application of the insulation, any damage or deterioration to the composite drainage and protection mat shall be repaired.

B. Loose lay insulation in a staggered manner, and tightly butt together all insulation boards. The maximum acceptable joint width is 3/8 inch. Cut and closely fit insulation within ¾ inches to perimeter and penetrations.

C. For multi-layer insulation applications, the bottom layer shall be the thickest layer and shall be a minimum of 2 inches thick. Stagger the joints of each insulation layer.

D. Vertical insulation applications can be spot-adhered to the drainage mat and to additional insulation layers, utilizing an acceptable adhesive.

E. Do not install damaged insulation boards.

3.16 FILTER FABRIC

A. Install filter fabric on horizontal and vertical surfaces over the extruded polystyrene insulation in accordance with the product data sheet.

B. Lay out and position filter fabric. Cut and closely fit filter fabric to perimeter and penetrations, extending the filter fabric vertically to the height of the overburden.

C. Overlap filter fabric to achieve 6 inch side and end laps. As required, bond all fabric overlaps with Sikaflex sealant to ensure filter fabric continuity prior to and during overburden installation.

3.17 CLEAN-UP

A. Work areas are to be kept clean, clear and free of debris at all times.

B. Do not allow trash, waste, and/or debris to collect on the work area. Trash, waste, and/or debris shall be removed from the work area on a daily basis.

C. All tools and unused materials shall be collected at the end of each workday and stored properly off of the finished waterproofed surface and protected from exposure to the elements.

D. Dispose of or recycle all trash and excess material in a manner conforming to current EPA regulations and local laws.

E. Properly clean the finished deck surface after completion, and make sure the drains and gutters are not clogged.

F. Clean and restore all damaged surfaces to their original condition

END OF SECTION

SECTION 071910 - CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes concrete sealer.

B. Related Sections:
   1. Division 3 Section “Polished Concrete Finishing” for polishing concrete flooring. (Not just sealing of concrete flooring)

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include manufacturer's printed statement of VOC content.

B. Samples: For each type of sealer and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

C. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

F. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.4 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
   1. Ambient temperature is above 40 deg F.
   2. Concrete surfaces and mortar have cured for more than 28 days.
   3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.
   4. Rain or snow is not predicted within 24 hours.
   5. Application proceeds more than 24 hours after surfaces have been wet.
   6. Substrate is not frozen, or surface temperature is above 40 deg F.

7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Patching compound, cementitious, thin patching and skim-coating material, designed for reducing surface defects on interior floors. : Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Degussa.
   2. ChemMasters.
   3. Or equal.

B. Concrete Clear Sealer for protecting floors: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Prosoco. (Basis of Design)
   2. Scofield.
   3. Degussa.
   4. ChemMasters.
   5. Or equal.

2.2 PATCHING COMPOUND

A. Patching compound, cementitious, thin patching and skim-coating material, designed for reducing surface defects on interior floors.
   1. Composition and Materials:
      a. Complex, precisely engineered, polymer-modified, cementitious, thin patching material produced by a proprietary manufacturing and intergrinding process.
      b. Designed for ease of mixing and installation, superior adhesion without priming, and rapid strength gain, it is a single-component, non-gypsum-based, powdered material containing no sand or calcium chloride.

2.3 SEALER

A. Product: Siloxane WB Concentrate by Prosoco or equal.
   1. Description:
      a. Sure Klean® Weather Seal Siloxane WB Concentrate is a concentrated water repellent designed for dilution with fresh water at the job site.

b. Solvent-free blend of silanes and oligomeric alkoxysiloxanes mixes easily with water to produce a penetrating water repellent ideal for application to dense or porous masonry surfaces.
c. An effective alternative to conventional solvent-based silanes or siloxanes, Siloxane WB penetrates and chemically bonds deep within the masonry substrate to provide long-lasting protection against water-related staining or deterioration.
d. Will not darken, produce a surface film or impair the natural breathing characteristics of treated surfaces.

2. Regulatory Compliance: VOC Compliance Sure Klean® Weather Seal Siloxane WB Concentrate is compliant with the following national, state and district regulations.
a. US Environmental Protection Agency.
b. California Air Resources Board SCM Districts.
c. South Coast Air Quality Management District.
d. Maricopa County, AZ.
e. Northeast Ozone Transport Commission.

PART 3 - EXECUTION

3.1 APPLICATION

A. Follow manufacturer’s written application instructions.

3.2 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071910

SECTION 072100 - BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Concealed thermal and sound insulation.

1.2 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Surface-Burning Characteristics: ASTM E 84.
   2. Fire-Resistance Ratings: ASTM E 119.
   3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of building insulation that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Mineral Wool Insulation:
   1. Rockwool. (Basis of Design)
   2. Thermafiber/Owens Corning.
   3. Fibrex Insulations Inc.
   4. Or equal.

2.2 MINERAL-WOOL INSULATION

A. Mineral Wool:
   1. Product: Safe'n'Sound by Rockwool or equal.
      a. Compliance: Mineral Fiber Blanket Thermal Insulation, Type 1 per ASTM C665.
   2. Reaction to Fire:
      a. Flame spread index = 0.
      b. Smoke developed index = 0.
   3. Density Actual Density - 2.4 lb/ft³ (38 kg/m³) ASTM C167.
   4. Acoustical Performance:
      a. 3" thick: 1.05 NRC.
      b. 6" thick: 1.15 NRC.

2.3 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inches wide.

B. Nails or Staples: Steel wire; electroplated, or galvanized; type and size to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Install insulation in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.
   4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072510 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall sheathing.
   2. Self-Adhered Vapor Permeable, Water Resistive Air Barrier.

B. Related Sections include the following:
   1. Division 6 Section "Sheathing" for plywood sheathing.

1.2 SUBMITTALS

A. Product Data: For each type of product.
   1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

B. Evaluation Reports: For water-resistive barrier, from ICC-ES.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass-Mat Gypsum Sheathing:
   1. Dens-Glass by G-P Gypsum Corporation.
   2. Securock Glass Mat Sheathing by USG.
   3. Gold Bond Brand e2XP by National Gypsum.
   4. Or equal.

B. Self-Adhered Vapor Permeable, Water Resistive Air Barrier.
   1. VaproShield. (Basis of Design).
   2. Blueskin SA by Henry
   3. Cosella Dorken Delta.
   4. Henry.
   5. Dupont.
   6. Or equal.

2.2 WALL SHEATHING

A. Plywood Sheathing: Comply with structural Drawings.

B. Glass-Mat Gypsum Sheathing: Dens-Glass by GP or equal.
   1. Thickness: As indicated on Drawings.

2.3 SELF-ADHERED AIR BARRIER MEMBRANE – SHEET

A. Product: Fully self-adhered air barrier sheet membrane WrapShield SA Self-Adhered Water-Resistive Vapor Permeable Air Barrier Sheet by VaproShield or equal.
   1. A zero VOC fully self-adhered vapor permeable air barrier sheet membrane consisting of multiple layers of spun-bonded polypropylene with vapor-permeable adhesive. Provide sheet membrane tested in accordance with ICC-ES AC 38 criteria to meet requirements for weather resistive barriers having the following properties:
   2. Color: Orange with allowable UV exposure for 180 days, prior to coverage.
   3. Breaking strength and Elongation to ASTM D5034: 88 lbf, machine direction; 83 lbf, cross-machine direction.
   4. Water Vapor Permeance tested to ASTM E96 water method, procedure B: minimum of 50 perms.
   5. Water Vapor Permeance tested to ASTM E398: minimum of 52.57 perms.
   6. Air Leakage: ≤0.00002 cfm/ft2 @ 1.57 psf when tested in accordance with ASTM E2178 and <0.01 cfm/ft2 @ 1.57 psf when tested in accordance with ASTM E2357. Meets Air Barrier Association of America (ABAA) requirements for "Adhesive Backed Commercial Building Wraps".
   7. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage
   8. Application Temperature: Ambient temperature must be above 20 °F.
   9. Surface Burning Characteristics tested to ASTM E84: Class A, Flame-spread index of less than 5, Smoke-developed index of less than 15.
   10. Physical Dimensions: 0.023 inches thick and 59 inches wide and 7.37 oz/yd2.
   11. Accessories: Vapromat, VaproShims, and others and recommend by manufacturer.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Power-Driven Fasteners: NES NER-272.

2.5 MISCELLANEOUS MATERIALS

1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to wood framing with nails or screws.
   2. Fasten gypsum sheathing to metal framing with screws.
   3. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
   4. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

3.3 SELF-ADHERING AIR/VAPOR BARRIER MEMBRANE INSTALLATION

A. Apply self-adhering air/vapor barrier membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.

B. Prime surfaces as per manufacturers’ instructions and allow to dry.

C. Align and position self-adhering air/vapor barrier membrane, remove protective film and press firmly into place. Ensure minimum 2 inch overlap at all end and side laps of membrane.

D. Roll all laps and membrane with a counter top roller to ensure seal.

E. At the end of each days work seal the top edge of the membrane where it meets the substrate with termination sealant. Trowel apply a feathered edge to seal termination and shed water.

3.4 TRANSITION MEMBRANE INSTALLATION

A. All transition membranes must be placed prior to application of air barrier.

B. Install strips, transition membrane, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition membrane to substrate with termination of sealant and liquid flashing.

E. Apply joint sealants forming part of air barrier assembly within sealant manufacturer's recommended application temperature ranges. Consult sealant manufacturer when seal-ant cannot be applied within these temperature ranges.

F. Wall Openings: Apply transition membrane so that a minimum of 3 inches of coverage is achieved over both substrates.
   1. Transition Membrane: Roll firmly to enhance adhesion.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with sealant.

H. Repair punctures, voids, and deficient lapped seams in strips and transition membrane. Slit and flatten fish-mouths and blisters. Patch with transition membrane extending 6 inches beyond repaired areas in strip direction.

3.5 SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.
   1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage and pay for a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.

2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Air barriers will be considered defective if they do not pass tests and inspections.
   1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
   2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 60 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
   2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072510

SECTION 074625 - FURFURYLATED WOOD CLICK-IN CLADDING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Furfurylated wood cladding.
   2. Rainscreen rail system.
   3. Deck board for planter bench.

B. Related Sections:
   1. Division 7 Section “Weather barriers” for Glass-Mat Sheathing and self-adhered weather resistive barrier.

1.2 REFERENCED STANDARDS

A. Edition Dates: Current edition at Bid Date, with applicable appendices and supplements if any, unless otherwise indicated or adopted by authorities having jurisdiction.

B. ASTM International (ASTM):
   1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

C. National Fire Protection Association (NFPA):
   1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. UL LLC, Underwriters Laboratories (UL):
   1. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials

1.3 ACTION SUBMITALS

A. Product Data: Indicate materials, sizes, profiles, support system, and fasteners.

B. Samples: Two samples of each size and profile of cladding, rail system, and clips, illustrating actual products to be installed.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver until construction work causing moisture, dust, soiling, and potential damage to furfurylated wood cladding system is complete.

B. Conform to manufacturers written instructions. Deliver in original, unopened, protective containers and packaging with seals intact and labels clearly identifying product name and manufacturer.

C. Store cladding, rails, and all products indoors preferably, or off ground, well-ventilated, and under cover at all times until just prior to installation. Protect from dirt, dampness, and damage.

1.5 FIELD CONDITIONS

A. Temperature Range: Between -40 degrees F and 140 degrees F (-40 degrees C and 60 degrees C).

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1.6 WARRANTY

A. Manufacturer Warranty: Repair or replace units that fail due to rot:
   1. Commercial: 30-yr non-prorated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/PRODUCTS

A. Acceptable Products:
   1. Kebony US: Click-in Cladding™ System (CCS) (formerly Grad for Kebony), https://us.kebony.com/modified-wood-click-in-cladding-wood-rainscreen-system/, info@kebony.us, +1-833-795-8660.
   2. Kebony Deck Board.

2.2 WOOD CLADDING

A. Kebony Cladding:
   1. Sizes: As indicated on Drawings.
   2. Fire Test Response Characteristics of Kebony Wood: Class B when tested to ASTM E84 (comparable to UL 723 or NFPA No. 255).
   3. Forest Stewardship Council certified (FSC Mix 70 percent) Radiata Pine furfurylated with bio-based liquid using furfurylation process, treated homogeneously.
   4. Density (at 12 percent mc):
      a. 41.8 lb/ft3.
      b. 670 kg/m3.
   5. Janka Hardness:
      a. 1618 lb.
      b. 7.2 kN.
   6. CE marked according to EN 14915.
   7. Nordic Ecolabel 2086 0001 - www.nordic-ecolabel.org.
   8. Complies with EU Timber Regulation (EUTR).
   9. Kebony products are exempted from the EU's biocide directive (76/769/EEC).

2.3 RAIL SYSTEM

A. Extruded Aluminum Alloy, ASTM B221 6060 T-66, 2.48 inch by 0.93 inch (63 mm by 23.6 mm).

B. Clips: Polyoxymethylene (POM) copolymer.

C. Air Gap: 0.47 inch (12 mm).

D. Aluminum Alloy Recycled Content: 80 percent.
   1. Post-Consumer: 45 percent.
   2. Pre-Consumer: 35 percent.

2.4 ACCESSORIES

A. Glass-Mat Sheathing and Weather Barrier: Comply with Division 7 Section “Weather barriers”.

B. Grad Riser Support: For roof lines or short runs, use riser support to maintain the correct air gap between the wall surface and the board. The riser support has an opening to face fasten the board using the Pro Plug system for Kebony.

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2.5 PLANTER BENCH

A. Product: 5/4x6 Clear Kebony Deck Board by Kebony or equal.
   1. Inner board: #2637.
   2. Outer board: #2638.

2.6 FINISHES

A. Furfurylated Wood: Natural, unfinished wood.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Confirm suitability of substrates, materials, and Project conditions. Notify Architect in writing of conditions that are not acceptable. Do not begin work of this Section until unacceptable conditions have been corrected.

3.2 PREPARATION

A. Metal Flashings: Specified in Section 076200, installed prior to installing weather barrier at horizontal intersections with other construction, such as doors and windows heads. Protect from metal interactions according to manufacturer's installation instructions.

B. Weather Barrier: Installed according to manufacturer's instructions.

3.3 INSTALLATION

A. Install rainscreen rail system, furfurylated wood cladding, and accessories in accordance with manufacturer's printed instructions, and requirements of Contract Documents.

B. Position end joints over solid wood stud framing members. Install siding in longest possible lengths with no board spanning less than three rails.

C. Gap between cladding joints as specified in Part 2 of this Section. Gap trim and other construction as recommended by manufacturers.

D. Install corner trim boards full length of run from soffit to bottom of siding where possible.

E. Miter horizontal and vertical siding end joints and corners at 45 degree angle and butt tight.

F. Stagger siding end joints to avoid alignment for minimum of 4 adjacent boards over face of wall within a single floor level.
   1. Maintain minimum 24 inch offset between adjacent courses.
   2. Maintain minimum 24 inch overall offset of joints within each three courses.

G. For vertical configurations, install a set screw at the bottom of each vertical board using a Riser Support and the Kebony Pro Plug System.

3.4 ADJUSTING

A. Repair or replace damaged siding and installations not meeting specified tolerances.

3.5 CLEANING

A. Leave installations clean, premises free from residue of work of this Section.

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END OF SECTION

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SECTION 07 54 19
PVC THERMOPLASTIC MEMBRANE ROOFING
MECHANICALLY ATTACHED

PART 1 - GENERAL

1.00 SUMMARY

Install a polyester scrim reinforced mechanically attached thermoplastic PVC roofing system including membrane, flashings and other components.

A. Section Includes

The work includes but is not limited to the installation of:

1. Tapered and Flat Polyisocyanurate (ISO) Rigid Insulation
2. Fasteners For Insulation and Cover Board
3. Approved Gypsum Roof Cover board
4. Fasteners For Roof Membrane
5. Polyester Reinforced 60 mils PVC Roof Membrane
6. 60 mils Glass Fiber Reinforced PVC Flashing Membrane
7. Low VOC Contact Adhesive for Flashings
8. PVC Clad Edge Metal and Fasteners
9. Other Metal Flashings
10. Sealants

1.01 SUBMITTALS

A. Copy of the ASTM Certification for the named flashing product showing Type III Class I polyester reinforced membranes.

B. Samples of each primary component to be used in the roof system and the manufacturer's current literature for each component.

C. Sample copy of Manufacturer's warranty.

D. Manufacturers ISO 14001 certificate.

E. Copy of Manufacturer's Platinum level NSF/ANSI 347 Sustainability Assessment certificate

F. Copy of Manufacturer's UL recycled content certificate

G. Material Safety Data Sheets (SDS)

H. Letter from proposed Roofing Manufacturer indicating the actual polymer thickness of the product supplied for this project is 60 mils.

I. Written confirmation from the proposed Roofing Manufacturer stating the number of years it has directly manufactured the roof system under the trade names and/or trademarks as proposed.

1.02 QUALITY ASSURANCE

A. Use only manufacturers systems certified Platinum by NSF/ANSI 347 Sustainability Assessment for Single Ply Roofing Membranes.

B. Roofing membrane must be UL Certified to contain a minimum of 10% recycled content.

C. Verify that the roofing system is manufactured directly by roofing system provider/supplier with the current formulation in use for past 20 years minimum to match the duration of the warranty.

D. Unreinforced or polyester reinforced membrane base flashings are prohibited.

E. No “Private Label”, re sold, or third-party manufactured membranes are approved alternates.

F. Qualifications of Roofer: The Roofing Contractor must be authorized by Manufacturer 5 years prior to bid.

G. No deviation from the Project Specification or the approved shop drawings is permitted without prior written approval by the Owner, the Owner's Representative.

H. Only Applicator personnel trained and authorized by manufacturer are permitted to complete work pertaining to the installation of Sarnafil membrane and flashings.

I. Verify the roof deck and roof construction is structurally sound to provide support for the new roof system.

J. The Manufacturer must provide interim and final roof inspection from a directly employed dedicated team of experienced inspectors. Sales personnel may not be used for on-site inspection of installations

K. All base flashings and penetrations must have a minimum 8-inch height above the finished roof assembly. Care must be taken to ensure this is possible when installing equipment pads and making allowances for associated crickets.

1.03 REGULATORY REQUIREMENTS

These requirements are minimum standards do no roofing work without written documentation of the system's compliance, as required in the "Submittals" section of this specification.

A. Field and Flashing membranes shall conform to ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type III Grade I.

B. Factory Mutual Research Corporation (FM) - Norwood, MA

Class 1-90

C. Underwriters Laboratories, Inc. - Northbrook, IL

Class A assembly

D. California Title 24 Part 6: Roof membrane (not post installation applied finish) must comply with current minimum 3-year aged solar reflectance and minimum thermal emittance values

1.04 PRE-INSTALLATION MEETING

A. Preinstallation Roofing Conference: Conduct conference at Project site.
   1. Meet with Owner's Representative, roofing Installer, and roofing system manufacturer's representative.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
   7. Review governing regulations and requirements for insurance and certificates if applicable.
   8. Review temporary protection requirements for roofing system during and after installation.
   9. Review roof observation and repair procedures after roofing installation.
   10. Review field testing procedures, as applicable, after roofing installation.

1.05 DELIVERY, STORAGE AND HANDLING

A. Accept only products delivered to the job site in the original unopened containers or wrappings bearing all seals and approvals.

B. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.

C. Store Membrane rolls lying down on pallets and fully protected from the weather with clean canvas tarpaulins. Unvented polyethylene tarpaulins are not accepted.

D. Store all adhesives at temperatures between 40º F and 80º F.

E. Store flammable materials in a cool dry area away from sparks and open flames. Follow precautions outlined on containers or supplied by material manufacturer/supplier.

F. Remove all damaged materials from the job site.

G. Load materials on the rooftop in such a manner to eliminate risk of deck overload due to concentrated weight.

1.06 PROJECT CONDITIONS

A. Schedule and execute all work without exposing the interior building areas to the effects of inclement weather.

B. Secure all new and temporary construction, including equipment and accessories, to preclude wind blow-off and roof or equipment damage.

C. Install uninterrupted waterstops at the end of each day's work. Completely remove before proceeding.

D. Prior to and during application, remove all excessive moisture, dirt, debris and dust.

E. Immediately take all existing and new roofing, insulation, flashings and metal work removed during construction to a legal dumping area authorized to receive such materials.

F. Verify that all roof drain lines are functioning correctly (not clogged or blocked) before starting work. Report any such blockages in writing to the Owner as appropriate for corrective action prior to the installation of the roof system.

G. Inspect the substrate for defects such as excessive surface roughness, contamination, structural inadequacy, or any other condition that will adversely affect the quality of work. Stop work if any contamination or unusual or concealed condition is discovered and immediately notify the Owner of such condition in writing for correction.

H. If any water is allowed to enter under the newly completed roofing, remove wet and damaged materials, provide new.

1.07 SEQUENCING

A. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. Provide a substantial protection layer consisting of plywood over Sarnafelt or plywood over insulation board for all roof areas that receive concentrated rooftop traffic during construction.

1.08 WARRANTY

Upon successful completion of work, the following warranties must be provided:

1. 20 Year Full System Warranty
2. 2 Year Roofing Contractor Warranty

B. Manufacturers System Warranty

Provide a “No Dollar Limit” non-prorated warranty that does not exclude ponding or standing water or contain time limits for standing water. No additional fees or roofing manufacturer inspections will be required to maintain the warranty. The System Warranty includes membrane, insulation, coverboard and attachment components of the roofing system provided by the Manufacturer.

C. Applicator/Roofing Contractor Warranty

Provide a separate workmanship warranty. In the event any work related to roofing, flashing, or metal is found to be within the Applicator warranty term, defective or otherwise not in accordance with the Contract Documents, the Applicator shall repair that defect at no cost to the Owner. The Applicator's warranty obligation shall run directly to the Owner and be copied to the Manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. PVC Thermoplastic Membrane Roofing: The components of the PVC membrane roof system are to be products by Sika Sarnafil Canton, Massachusetts as basis of design; local contact (562) 676-0459.

1. Sika Sarnafil S327 Minimum thickness 60mils.

B. Private label and third-party-manufactured membranes are not permitted.

C. Polymer Thickness

1. Membrane manufacturer is to certify that the polymer thickness is within 2 mils of the polymer thickness specified. Certification is to be signed by the membrane manufacturer’s quality control manager.

2. Compliance with ASTM +/- 10% tolerance for membrane thickness is not sufficient or acceptable.

2.02 MATERIALS

A. PVC fiberglass reinforced membrane with a lacquer coating.

B. Membrane shall conform to ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type III, Grade I.

1. Field Sheet –Sika Sarnafil S327-15, 60 mils minimum thickness.
2. Color: Reflective Gray to Meet CA Title 24 Criteria:

    a) Minimum 3-Year Solar Reflectance: 0.66
    b) Minimum 3-Year Thermal Emmitance: 0.88
    c) Minimum 3-Year Solar Reflectance Index: 0.80

3. Flashing Membranes – Sika Sarnafil G410 60mils thickness membrane with fiberglass reinforcement. Color to match field sheet.

C. Polymer Thickness

1. Membrane manufacturer is to confirm that the field sheet has the specified minimum polymer thickness with at least 27 mils above the reinforcement scrim. ASTM +/- tolerance for membrane thickness is not accepted.

2.03 INSULATION

A. Uniform Thickness Sarnatherm

Sarnatherm Rigid Polyisocyanurate Roof Insulation, ASTM C1289 Type II, Class 1 Grade 2 (20 psi)

Complies with UL 2818 and has Green Guard Gold certification. Gold Standard for Chemical Emissions for Building Materials.

Provide R30 (2 Layers 2.6”).

A. Sarnatherm tapered crickets.

B. Tapered rigid Polyisocyanurate foam with felt or glass fiber facer complying with ASTM C1289 Type II, Class 1 Grade 2 (20 PSI).
Crickets to provide ¼ inch per foot finish slope. Cricket valleys slope should be maximized but are not expected to achieve the major ¼ inch per foot slope.

2.04 COVER BOARD

A. Cover Board: 1/4 in. Dens Deck manufactured by Georgia-Pacific, 1/4 in. Fiberglass Mat Faced Gypsum Roof Board.

2.05 COMPONENTS

A. Sarnaclad PVC Laminated Metal

B. Sarnareglet - A heavy-duty, extruded aluminum flashing termination reglet used at walls and large curbs.

C. Universal PVC Prefabricated stack - A prefabricated vent pipe flashing made from 0.060-inch thickness PVC.

D. Prefabricated Corners - Prefabricated outside and inside flashing corners made of 0.060-inch-thick PVC.

2.06 ATTACHMENT COMPONENTS

A. Sarnafastener-XP

1. A specially designed, heavy-duty, corrosion-resistant fastener used to secure Sarnadisc-XPN and Sarnafil S327 roof membrane to roof decks. Acceptable substrates include 22-24 gauge steel and 1/2-5/8 plywood roof decks.

B. Sarnadisc-XPN
   1. A high strength linear plate used with a Sarnafastener to attach the roof membrane to steel, wood or concrete roof decks.

C. Sarnafastener #12
   1. A #12 corrosion-resistant fastener used with Sarnaplates to attach insulation boards to steel or wood roof decks.

D. Sarnaplate
   1. Used with various Sarnafasteners to attach insulation boards to roof deck. Sarnaplate is a 3 inch (75 mm) square or round, 26 gauge stamping of SAE 1010 steel with an AZ 55 Galvalume coating. Consult Product Data Sheet for additional information.

E. Flashing Adhesive
   1. A low VOC reactivating-type adhesive used to attach membrane to flashing substrate.
   2. Stabond U148A Adhesive.

F. Peelstop
   1. An extruded aluminum, low profile bar used with certain fasteners to attach to the roof deck or to walls/curbs at terminations, penetrations and at certain incline changes of the substrate.

G. Termination Reglet
   1. A heavy-duty, extruded aluminum flashing termination reglet used at walls and large curbs.

H. Miscellaneous Fasteners and Anchors
   1. Provide only post-galvanized steel, aluminum or stainless-steel fasteners. Take precautions to avoid galvanic corrosion from dissimilar metals.
   2. Install expansion type fasteners with stainless steel pins for the attachment of metal to masonry.
   3. The minimum embedment for miscellaneous fasteners and anchors is as follows:
      a. 1-1/4 inch at concrete.
      b. 1 inch at wood/steel.

2.07 SEALANTS

A. Multi-Purpose Sealant (for termination details). Sika 1A or approved equal.

B. Approved two-component urethane adhesive sealant.

C. Depending on substrates, the following sealants are options for temporary overnight tie-ins:

1. Spray-applied, water-resistant urethane foam.
2. Mechanical attachment with rigid bars and compressed sealant.

2.08 WALKWAY PROTECTION

D. Sarnatred V

Polyester reinforced, 0.096-inch, weldable membrane with surface embossment. Used as a protection layer. Sarnatred is supplied in rolls of 39.3 inches wide and 50 feet long.

2.09 MISCELLANEOUS FASTENERS AND ANCHORS

A. Provide only post-galvanized steel, aluminum or stainless-steel fasteners. Take precautions to avoid galvanic corrosion. Install expansion type fasteners with stainless steel pins for the attachment of metal to masonry. The minimum embedment for all concrete fasteners and anchors is 1¼ inch and for all miscellaneous wood fasteners and anchors used for flashings 1 inch.

PART 3 - EXECUTION

3.01 COVERBOARD INSTALLATION

A. Install coverboard according to insulation manufacturer's instructions and shop drawings.

B. Neatly cut coverboard to fit around penetrations and projections.

C. Install tapered insulation around drains creating a drain sump.

D. Cover all coverboard with Sarnafil membrane by the end of the day or before the onset of inclement weather.

E. Boards are to rest evenly on the roof deck avoiding air spaces between the boards and the substrate. Install each board tightly against the adjacent boards on all sides.

F. Mechanically fasten all insulation board layers simultaneously into the roof deck with approved fasteners and plates at a rate of 6 fasteners/board (8 feet x 4 feet).

3.02 INSTALLATION OF MEMBRANE

A. General:

1. Attach Sarnafil S327 membrane into the plywood deck with Sarnafasteners according to Sika Sarnafil and Factory Mutual’s requirements. Fasteners must penetrate the deck by a minimum of 1 inch.
2. Install Sarnafasteners and Sarnadiscs along the edge of the membrane on the fastening line at 6 inches on center spacing as determined by Sika Sarnafil. Clamp the S327 membrane tightly to the substrate.
3. Tack welding of S327 full or half-width rolls for purposes of temporary restraint during installation is not permitted.

B. Perimeter and Corner Areas

1. Install minimum 2 number S327 half-width rolls either parallel or perpendicular to the entire perimeter edge. The number of adjacent half-rolls will be determined by building height and width and other conditions according to FM guidelines and Sika Sarnafil Technical. In corner areas where perimeters half-rolls intersect, and where 10 feet wide rolls must be used provide additional rows of Sarnafasteners and Sarnadiscs and a welded coverstrip.

C. Interior Area

1. Install S327 full-width rolls.
2. Hot-air weld overlaps according to Sika Sarnafil's recommendations. Take seam test cuts at least 3 times per day.
3. Securement Around Rooftop Penetrations
4. Around all perimeters, at the base of walls, drains, curbs, vent pipes, or any other roof penetrations, install Sarnafasteners and Sarnadiscs according to perimeter rate of attachment.
5. Overlap Sarnafil membrane flashings minimum 2-1/4 inches past the Sarnadisc. Hot-air weld to the Sarnafil deck membrane.

3.03 HOT-AIR WELDING OF SEAM OVERLAPS

A. General

1. Hot air weld all seams in accordance with Manufacturer requirements.
2. Weld only clean and dry membrane.
3. Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
4. Test lap edges with probe (rounded screwdriver) to verify seam weld continuity.
5. Verify field strength of seams. Take a minimum of three, one-inch-wide, cross-section samples of welded seams daily. Repair seam sample areas.
6. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

3.04 MEMBRANE FLASHINGS

A. Install flashings concurrently with the roof membrane as the job progresses.

B. Adhere flashing materials to compatible surfaces only.

C. Apply adhesive in smooth, even coats with no gaps, globs or similar inconsistencies. Press the bonded sheet firmly in place with a hand roller. Do not apply adhesive in seam areas. Apply membrane panels uniformly.

D. The minimum flashing height is 8 inches above finished roofing level unless otherwise accepted in writing.

E. Mechanically fasten all flashing membranes along the counter-flashed top edge with Peelstop/Reglet or approved alternate at 6-8 inches on center.

F. Additionally, secure all adhered flashings that exceed 30 inches in height. Sheet metal backing is required behind gypsum sheathing to accommodate the required 12-inch

fastener spacing. Consult Manufacturers Technical Department for securement methods.

3.05 METAL FLASHINGS

A. Install airtight and continuous metal hook strips behind metal fascias. Fasten hook strips 12 inches on center into a wood nailer or masonry wall.

B. Overlap base flashings with counter flashings at least 4 inches.

C. Extend Hook strips past wood nailers over wall surfaces by 1-1/2 inch minimum and be securely sealed from air entry.

D. Space adjacent sheets of PVC coated metal 1/4 inch apart. Fasten the end joints of the metal 6 inches on center. Cover the joints with 1-inch-wide aluminum tape. Hot air weld a 4-inch-wide membrane flashing strip over the joint.

3.06 PVC CLAD FLASHINGS/EDGE METAL

A. Form and install PVC clad metal flashings as described in the Detail Drawings.

1. Fasten all metal flashings into approved substrates solid wood nailers with two rows of approved fasteners 4” on center staggered.

2. Install metal to provide adequate resistance to bending and allow for normal thermal expansion and contraction.

B. Space adjacent sheets of PVC clad metal 1/4 inch apart. Cover the joint with 2-inch-wide aluminum tape. Hot air weld a 4-inch minimum wide strip of Sarnafil flashing membrane over the joint.

3.07 WALKWAY INSTALLATION

A. Verify the lap welds to be covered are continuous and the membrane is clean and dry before installing walkway. Apply a continuous coat of adhesive to the deck sheet and the back of the walkway and press walkway into place with a water-filled, foam-covered lawn roller. Hot-air weld the overlaps and the perimeter

3.08 TEMPORARY CUT-OFF

Construct all temporary waterstops to provide a 100% watertight seal. Maintain the stagger of insulation joints by installing partial panels of insulation. Carry the new membrane into the waterstop. Seal the waterstop to the deck and/or substrate so that water will not be allowed to travel under the new or existing roofing. Seal the edge of the membrane in a continuous heavy application of sealant. Cut out all contaminated membrane before resuming work.

3.09 FIELD QUALITY CONTROL

A. Quality Control of Welded Seams - Check all welded seams for continuity using a rounded screwdriver. Visible evidence that welding is proceeding correctly is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of dark grey material from the underside of the top membrane.

B. On-site evaluation of welded seams shall be made daily at locations as directed by the Owner's Representative or Manufacturer's representative. Take one inch wide cross-section samples of welded seams at least three times a day. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each test cut shall be patched by the Applicator at no extra cost to the Owner.

C. Install the new roof system in such a manner as to maintain watertight integrity on a daily basis. If water is allowed under the completed roof remove the roofing and dispose of all wet and damaged insulation and coverboards. Provide and reinstate new dry roofing materials once the roof deck has been allowed to dry.

D. Interim and Final Inspections - Upon completion of the installation and the delivery to Manufacturer by the Applicator of a certification that all work has been done in strict accordance with the contract specifications and Manufacturer's requirements, a warranty inspection shall be made by the manufacturers Specialist Technical Representative no personnel with a sales role/function within the company shall be permitted to inspect contractors work. Water test all drains to confirm they are functioning properly after roofing work is completed. Correct any blockages and restore drain operation

3.10 COMPLETION

Correct all punch-list items to the satisfaction of the Owner's Representative and Manufacturer prior to demobilization.

3.11 DEMONSTRATION

A. Provide maintenance documents and personal instruction for the facilities staff and other interested parties at a single pre-determined mutually convenient time. The instruction shall include the following topics:

- Access restriction and precautions
- Avoiding Mechanical Damage
- Potential Contaminants and rectification
- Cleaning
- Emergency repairs
- Procedures for permanent repairs and alterations

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sheet metal flashing and trim not specifically specified in other sections.

B. Related Sections:
   1. Division 9 Section “Painting” for painting of sheet metal flashing and trim.

1.2 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
   1. Identification of material, thickness, weight, and finish for each item and location in Project.
   2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
   3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   4. Details of termination points and assemblies, including fixed points.
   5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
   6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   7. Details of special conditions.
   8. Details of connections to adjoining work.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sheet metal flashing and trim that fails in materials or workmanship within specified warranty period.
   1. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Galvanized Sheet Metal Flashing and Trim:
   1. Fry Reglet Corporation.
   2. Hickman, W. P. Company.
   3. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
   4. Or equal.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
      c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   2. Obtain field measurements for accurate fit before shop fabrication.
   3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
   4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.

G. Flashing corners shall be shop fabricated and fully soldered such that corner assemblies are single monolithic units for 18" in all directions from corners.

3.3 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 076500 - FLEXIBLE SHEET FLASHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Flexible sheet flashing for windows, doors, parapets, and other openings and where indicated on Drawings.

1.2 SUBMITTALS

A. Concurrent Review Requirements: Submit submittals of this section with doors and windows sections.

B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of flexible sheet flashing.

C. Shop Drawings: Show locations and extent of flexible sheet flashing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

D. Samples: For the following products:
   1. 12-by-12-inch square of flexible sheet flashing.

E. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

F. Qualification Data: For Installer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for flexible sheet flashing.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is acceptable to flexible sheet flashing manufacturer for installation of flexible sheet flashing required for this Project.

B. Source Limitations: Obtain flexible sheet flashing materials through one source from a single manufacturer.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup with doors and windows.

D. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to flexible sheet flashing including, but not limited to, the following:

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the flashing to be coordinated with the finishing of doors and windows.
3. Review, discuss, and coordinate the interrelationship of flexible flashing with other exterior wall components. Include provisions for sealants and fasteners.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by flexible sheet flashing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of flexible sheet flashing that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Flexible Sheet Flashing: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. VaproShield. (Basis of Design)
   2. WR Grace.
   3. FortiFlash by Fortifiber.
   4. FlexWrap and StraightFlash by DuPont.
   5. Or equal.

2.2 FLEXIBLE SHEET FLASHING

A. Product: RevealShield SA Self-Adhered Water-Resistive Vapor Permeable Air Barrier Sheet as by VaproShield or equal.
   1. Water-Resistive Vapor Permeable Self-Adhered Air Barrier Materials.
   2. A zero VOC fully self-adhered vapor permeable air barrier sheet membrane consisting of coated spun-bonded polyethylene with vapor-permeable adhesive. Provide sheet membrane tested in accordance with ICC-ES AC 38 criteria to meet IBC and IRC requirements for weather resistive barriers having the following properties:
   3. Color: Black with allowable UV exposure for 12 months, prior to coverage.
   4. Dry Tensile strength and Elongation to ASTM D828: 37.7 lbf, machine direction; 21.3 lbf, cross-machine direction.
   5. Dry Breaking strength and Elongation to ASTM D5034: 119 lbf, machine direction; 96 lbf, cross-machine direction.
   6. Water Vapor Permeance tested to ASTM E96 desiccant method, procedure A: minimum of 28.058 perms.
   7. Water Vapor Permeance tested to ASTM E96 water method, procedure B: minimum of 63.481 perms.
   8. Water Vapor Permeance tested to ASTM E398: minimum of 65.53 perms.
   9. Air Leakage: ≤0.00002 cfm/ft2 @ 1.57 psf when tested in accordance with ASTM E2178 and <0.01 cfm/ft2 @ 1.57 psf when tested in accordance with ASTM E2357. Meets Air Barrier Association of America (ABAA) requirements.
   10. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage
   11. Application Temperature: Ambient temperature must be above 20 °F.
   12. Surface Burning Characteristics tested to ASTM E84: Class A, Flame-Spread index of less than 0, Smoke-Developed index of less than 75.
   13. Physical Dimensions: RevealShield SA: 19 mil thick, 59 inches wide, 102 feet. 380.67 g/m2 membrane weight.
   14. Water-Resistive Vapor Permeable Transition and Flashing Membrane
   15. Provide self-adhered air barrier transition and flashing membrane for all window jambs, headers, door openings, inside and outside corners, and other transitions. Provide pre-cut RevealFlashing SA by VaproShield. RevealFlashing SA is a zero VOC fully self-adhered water-resistive vapor permeable sheet membrane having the following properties:
   16. Same material and properties as RevealShield SA Self-Adhered Water-Resistive Vapor Permeable Air Barrier Sheet, factory slit to flashing sizes.
   17. Physical Dimensions: RevealFlashing SA Black: 113/4 inches wide x 164 feet long.

2.3 AUXILIARY MATERIALS

A. Mastic, Joint Sealant, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by flexible sheet flashing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by flexible sheet flashing manufacturer.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install flexible sheet flashing in accordance with the manufacturer's written instructions, AAMA Publication 2400, and the applicable code.

END OF SECTION 076500

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Roof hatches.

B. Related Sections include the following:
   1. Division 9 Section “Painting” for field finishes.

1.2 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

C. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of roof accessories that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Roof Hatches: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Bilco Company (The). (Basis of Design)
   2. Milcor Inc.; a Gibraltar Company.
   3. Nystrom, Inc.
   4. O'Keeffe's Inc.
   5. ThyCurb; Div of Thybar Corporation.
   6. Or equal.

2.2 METAL MATERIALS

A. Galvanized Steel Sheet: ASTM A 653, G90 coated and mill phosphatized for field painting.
   1. Comply with Division 9 Section “Painting” for field finishes.

2.3 MISCELLANEOUS MATERIALS

A. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.

B. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

C. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

D. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
   1. Caulking and sealants applied on the interior of the building envelope shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

2.4 ROOF HATCHES

A. General: Fabricate roof hatches with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

B. Product: Type S or E depending on size by Bilco.
   1. Size: As indicated on Drawings but minimum 30 by 37 inches.
   2. Type: Galvanized 14 gauge paint bond G-90 galvanized steel single (S) or double-leaf (E) lid as indicated on Drawings.
   3. Cover:
      a. 3 inch beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
      b. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
      c. Operation of the cover shall not be affected by temperature.
      d. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.
   4. Cover insulation: Shall be fiberglass of 1 inch thickness, fully covered and protected by a metal liner 22 gauge paint bond G-90 galvanized steel.
   5. Curb: 12 inch in height with integral capflashing, 1 inch fiberboard insulation, fully welded at corners, and 3-1/2 inch mounting flange with 7/16 inch holes provided for securing frame to the roof deck.
   6. Curb insulation: Shall be rigid, high-density fiberboard of 1 inch thickness on outside of curb.
   7. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.
   8. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation. Bil-Guard Hatch Rail System or equal.
   9. Factory Prime Finish:
      a. Steel: Alkyd base red oxide primer.
   10. Field Finish: Comply with Division 9 Section ”Painting”.
   11. Hardware
      a. Heavy pintle hinges shall be provided
      b. Cover shall be equipped with a spring latch with interior and exterior turn handles
      c. Roof hatch shall be equipped with interior and exterior padlock hasps.
      d. The latch strike shall be a stamped component bolted to the curb assembly.
      e. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1” diameter red vinyl grip handle to permit easy release for closing.
      f. Compression spring tubes shall be Type 316 stainless steel hardware.

g. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

2.5 FINISH

A. Galvanized Steel: Field finish per Division 9 Section “Painting”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
   2. Verify dimensions of roof openings for roof accessories.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
   2. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Roof Hatch Installation:
   1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
   2. Attach ladder safety post according to manufacturer's written instructions.

3.3 TOUCH UP

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, whether indicated on drawings or not, and other openings indicated.

B. Related Sections include the following:
   1. Division 7 Section "Fire-Resistive Joint Systems."
   2. Division 7 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.2 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
   1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.
   2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
   1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
   2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
      a. Penetrations located outside wall cavities.
      b. Penetrations located outside fire-resistance-rated shaft enclosures.
   3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
   1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
   1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
   2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
      a. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
         1) UL in its "Fire Resistance Directory."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of through-penetration firestop system that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Through-Penetration Firestop Systems: Subject to compliance with requirements, provide one of the through-penetration firestop systems for each application that are produced by one of the following manufacturers.
   1. Hilti, Inc.
   2. Specified Technologies Inc.
   3. 3M; Fire Protection Products Division.
   4. Or equal.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-/rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.

3. Substrate primers.
4. Collars.
5. Steel sleeves.

C. Caulking, sealants, and adhesives applied on the interior of the building envelope shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a

nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
   1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Through-penetration firestop system designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Through-penetration firestop system manufacturer's name.
   6. Installer's name.

B. Marking and Identification: Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:
   1. Be located in accessible concealed floor, floor-ceiling or attic spaces.
   2. Be repeated at intervals not exceeding 30 feet measured horizontally along the wall or partitions.
   3. Include lettering not less than 0.5 inch in height, incorporating the suggest wording: “fire and/or smoke barrier – protect all openings,” or other wording.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM LOCATION

A. Provide assemblies as indicated on Drawings. Provide following products for additional locations not identified on Drawings.

B. For penetrations by non combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following materials are acceptable:
   1. Hilti FS 601 Elastomeric Firestop Sealant.
   2. Hilti FS ONE High Performance Intumescent Firestop Sealant.
   3. 3M Fire Stop Sealant 2000 4. 3M Fire Barrier CP25 WB.
   4. Tremco Tremstop Fyre Sil Sealant.
   5. Or equal.

C. For penetrations by combustible items (penetrants consumed by high heat flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe (closed piping systems) the following materials are acceptable:
   1. Hilti FS ONE High Performance Intumescent Firestop Sealant.
   2. Hilti CP 618 Firestop Putty.
   3. Hilti CP 642 Firestop Jacket.
   4. Hilti CP 643 Firestop Jacket.
   5. 3M Fire Barrier CP25 WB.
   6. 3M Fire Barrier FS 195 Wrap/Strip.
   7. Tremco Tremstop WBM Intumescent Firestop Sealant.
   8. Or equal.

D. For penetrations by combustible plastic pipe (open piping systems), the following materials are acceptable:
   1. Hilti CP 642 Firestop Jacket.
   2. Hilti CP 643 Firestop Jacket.
   3. Hilti FS ONE High Performance Intumescent Firestop Sealant.
   4. 3M Fire Barrier PPO Plastic Pipe Device.
   5. Or equal.

E. For large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways' the following materials are acceptable:
   1. Hilti FS 635 Trowelable Firestop Compound.
   2. Hilti FIRE BLOCK.
   3. 3M Firestop Foam 2001.
   4. 3M Fire Barrier CS 195 Composite Sheet.
   5. Or equal.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes fire-resistive joint systems for interruptions to fire rated assemblies, whether indicated on drawings or not, and other openings indicated.

B. Related Sections include the following:
   1. Division 7 Section "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.
   2. Division 7 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities and L-ratings indicated as determined by UL 2079.
   1. Load-bearing capabilities as determined by evaluation during the time of test.

C. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.
   1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Evaluation Reports: Evidence of fire-resistive joint systems' compliance with ICBO ES AC30, from the ICBO Evaluation Service.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
   1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
   2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:
      a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
      b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of authorities having jurisdiction have examined each installation.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fire-resistive joint systems that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fire-Resistive Joint Systems: Subject to compliance with requirements, provide one of the through-penetration firestop systems for each application that are produced by one of the following manufacturers.
   1. Hilti, Inc.
   2. Specified Technologies Inc.
   3. 3M; Fire Protection Products Division.
   4. Or equal.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
   1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
   2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
   2. Apply fill materials so they contact and adhere to substrates formed by joints.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Engage a qualified independent inspecting agency to inspect fire-resistive joint systems and prepare inspection reports.

B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.
   1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.6 FIRE-RESISTIVE JOINT SYSTEM LOCATION

A. For fire rated construction joints and other gaps, the following materials are acceptable:
   1. FS 601 Elastomeric Firestop Sealant by Hilti.
   2. CP 601 s Elastomeric Firestop Sealant by Hilti.
   3. CP 606 Flexible Firestop Sealant by Hilti.
   4. CP 672 Firestop Joint Spray by Hilti.
   5. Firestop Sealant 2000 by 3M.
   6. Tremstop Fyre Sil Sealant by Tremco.
   7. Or equal.

B. For openings between structurally separate sections of wall and floors. Top of walls, the following materials along with Thermafiber Safing are acceptable:
   1. FS 60t Elastomeric Firestop Sealant by Hilti.
   2. CP 601s Elastomeric Firestop Sealant by Hilti.
   3. CP 606 Flexible Firestop Sealant. by Hilti

4. FS ONE High Performance Intumescent Firestop Sealant by Hilti.
5. Fire Barrier CP 25 WB by 3M.
6. Or equal.

C. Firestopping at Electrical Boxes and Utility Outlets.
1. CP 618 Firestop Putty Stick by Hilti.
2. CP 617 and CP 617L Firestop Putty Pad by Hilti.
3. Or equal.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants.

B. Related Sections include the following:
   1. Division 7 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
   2. Division 7 Section "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.

1.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

E. Qualification Data: For Installer.

F. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

G. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

H. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

D. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 2 years.

B. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
   1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

C. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 2 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Joint Sealants: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Sika Corporation
   2. Pecora Corporation.
   3. Bostik.
   4. Dow Corning Corp.
   5. GE Plastics.
   6. Sonneborn Building Products, ChemRex, Inc.
   7. Tremco, Inc.
   8. The Sherwin-Williams Company.
   9. Or equal.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants:
   1. As selected by Owner’s Representative from manufacturer's full range.
   2. Areas where concrete joint sealant will be adjacent to concrete other than standard gray, sealant color shall match adjacent color as approved by Owner’s Representative.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
   3. Remove laitance and form-release agents from concrete.
      a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
   4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
   5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

I. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
   1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
   2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
   3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
   4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

J. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT LOCATION

A. General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single component.
   1. Products:
      a. SikaFlex 1A or 15LM by Sika Corp.
      b. Dynatrol I-XL by Pecora.
      c. Stampede 1 by The Sherwin-Williams Company.
   2. Color: Standard colors matching finished surfaces.
   3. Applications:
      a. Control, expansion, and soft joints in masonry.
      b. Joints between concrete and other materials.
      c. Joints between metal frames and other materials.
      d. Other exterior joints for which no other sealant is indicated.

B. Exterior Metal Lap Joint Sealant: Silicone, Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
   1. Products:
      a. SikaSil WS-295 Silicone by Sika Corp.
      b. 895 Silicone or Sil-Span by Pecora.
   2. Color: Standard colors matching finished surfaces.
   3. Applications:
      a. Concealed sealant bead in sheet metal work.
      b. Concealed sealant bead in siding overlaps.

C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP, Grade NF single component, paintable.
   1. Products:

a. AC-20 manufactured by Pecora.
b. 950A manufactured by The Sherwin-Williams Company.
2. Color: Standard colors matching finished surfaces.
3. Applications:
a. Interior wall and ceiling control joints.
b. Joints between door and window frames and wall surfaces.
c. Other interior joints for which no other type of sealant is indicated.

D. Interior Floor Joint Sealant: Polyurethane, chemically-curing, cold-applied, self-leveling elastomeric sealant; ASTM C 920, Grade P, Class 25, Uses T, M and A; two-part.
1. Products:
a. SikaFlex 2C SL or NS with TG Additive by Sika Corp.
b. NR-200 self-leveling polyurethane and/or DYNATRED non-sag, traffic-grade polyurethane sealants by Pecora.
c. Stampede 2SL by The Sherwin-Williams Company.
2. Primer: SikaFlex 429 Primer; P-150, P-75 or P-200.
3. Color: Standard colors matching finished surfaces.
4. Applications: Use for joints up to 1-1/2 inches.
a. Expansion joints in floors.

E. Concrete Paving Joint Sealant: Polyurethane, chemically-curing, cold-applied, self-leveling elastomeric sealant; ASTM C 920, Class 25, Uses T, I, M and A; two-part.
1. Products:
a. NR-200 Urexpan and/or DYNATRED non-sag, traffic-grade polyurethane sealant by Pecora or equal.
b. Stampede 2NS by The Sherwin-Williams Company.
2. Primer: SikaFlex 429 Primer; P-150, P-75 or P-200.
3. Color: Gray or Limestone.
4. Applications:
a. Joints in sidewalks and vehicular paving.

F. Butyl Sealant: ASTM C 920, Grade NS, Class 12-1/2, Uses NT, M, A, G, O; single component, solvent release, non-skinning, non-sagging.
1. Products:
a. BC-158 sealant by Pecora.
b. WL Silicone Rubber by The Sherwin-Williams Company.
2. Color: Standard colors matching finished surfaces.
3. Movement Capability: Plus and minus 12-1/2 percent.
4. Service Temperature Range: -13 to 180 degrees F.
5. Shore A Hardness Range: 10 to 30.

G. Silicone Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, A, G, M, O; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.
1. Products:
a. SikaSil WS 290 or WS 295 by Sika Corp.
b. 864 LM Architectural silicone or 890 silicone sealant by Pecora.
c. 790 by Dow Corning Corporation.
d. WL Silicone Ultra WL09210.
2. Color: Standard colors matching finished surfaces.
3. Movement Capability: Plus and minus 25 percent.
4. Applications:

a. Interior or exterior for joints 1/8 to 1-1/2 inch wide.
b. Exterior use at expansion joints in masonry where substantial movement is expected.
c. Glazing application.

END OF SECTION 079200

SECTION 081113 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Standard hollow metal doors and frames.

B. Related Sections include the following:
   1. Division 8 Section “Door Hardware” for door hardware for hollow metal doors.
   2. Division 9 Section “Painting” for field painting hollow metal doors and frames.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, and finishes.

B. Other Action Submittals:
   1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference designation for details and openings as those on Drawings. Coordinate with door hardware schedule.
      a. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
      b. Indicated specific model number of door and frame.
      c. Indicate steel sheet type (galvanized, non-galvanized, etc.)
      d. Indicate door and frame type (A, A1, B, C, etc.)
      e. Indicated hardware group.
      f. Indicate dimensions and locations of mortises and holes for hardware.
      g. Indicate dimensions and locations of cutouts.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with CBC 716.5 Opening Protection Ratings and Markings and NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL-10C.

1. Temperature-Rise Limit: Where required, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure per CBC Section 716.5.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with CBC 716.5 Opening Protection Ratings and Marking sand NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to CBC Section 716.6 Fire-Protection-Rated Glazing. Label each individual glazed lite.

D. Smoke-Control Door Assemblies: Comply with CBC Section 716.5.5.1 Glazing in Exit Enclosure and Exit Passageway Doors.

E. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.
1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel doors and frames that fails in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2 years.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Doors and Frames: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Anemostat. (Basis of Design)
2. Steelcraft; an Ingersoll-Rand company.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Or equal.

2.2 MATERIALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications for interior doors and frames.

C. Galvannealed (Metallic-Coated) Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B; with minimum A60 metallic coating for exterior doors and frames.

D. Frame Anchors: ASTM A 591, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143.

H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
   1. Design: Flush panel.
   2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
      a. Fire Door Core: As required to provide fire-protection indicated.
      b. Standard Core: Honeycomb, U-factor of 0.69, R-value of 1.45.
   3. Vertical Edges for Single-Acting Doors: Beveled edge.
      a. Beveled Edge: 1/8 inch in 2 inches.
   4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
   5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
   6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
   7. Vision, Narrow Lite, Half Glass Doors: Size as indicated on Drawings.

B. Exterior Doors: Face sheets fabricated from galvannealed (metallic-coated) steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush):
      a. Face thickness: 16 gage (0.053 inch).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless galvanized (metallic-coated) sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush):
      a. Face thickness: 18 gage (0.042 inch).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.
   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Frame: 16 gage (0.053-inch) thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet.
   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded. Knocked down is not allowed.
   3. Frame: 16 gage (0.053-inch) thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.7 ACCESSORIES

A. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.

B. Provide Screw-In Top Cap for exterior doors.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances:

1. Standard doors and frames: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:
   1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
   2. Glazed Lites: Factory cut openings in doors.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   2. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
   3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
   5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
   6. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
         1) Two anchors per jamb up to 60 inches high.
         2) Three anchors per jamb from 60 to 90 inches high.
         3) Four anchors per jamb from 90 to 120 inches high.
         4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
      b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
         1) Three anchors per jamb up to 60 inches high.
         2) Four anchors per jamb from 60 to 90 inches high.
         3) Five anchors per jamb from 90 to 96 inches high.
         4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
         5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
      c. Compression Type: Not less than two anchors in each jamb.
      d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
   7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
      a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
      b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
   1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
   2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
   1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   4. Provide loose stops and moldings on inside of hollow metal work.
   5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

H. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
   1. Maximum Rate: 0.3 cfm/sq. ft. of area at an inward test pressure of 1.57 lbf/sq. ft.
   2. Maximum Rate: 0.1 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq. ft.

2.9 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

B. Field-Applied Paint Finish: Comply with Division 9 Section “Painting”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-protection-rated openings, install frames according to CBC 716 and NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable glazing stops located on secure side of opening.
      d. Install door silencers in frames before grouting.
      e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
      a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
4. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
8. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

D. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081116 FIRE-RATED ALUMINUM FULL VISION DOORS AND FRAMES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire-rated aluminum full vision Aluflam door system including pre-finished door, frame, glazing, and hardware.

1.02 RELATED SECTIONS

A. Section 087100 Door Hardware.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
   2. ASTM E2074 Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.

B. National Fire Protection Association (NFPA):
   1. NFPA 80: Standard for Fire Doors and Fire Windows.
   2. NFPA 251: Standard Methods of Tests of Fire Endurance of Building Construction and Materials.
   3. NFPA 252: Standard Methods of Fire Tests of Door Assemblies.

C. Uniform Building Code (UBC):
   1. UBC-7-2: Methods for Fire Tests of Door Assemblies.

D. Underwriters Laboratories, Inc. (UL):
   1. UL 10C: Positive Pressure Fire Tests of Door Assemblies.

E. Standard Council of Canada:
   1. ULC Standard CAN4-S104: Fire Tests of Door Assemblies.

F. American National Standards Institute (ANSI):
   1. ANSI Z97.1 Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.

G. Consumer Product Safety Commission (CPSC):
   1. CPSC 16 CFR 1201 Categories I and II: Safety Standard for Glazing Materials.

1.04 SYSTEM DESCRIPTION

A. Performance Requirements:

   1. Fire Rating: 45 minutes.
   2. Certification: Doors and frames shall be tested in accordance with ASTM E 2074, NFPA 252, UBC 7-2, UL 10C, CAN4-S104.

3. Testing Laboratory: Fire tests shall be conducted by an approved independent testing laboratory, similar to Underwriter's Laboratories, Inc.

1.05 SUBMITTALS

A. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedure Section.
   1. Shop Drawings: Submit shop drawings showing layouts, profiles and product components.
   2. Samples: Submit samples for finishes, colors and textures.
   3. Technical Information: Submit latest edition of manufacturer's product data providing product description, technical data and installation instructions.

1.06 QUALITY ASSURANCE

A. Listings and Labels:
   Fire rated framing and glazing shall be under current follow-up services by an approved independent agency and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.

1.07 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials to specified destination in manufacturer's packaging undamaged, complete with installation instructions.

C. Storage and Protection: Store off ground, under cover, protected from weather, direct sunlight, construction activities and at temperature conditions recommended by manufacturer, +10°F to +110°F.

D. Handling: Protect materials and finish during handling and installation to prevent damage.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART 2 - PRODUCTS

2.01 FIRE-RATED ALUMINUM FULL VISION DOORS AND FRAMES

A. Manufacturer: Aluflam North America
   1. Contact: 16604 Edwards Road, Cerritos, CA 90703: Telephone 562.926.9520 Fax 562.404.1394. E-mail info@aluflam-usa.com Website www.aluflam-usa.com, or local representative (www.aluflam-usa.com/contact/representatives.php).
   2. Fireglass.
   3. SaftiFirst.
   4. Or equal.

2.02 MATERIALS – ALUMINUM FRAMING

A. Frame construction: Integral structure and glazing stops from extruded and thermally broken aluminum profiles. Filled internally with cement composite material.

B. Dimensions:
   1. Door framing face dimension: 2-½ inch
   2. Depth of door framing: 3-7/16 inch (3-5/8 for 90 Min Door)
   3. Door stile face dimension: 3-9/16 inch (3-3/4 for (90 Min Door)
   4. Door cross rail (if applicable): 3-9/16 inch (N/A for 90 Min Door)

C. Assembly: Frame corners assembled by means of crimped and bonded miter joints.

D. Sealing: Framing system shall insulate against effects of fire, smoke, and heat transfer from either side. Perimeter of the framing system to the rough opening shall be firmly packed with mineral wool insulation.

2.03 MATERIALS – FIRE RESISTANT GLAZING

A. Assemblies shall be glazed 45 minute rated ¾ inch thick SGG Contraflam 45 fire resistant glazing material as manufactured by Vetrotech Saint-Gobain (www.vetrotechusa.com).
   1. Individual lites shall be permanently identified with a listing mark.
   2. Glazing material installed in “Hazardous Locations” (subject to human impact) shall be certified to meet the applicable requirements for fire rated assemblies referenced in ANSI Z97.1 Standard for Safety Glazing Materials Used In Buildings and/or CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials.
   3. Visible daylight transmission shall be a minimum of 81%. Glazing material shall be optically clear, colorless and free from unusual distortion.

B. Fire-rated glazing shall be insulated with ¼” airgap (½” airgap for 20 or 45 min glazing) and ¼” low-E coated outboard glass lite. Installation conditions shall be analyzed to assure that fire-rated glazing is not exposed to temperatures outside the 10 – 110 degrees F limits.

2.04 MATERIALS – GLAZING AND ASSEMBLY ACCESSORIES

A. Fasteners: All fasteners, setting pads, and glazing clips, shall be stainless or zinc-plated steel.

B. Glazing Accessories: The glazing material perimeter shall be separated from the perimeter framing system with approved flame retardant intumescent glazing tape. Ceramic setting blocks shall be placed between the metal setting pads and the glazing material. Setting pads and blocks provided by manufacturer.

2.05 FABRICATION

A. Door frames and door leaves shall be furnished pre-assembled. Door assemblies shall be field glazed.

B. Door assemblies shall be factory prepared for field mounting of hardware.

C. Fabrication Dimensions: Fabricate to approved dimensions. The general contractor shall guarantee dimensions within required tolerance (+ - 1/8”). Obtain approved shop drawings prior to

fabrication.

2.06 FINISHES

A. Framing shall be chemically cleaned and pretreated, then finished on all exposed areas with: Anodized – Dark Bronze

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Slight variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

2.07 DOOR HARDWARE

A. Hardware shall be supplied from door manufacturer's standard recommended hardware groups as specified.

[D. Operating hardware for active/active pairs of doors. Each to have the following:

Quantity	Description	Manufacturer/Model	Finish
2	Surface applied door closers	Dorma TS93 series	Aluminum
6	Surface applied hinges (Qty 8 for 90 Min Doors)	Dr Hahn A901/951 series	Aluminum
2	Vertical rod exit devices (top rod only for 60 min and lower rated, 90 min - top & bottom rods)	Dorma 9800 series	Stainless
2	*) 10" bottom kickplate	Aluflam	Match door finish
2	*) Automatic floor seal	Planet MF	Aluminum

Balance of hardware by others]

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine area to receive doors. Openings shall be plumb, square and within allowable tolerances. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Door installation shall be by a specialty contractor with appropriate experience qualifications; and in strict accordance with the approved shop drawings.

3.03 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Glass and frame should be cleaned using soft clean cloth, chamois leathers, sponges or soft paper. Use clean warm water with a mild detergent. Do not use detergent that contains either alkaline, acids or

fluoride! Abrasive cleaning methods can damage surfaces! Clean prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Access doors and frames for walls and ceilings.

B. Related Sections include the following:
   1. Division 9 Section “Painting” for field applied finishes.

1.2 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.

B. Size Variations: Obtain Owner’s Representative’s acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.4 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of access doors and frames that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:

a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 3 years.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Access Doors and Frames: Subject to compliance with requirements, provide products by one of the following:
1. Acudor.
2. Milcor Inc.
3. Nystrom, Inc.
4. Karp Associates Inc.
5. MIFAB.
6. Or equal.

2.2 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.
1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153, for galvanizing steel and iron hardware.

B. Steel Sheet: Cold-rolled steel sheet substrate complying with ASTM A 1008, Commercial Steel (CS), exposed.

C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Factory Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Field Finish: Factory prime for field painting as specified in Division 9 "Painting".

D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Recessed Door to Receive Drywall Type:
1. Fire-Rated: Model 450FR by Karp.
2. Non-Fire-Rated: Model RDW by Karp.
a. Stainless steel in wet areas.
b. 14 gage steel frame and shall be 16 gage steel doors in other areas.
3. Door shall be recessed 1 inch.

4. Trim shall be galvanized steel dry wall bead.
5. Hinge shall be concealed pivoting rod type.
6. Locks shall be flush and screwdriver operated with stainless steel cam and studs, or shall be key operated cylinder lock with automatic dust shutter.
7. Finish shall be prime coat of rust inhibitive electrostatic powder, baked grey coat.
8. Door Sizes:As indicated on Drawings.
9. Field Finish: Comply with Division 9 Section “Painting”.

B. Flange Type:
1. Fire-Rated: Model KRP-250 by Karp.
2. Non-Fire-Rated: Model DSC-214M by Karp.
   a. Stainless steel in wet areas.
   b. 14 gage steel frame and shall be 16 gage steel doors in other areas.
3. Flange: One-piece construction, 3/4 inch wide.
4. Hinge shall be concealed continuous piano hinge.
5. Locks shall be flush and screwdriver operated with stainless steel cam and studs, or shall be key operated cylinder lock with automatic dust shutter.
6. Finish shall be prime coat of rust inhibitive electrostatic powder, baked grey coat.
7. Door Sizes:As indicated on Drawings.
8. Field Finish: Comply with Division 9 Section “Painting”.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.5 FINISHES

A. Field finish per Division 9 Section “Painting”.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes overhead coiling doors.

B. Related Sections include the following:
   1. Division 5 Section "Metal Fabrications" for miscellaneous steel supports.
   2. Division 8 Section "Door Hardware" for lock cylinders and keying.
   3. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.2 SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
   1. Summary of forces and loads on walls and jambs.

B. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's product data.

C. Samples for Verification: Of each type of exposed finish required, prepared on Samples of size indicated below.
   1. Curtain Slats: 12 inches long.
   2. Bottom Bar: 6 inches long.
   3. Guides: 6 inches long.
   4. Brackets: 6 inches square.
   5. Hood: 6 inches square.

D. Qualification Data: For Installer.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.
   1. Obtain operators and controls from overhead coiling door manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

1.4 WARRANTY

A. Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.

B. Warranty: Manufacturer's limited door warranty for 2 years for all parts and components.

C. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Overhead Coiling Doors: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Overhead Door Corp. (Basis of Design)
   2. Cornell Iron Works Inc.
   3. Cookson Company.
   4. CHI.
   5. Or equal.

2.2 OVERHEAD COILING DOORS

A. Product: Light Commercial Doors, Model 600 Coil-Away Rolling Service Doors by Overhead or equal.
   1. Curtain: Interlocking roll-formed galvanized steel slats, flat crown profile type CAW, 26 gauge for widths up to 12 feet 4 inches, 24 gauge for widths up to 16 feet . End of each slat shall be locked from lateral movement by a staking lock system. (Galvanized alternate malleable end locks.)
   2. Finish:
      a. Curtain slats and hood shall be galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.
         1) Powder Coat: PowderGuard Premium: Powder coat color as selected by the Architect.
   3. Weatherseals: Vinyl bottom seal.
   4. Bottom Bar: Extruded aluminum.
   5. Guides: Roll-formed galvanized steel shapes attached to continuous galvanized steel wall angle.
      a. Finish: PowderGuard Premium powder coat, color as selected by Architect.
   6. Brackets: Galvanized steel to support counterbalance and curtain.
      a. Finish: PowderGuard Premium powder coat, color as selected by Architect.
   7. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel and supporting the curtain with deflection limited to 0.03 inch per foot of span. Spring tension shall be adjustable.
   8. Hood: 24 gauge galvanized steel with intermediate supports as required.
   9. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.

a. Sensing Edge Protection:
   1) Electric sensing edge.
b. Operator Controls:
   1) Key operation with open, close, and stop controls.
   2) Controls for both interior and exterior location.
   3) Controls surface mounted.
c. Motor Voltage: 115/230 single phase, 60 Hz.

10. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
11. Locking:
    a. Cylinder lock for electric operation.
12. Wall Mounting Condition: Face-of-wall.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

A. General: Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports.

B. Follow manufacturer's installation instructions.

3.3 ADJUSTING

A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

3.4 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

3.5 DEMONSTRATION

A. Demonstrate proper operation to Owner.

B. Instruct Owner in maintenance procedures.

END OF SECTION 083323

SECTION 083613 – SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Sectional doors.

B. Related Sections include the following:
   1. Division 5 Section "Metal Fabrications" for miscellaneous steel supports.

1.2 SUBMITTALS

A. Product Data: For each type and size of door and accessory.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.

B. Protect materials from exposure to moisture until ready for installation.

C. Store materials in a dry, ventilated weathertight location.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.5 WARRANTY

A. Limited lifetime against splitting and cracking, 5 year against delamination of polyurethane foam from steel face and all other components for 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sectional Doors: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Overhead Door Corp. (Basis of Design).
   2. CHI.
   3. Cornell Iron Works Inc.
   4. Cookson Company
   5. Or equal.

2.2 GLAZED ALUMINUM SECTIONAL OVERHEAD DOORS

A. Product: 521 Series Aluminum Doors by Overhead Door Corporation or equal.
   1. Door Assembly: Stile and rail assembly secured with 1/4 inch diameter through rods.
      a. Panel Thickness: 1-3/4 inches.
      b. Center Stile Width: 2-11/16 inches.
      c. End Stile Width: 3-5/16 inches.
      d. Intermediate Rail Pair Width: 3-11/16 inches.
      e. Top Rail Width: 2-3/8 inches.
      f. Bottom Rail Width: 3-3/4 inches.
      g. Aluminum Panels: 0.050 inch thick, aluminum.
      h. Stiles and Rails: 6063 - T6 aluminum.
      i. Springs: 10,000 cycles.
      j. Glazing: 1/2 inch tempered insulating glass. Finish as shown on drawings.
      k. Insulated, as indicated on Drawings.
   2. Finish and Color:
      a. Color Anodized Finish: As indicated on Drawings.
   3. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
   4. Lock: Interior galvanized single unit.
   5. Weatherstripping:
      a. Flexible bulb-type strip at bottom section.
      b. Flexible Jamb seals.
      c. Flexible Header seal.

6. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
7. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
    a. Entrapment Protection: Required for momentary contact, includes radio control operation.
        1) Photoelectric sensors monitored to meet UL 325/2010.
    b. Operator Controls:
        1) Key operated control stations with open, close, and stop buttons.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until openings and substrates have been properly prepared.

B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

C. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install overhead doors, track and openers in accordance with approved shop drawings and the manufacturer's printed instructions.

B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.

C. Anchor assembly to wall construction and building framing without distortion or stress.

D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

E. Fit and align door assembly including hardware.

3.4 CLEANING AND ADJUSTING

A. Adjust door assembly to smooth operation and in full contact with weatherstripping.

B. Clean doors, frames and glass.

C. Remove temporary labels and visible markings.

3.5 PROTECTION

A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

B. Protect installed products until completion of project.

C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Aluminum-framed storefronts.
   2. Manual-swing aluminum entrances.
   3. Aluminum Windows.

B. Related Sections include the following:
   1. Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
   2. Division 8 Section "Glazing" for glazing requirements to the extent not specified in this Section.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
   1. Structural loads.
   2. Thermal movements.
   3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
   4. Dimensional tolerances of building frame and other adjacent construction.
   5. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferred to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
      d. Noise or vibration created by wind and thermal and structural movements.
      e. Loosening or weakening of fasteners, attachments, and other components.
      f. Sealant failure.
      g. Failure of operating units to function properly.

B. Deflection of Framing Members:
   1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

C. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity but not less than 10 seconds.

D. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.

E. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

F. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.

G. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
1. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
2. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

D. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units

in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Accessible Entrances: Comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water leakage through fixed glazing and framing areas.
      e. Failure of operating components to function properly.
   2. Warranty Period: 2 years.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

C. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Entrance, Storefronts, and Windows: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Arcadia Inc. (Basis of Design)
   2. Kawneer.
   3. EFCO Corporation.
   4. US Aluminum.
   5. Vistawall Architectural Products.
   6. Or equal.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B 209.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   3. Extruded Structural Pipe and Tubes: ASTM B 429.
   4. Structural Profiles: ASTM B 308.
   5. Welding Rods and Bare Electrodes: AWS A5.10.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   1. Structural Shapes, Plates, and Bars: ASTM A 36.
   2. Cold-Rolled Sheet and Strip: ASTM A 1008.
   3. Hot-Rolled Sheet and Strip: ASTM A 1011.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

G. Product: AG451T, Thermal Series by Arcadia or equal.
   1. 2” x 4-1/2” Thermal; center glazed, screw spline, shear block, compensating stick or punched opening fabrication for 1” glass.
   2. Framing Materials and Accessories:
      a. Framing members, transition members, mullions, adaptors, and mounting: Extruded 6063-T6 aluminum alloy (ASTM B221 – Alloy G.S. 10a T6).
      b. Screws, fastening devices, and internal components: Aluminum, stainless steel, or zinc-plated steel in accordance with ASTM.A-164. Perimeter anchors shall be aluminum or steel, providing the steel is properly isolated from aluminum.
   3. Water Resistance: 8 PSF per ASTM E331 Static Test.
   4. Glazing Gasket:
      a. Compression-type design, replaceable, molded or extruded santoprene, polyvinyl chloride (PVC), or ethylene propylene diene monomer (EPDM).
      b. Shall be of type that locks securely into the glazing reglet to prevent glazing gaskets from disengaging.
   5. Fabrication:
      a. Continuous sub-sill shall be provided under sill members to collect water infiltration and divert from the interior of the system.
      b. Framing members shall be internally reinforced and secured at head and sill as necessary for structural performance requirements, for hardware attachment, and as indicated.
      c. Fasteners shall be so located as to ensure concealment from view in the final assembly.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 DOORS AND FRAMES

A. Product: MS362 Series, Medium Stile Door by Arcadia.
   1. Frame thickness: 1-3/4 inch.
   2. Vertical Stiles: 3-1/2 inches.
   3. Top Rail: 3-5/8 inches.

4. Bottom Rail: 10-1/2 inches.
5. Glazing Stops: Square snap-in type.
6. Glazing: Tempered as specified in Division 8 Section “Glazing”.
7. Major portions of the door stiles a nominal .125 inches and glass stops .050 inches thick.
8. Door members: Extruded 6063-T6 aluminum alloy (ASTM B221-Alloy G.S. 10a T6).
9. Screws, fastening devices, and internal components: Aluminum, stainless steel, or zinc plated steel in accordance with ASTM A-164. Shall be aluminum or steel, providing the steel is properly isolated from aluminum.
10. Glazing Gasket (compression-type design).
11. Prepare internal reinforcement for door hardware.
12. Weatherstripping: Hard-backed poly pile in door and/or frame. Meeting stile of all pair of doors have a double line hard-backed poly-pile astragal.

B. Product: NS212 Series, Narrow Stile Door by Arcadia or equal.
1. Frame thickness: 1-3/4 inch.
2. Vertical Stiles: 2 inches.
3. Top Rail: 2-1/16 inches.
4. Bottom Rail: 10-1/2 inches.
5. Glazing Stops: Square snap-in type.
6. Glazing: As indicated on Drawings and as specified in Division 8 “Glazing”.
7. Major portions of the door stiles a nominal .125 inches and glass stops .050 inches thick.
8. Door members: Extruded 6063-T6 aluminum alloy (ASTM B221-Alloy G.S. 10a T6).
9. Screws, fastening devices, and internal components: Aluminum, stainless steel, or zinc plated steel in accordance with ASTM A-164. Shall be aluminum or steel, providing the steel is properly isolated from aluminum.
10. Glazing Gasket (compression-type design).
11. Prepare internal reinforcement for door hardware.
12. Weatherstripping: Hard-backed poly pile in door and/or frame. Meeting stile of all pair of doors have a double line hard-backed poly-pile astragal.

C. Door Hardware: Factory hardware and as specified in Division 8 Section "Door Hardware."
1. Door hardware supplier shall be responsible for furnishing physical hardware to the entrance manufacturer prior to fabrication, and for coordinating hardware delivery requirements with the hardware manufacturer, the general contractor and the entrance manufacturer to insure the building project is not delayed. Coordinate master-keyed requirements.

2.6 WINDOWS

A. Product: T200 Series (thermal) Heavy Commercial windows by Arcadia or equal.
1. Types: Fixed, casement, and awnings and as indicated on Drawings.
2. Extruded aluminum profiles 6063-T6 alloy and temper (ASTM B221 G.S. 10A-T6).
3. Framing members: .125 minimum wall thickness.
4. Weatherstrip EPDM bulb type conforming to ASTM D2000 AA515 and shall be keyed into extruded grooves.
5. Back glazing two-sided adhesive, 15 lbs./ft.3 density, polyethylene tape. Glazing wedges shall be EPDM or Santoprene.
6. Thermal barrier material poured-in-place two part polyurethane.
7. Grade: AW55 grade. Conformance to 55 design pressure. Tested and engineered to meet or exceed AAMA 101/I.S. 2-97/NAFS 2.

8. Overall Frame Depth: 2 inch.
9. 1 inch insulated glazing in-fills as specified in Division 8 “Glazing”.
10. Type: Fixed and operable as indicated on Window Schedule on Drawings.
11. At operable windows provide screens made of extruded aluminum frame and screened with either 18 x 14 aluminum or fiber mesh.
12. At Casement, Awning, and Hopper windows provide heavy duty four bar hinges shall be stainless steel only, with asymmetric end caps, and adjustable limit stops.
    a. Lock and latches cast white bronze, US-25D finish.

2.7 ACCESSORY MATERIALS

A. Insulating Materials: As specified in Division 7 Section "Building Insulation."

B. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Doors: Reinforce doors as required for installing hardware.

1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Hardware Installation:
1. Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.
2. Hardware supplier shall furnish hardware to door manufacturer prior to fabrication and coordinate hardware delivery with door manufacturer to insure project is not delayed.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
1. Color: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Entrances: Install to produce smooth operation and tight fit at contact points.
1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

G. Install insulation materials as specified in Division 7 Section "Building Insulation."

H. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

I. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
   a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
   b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

END OF SECTION 084113

SECTION 084124 - ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. All-glass entrance doors.
   2. All-glass storefronts.

B. Related Sections:
   1. Division 5 Section "Metal Fabrications" for overhead-steel support for all-glass systems.
   2. Division 8 Section "Aluminum-Framed Entrances and Storefronts" for storefront systems that incorporate all-glass entrance doors.
   3. Division 8 Section "Glazing" for general glass requirements.

1.2 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: All-glass systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system.

B. Shop Drawings: Show fabrication and installation details, including the following:
   1. Plans, elevations, and sections.
   2. Details of fittings and glazing, including isometric drawings of patch fittings.
   3. Door hardware locations, mounting heights, and installation requirements.

C. Samples for Initial Selection: For each type of exposed finish indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Metal Finishes: 6-inch- long sections of patch fittings, accessory fittings, and other items.
   2. Glass: 6 inches square, showing exposed-edge finish.
   3. Door Hardware: For exposed door hardware of each type, in specified finish, full size.

E. Other Action Submittals:
   1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Qualification Data: For qualified Installer.

G. Seismic Qualification Certificates: For all-glass systems, accessories, and components, from manufacturer.

H. Maintenance Data: For all-glass systems to include in maintenance manuals.

I. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain all-glass systems from single source from single manufacturer.

C. Accessible All-Glass Entrance Doors: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with all-glass systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including excessive deflection.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      c. Failure of operating components.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All-Glass Entrances and Storefronts: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. C.R. Laurence Co., Inc. (Basis of Design)
   2. Arch Aluminum & Glass Co., Inc.
   3. Oldcastle Glass, Inc.
   4. Or equal.

2.2 ALL GLASS-ENTRANCES AND STOREFRONTS

A. Product: Cascade Series Frameless Glass Wall Office System by C.R. Laurence Co., Inc. or equal.
   1. Frameless Glazed Interior Wall Assembly: Factory fabricated assemblies consisting of full-width and height glass panels fastened with U-channel fittings on top and bottom edge of glass wall.
      a. Configuration: As indicated on drawings.
      b. U-Channel Fittings: Extruded aluminum, satin anodized finish, dry glazed, and with matching end caps.
         1) Top channel is 1-1/2 inch high by 1 inch deep.
         2) Bottom channel is 1 inch high by 1 inch deep.
      c. Glass Thickness: 1/2 inch, tempered.
      d. Designed to withstand normal operation without damage, racking, sagging, or deflection.
      e. Coordinate wall and door assembly preparation and provide hardware as necessary for fully operable installation.
      f. Finished metal surfaces protected with strippable film.
      g. Factory assembled to greatest extent practical; may be disassembled to accommodate shipping constraints.

B. Product: CRL Commercial Patch Hardware, Catalog No. PH20AA (Top), PH10CA (Bottom) by C.R. Laurence Co., Inc. or equal.
   1. Pivoting Glass Doors: Dry glazed patch fittings.
      a. Door Configuration: As indicated on drawings.
      b. Height: 2 inch.
      c. Length: 6-7/16 inch.
      d. Glass Thickness: 1/2 inch, tempered.
      e. Door Hardware: Patch bottom fitting, brushed stainless steel.
      f. Provide accessories as required for complete installation.

C. Door System Hardware:
   1. As selected by Architect from manufacturer’s standard door hardware and comply with Division 8 Section “Door Hardware”.

2.3 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts according to manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.
   1. For all-glass entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION 084124

SECTION 084410 - FIRE-RATED ALUMINUM CURTAIN WALL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire-rated aluminum curtain wall including frame and glazing which consist of the standard system CW-EI60 and the deeper frame system CW2-EI60.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
   2. ASTM E2010 Standard Test Method for Positive Pressure Fire Tests of Window Assemblies.
   3. ASTM E 283-04, Test Method for Determining Rate of Airflow Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
   4. ASTM E 330-02, Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
   5. ASTM E 331-00, Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

B. National Fire Protection Association (NFPA):
   1. NFPA 80: Standard for Fire Doors and Fire Windows.
   2. NFPA 257: Standard on Fire Test for Window and Glass Block Assemblies.

C. Uniform Building Code (UBC):
   1. UBC-7-4: Methods for Fire Tests of Window Assemblies.

D. Underwriters Laboratories, Inc. (UL):
   1. UL 9: Fire Tests of Window Assemblies.
   2. UL 263: Fire Tests of Building Construction and Materials

E. Standard Council of Canada:
   1. ULC Standard CAN4-S101: Fire Tests of Building Construction and Materials.
   2. ULC Standard CAN4-S106: Fire Tests of Door Assemblies.

F. American National Standards Institute (ANSI):
   1. ANSI Z97.1 Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.

G. Consumer Product Safety Commission (CPSC):
   1. CPSC 16 CFR 1201 Categories I and II: Safety Standard for Glazing Materials.

H. American Architectural Manufacturers Association (AAMA)
   1. AAMA 501.1-05, Standard Test Method for Metal Curtain Walls for Water Penetration Using Dynamic Pressure.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Fire Rating: 60 minutes.
2. Certification: Windows shall be tested in accordance with ASTM E 2010, NFPA 252, UBC 7-4, UL263, CAN4-S106.
3. Testing Laboratory: Fire tests shall be conducted by an approved independent testing laboratory, similar to Underwriter's Laboratories, Inc.
4. Air Infiltration: The test specimen shall be tested in accordance with ASTM E283 at a minimum frame size of 97" x 145". Air infiltration rate shall not exceed 0.00 cfm/ft of area at a static air pressure differential of 8 psf.
5. Static Water Resistance: The test specimen shall be tested in accordance with ASTM E331 at a minimum frame size of 97" x 145". There shall be no leakage as defined in test method at a static pressure differential of 8 psf.
6. Dynamic Water Resistance: The test specimen shall be tested in accordance with AAMA 501.1 at a minimum frame size of 97" x 145". There shall be no leakage as defined in test method at a dynamic pressure differential of 8 psf.
7. Uniform Load Deflection: A minimum static air pressure difference of 100 psf shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member. (This only cover the CW2-EI60 system)
8. Uniform Load Structural Test: A minimum static air pressure difference of 150 psf shall be applied in the positive and negative direction in accordance with ASTM E330.
9. Thermal Transmittance (U-value): When tested to AAMA Specification 503.1, the thermal transmittance (U-value) shall not be more than 0.48 BTU/hr/sf/˚F.

1.05 SUBMITTALS

A. listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedure Section.
   1. Shop Drawings: Submit shop drawings showing layouts, profiles and product components.
   2. Samples: Submit samples for finishes, colors and textures.
   3. Technical Information: Submit latest edition of manufacturer's product data providing product description, technical data and installation instructions.

1.06 QUALITY ASSURANCE

A. Listings and Labels:
   Fire rated framing and glazing shall be under current follow-up services by an approved independent agency and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.

1.07 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials to specified destination in manufacturer's packaging undamaged, complete with installation instructions.

C. Storage and Protection: Store off ground, under cover, protected from weather, direct sunlight, construction activities and at temperature conditions recommended by manufacturer, +10°F to +110°F.

D. Handling: Protect materials and finish during handling and installation to prevent damage.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART 2 - PRODUCTS

2.01 FIRE-RATED ALUMINUM FIXED WINDOWS

A. Manufacturer: Aluflam North America
   1. Contact: 16604 Edwards Road, Cerritos, CA 90703: Telephone 562.926.9520 Fax 562.404.1394. E-mail info@aluflam-usa.com Website www.aluflam-usa.com, or local representative (www.aluflam-usa.com/contact/representatives.php).
   2. Fireglass.
   3. SaftiFirst.
   4. Or equal.

2.02 MATERIALS – ALUMINUM FRAMING

A. Frame construction: Integral structure, pressure plate, and cap from extruded aluminum profiles. Filled internally with cement composite material.

B. Dimensions:

   CW-EI60
   1. Perimeter framing face dimension: 2 inch
   2. Depth of vertical framing: 5-3/16 inch
   3. Depth of horizontal framing: 5 inch

C. Assembly: Frame corners assembled with mechanical fasteners – in factory or in the field.

D. Sealing: Framing system shall insulate against effects of fire, smoke, and heat transfer from either side. Perimeter of the framing system to the rough opening shall be firmly packed with mineral wool insulation.

2.03 MATERIALS – FIRE RESISTANT GLAZING

A. Assemblies shall be glazed with 60 minute rated 1 inch thick SGG Contraflam 60 fire resistant glazing material as manufactured by Vetrotech Saint-Gobain (www.vetrotechusa.com).
   1. Individual lites shall be permanently identified with a listing mark.
   2. Glazing material installed in “Hazardous Locations” (subject to human impact) shall be certified to meet the applicable requirements for fire rated assemblies referenced in ANSI Z97.1 Standard for Safety Glazing Materials Used In Buildings and/or CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials.
   3. Visible daylight transmission shall be a minimum of 81%. Glazing material shall be optically clear, colorless and free from unusual distortion.

B. Fire-rated glazing shall be insulated with ¼” airgap and ¼” low-E coated outboard glass lite. Installation conditions shall be analyzed to assure that fire-rated glazing is not exposed to temperatures outside the 10 – 110 degrees F limits.

2.04 MATERIALS – GLAZING AND ASSEMBLY ACCESSORIES

A. Fasteners: All fasteners, setting pads, and glazing clips, shall be stainless or zinc-plated steel.

B. Glazing Accessories: The glazing material perimeter shall be separated from the perimeter framing system with approved flame retardant intumescent glazing tape. Ceramic setting blocks shall be placed between the metal setting pads and the glazing material. Setting pads and blocks provided by manufacturer.

2.05 FABRICATION

A. Curtainwall frames shall be furnished pre-assembled or K-D. Curtainwall assemblies shall be field glazed.

B. Fabrication Dimensions: Fabricate to approved dimensions. The general contractor shall guarantee dimensions within required tolerance (+ - 1/8”). Obtain approved shop drawings prior to fabrication.

2.06 FINISHES

A. Framing shall be chemically cleaned and pretreated, then finished on all exposed areas with:
   Anodized – Dark Bronze

C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D.

C. Slight variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine area to receive curtainwall. Openings shall be plumb, square and within allowable tolerances. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Curtainwall installation shall be by a specialty contractor with appropriate experience qualifications; and in strict accordance with the approved shop drawings.

3.03 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Glass and frame should be cleaned using soft clean cloth, chamois leathers, sponges or soft paper. Use clean warm water with a mild detergent. Do not use detergent that contains either alkaline, acids or fluoride! Abrasive cleaning methods can damage surfaces! Clean prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

SECTION 086200 - UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes factory-assembled unit skylights.

B. Related Sections include the following:
   1. Division 7 Section "Sheet Metal Flashing and Trim" for flashing at unit skylights.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Loads: Provide unit skylights, including glazing and anchorage, capable of withstanding the effects of the following design loads:
   1. Deflection: Skylight framing members shall not exceed L/175 when subject to a uniform load deflection test in accordance with ASTM E330.

B. Water Penetration: No water penetration shall occur when system is tested in accordance with ASTM E331. Water penetration is defined as the appearance of uncontrolled water other than condensation on the interior surface of any part of the skylight.
   1. Drain to the exterior all water entering at joints or glazing reveals as well as all condensation occurring within unit construction.

C. Air Infiltration: Air infiltration through the skylight assembly when tested in accordance with ASTM E283 shall not exceed 0.06 cubic feet per minute per square foot of fixed area.

D. Thermal Movement: Skylight assembly shall be so designed and anchored that there will be no objectionable distortion or stresses in fastening and joinery due to expansion and contraction when subjected to temperature variance.

1.3 SUBMITTALS

A. Product Data: For unit skylights. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For unit skylights. Include plans, elevations, sections, details, and attachments to other Work.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in a representative section of each unit in manufacturer's standard size.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Uncontrolled water leakage.
   2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   3. Deterioration of insulating-glass hermetic seal.
   4. Warranty Period: 5 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Unit Skylights: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Velux America. (Basis of Design)
   2. Bristolite Skylights.
   3. CPI International.
   4. Kalwall Corporation.
   5. Or equal.

2.2 UNIT SKYLIGHTS

A. General: Factory-assembled units that include glazing, extruded-aluminum glazing retainers, gaskets, and inner frames and that are capable of withstanding design loads indicated.

B. Product: FCM by Velux or equal.
   1. Size: As indicated on Drawings.
   2. Aluminum Frame: Roll-formed 15 gauge, 0.06 inch thick.
   3. Fasteners: Sanoprene Gasket #6-20.783, Torx, AB Thrd., stainless steel.
   4. Gasketing: Factory applied sanoprene gasket to effect drainage.
   5. Fasteners: (Skylight lens to curb) #8 x 1-1/2 inch wood screw, #2 phillips, pan head, stainless steel (# per skylight as indicated in manufacturer’s installation instructions).
   6. Flashing Accessories: Type ECL Flashings is a prefabricated step flashing system designed for use with roofing materials 3/4 inch thick and for slopes of 3:12 (15 degrees) to 60 degrees.
   7. Glazing: Type 74 Laminated Low-E Gas Filled: Exterior lite 1/8 inch clear tempered with Low-E2 coating on surface #2, 0.44 inch air space filled with argon gas, interior lite two plies of 0.090 inch heat-strengthened laminated with 0.030 inch vinyl interlayer.
   8. Fabricate roll-formed aluminum frame with mitered corners, molded ASA UV resistant corner keys, siliconed for weather tight fit.
   9. Fabricate frame components within minimum tolerances enabling installation and movement of frame and dynamic movement of perimeter sealant.

10. Permit external drainage channels for migration of moisture to exterior. Provide internal drainage of glazing spaces to exterior through sanoprene gasket with integrated condensation gutter.
11. Exterior surfaces: Maintenance free roll-formed aluminum exterior frame with umber gray Kynar 500 polyvinylidene fluoride resin finish.

2.3 INSTALLATION MATERIALS

A. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers, formulated for 15-mil dry film thickness per coating.

B. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

C. Elastomeric Sealant: ASTM C 920; Type S; Grade NS; Class 25; and Uses NT, G, A, and (as applicable to joint substrates indicated) O; recommended by unit skylight manufacturer and compatible with joint surfaces.

D. Roofing Cement: ASTM D 4586, asbestos free, designed for trowel application or other adhesive compatible with roofing system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate unit skylight installation with installation of substrates, vapor retarders, roof insulation, roofing, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.
   1. Unless otherwise indicated, install unit skylights according to construction details of NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Where metal surfaces of units will contact incompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation recommended in writing by unit skylight manufacturer.

C. Anchor unit skylights securely to supporting substrates.

D. Set unit skylight flanges in thick bed of roofing cement to form a seal, unless otherwise indicated.

E. Where cap flashing is indicated, install to produce waterproof overlap with roofing or roof flashing. Seal with thick bead of mastic sealant except where overlap is indicated to be left open for ventilation.

3.2 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 086200

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Door hardware, including electric hardware.
2. Storefront and entrance door hardware.
3. Battery-powered electronic credential access control locks and panic hardware lever trim.

1.2 REFERENCES**:**

A. Use date of standard in effect as of Bid date.

1. American National Standards Institute

a) ANSI 156.18 – Materials and Finishes.

2. BHMA – Builders Hardware Manufacturers Association
3. 2019 California Building Code

a) Chapter 11B – Accessibility To Public Buildings, Public Accommodations, Commercial Buildings and Public Housing

4. DHI – Door and Hardware Institute
5. NFPA – National Fire Protection Association

a) NFPA 80 2019 Edition – Standard for Fire Doors and Other Opening Protectives.
b) NFPA 105 – Smoke and Draft Control Door Assemblies
c) NFPA 252 – Fire Tests of Door Assemblies

6. UL – Underwriters Laboratories

a) UL10C – Positive Pressure Fire Tests of Door Assemblies.
b) UL 305 – Panic Hardware

7. WHI – Warnock Hersey Incorporated State of California Building Code
8. Local applicable codes
9. SDI – Steel Door Institute
10. WI – Woodwork Institute
11. AWI – Architectural Woodwork Institute
12. NAAMM – National Association of Architectural Metal Manufacturers

B. Abbreviations

1. Manufacturers**:** see table at 2.1.A of this section
2. Finishes**:** see 2.7 of this section.

1.3 SUBMITTALS & SUBSTITUTIONS

A. SUBMITTALS**:** Submit six copies of schedule per D. Only submittals printed one sided will be accepted and reviewed. Organize vertically formatted schedule into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Minimum 10pt font size. Include following information**:**

1. Type, style, function, size, quantity and finish of hardware items.
2. Use BHMA Finish codes per ANSI A156.18.
3. Name, part number and manufacturer of each item.
4. Fastenings and other pertinent information.
5. Location of hardware set coordinated with floor plans and door schedule.
6. Explanation of abbreviations, symbols, and codes contained in schedule.
7. Mounting locations for hardware.
8. Door and frame sizes, materials and degrees of swing.
9. List of manufacturers used and their nearest representative with address and phone number.
10. Catalog cuts.
11. Point-to-point wiring diagrams.
12. Manufacturer's technical data and installation instructions for electronic hardware.

B. Bid and submit manufacturer's updated/improved item if scheduled item is discontinued.

C. Deviations**:** Highlight, encircle or otherwise identify deviations from "Schedule of Finish Hardware" on submittal with notations clearly designating those portions as deviating from this section.

D. If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.

E. Substitutions per Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.

F. Items listed with no substitute manufacturers have been requested by Owner to meet existing standard.

G. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, riser and point-to-point wiring diagrams, manufacturers' installation, adjustment and maintenance information, and supplier's final inspection report.

1.4 QUALITY ASSURANCE**:**

A. Qualifications**:**

1. Hardware supplier**:** direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course of work for project hardware consultation to Owner, Architect and Contractor.

    a) Responsible for detailing, scheduling and ordering of finish hardware. Detailing implies that the submitted schedule of hardware is correct and complete for the intended function and performance of the openings.

B. Hardware**:** Free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.

C. Exit Doors**:** Operable from inside with single motion without the use of a key or special knowledge or effort.

D. Fire-Rated Openings**:** NFPA 80 compliant. Hardware UL10C (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, and resilient seals. Coordinate with wood door section for required intumescent seals. Furnish openings complete.

E. Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers' instructions and code requirements.

F. Pre-Installation Meetings**:** Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Include manufacturers' representatives of locks, panic hardware and door closers in the meetings. Convene prior to commencement of related work.

1.5 DELIVERY, STORAGE AND HANDLING**:**

A. Delivery**:** coordinate delivery to appropriate locations (shop or field).

1. Permanent keys and cores**:** secured delivery direct to Owner's representative.

B. Acceptance at Site**:** Items individually packaged in manufacturers' original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.

C. Storage**:** Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

1.6 PROJECT CONDITIONS AND COORDINATION**:**

A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.

B. Coordination**:** Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents. Furnish related trades with the following information**:**

1. Location of embedded and attached items to concrete.
2. Location of wall-mounted hardware, including wall stops.
3. Location of finish floor materials and floor-mounted hardware.

4. At masonry construction, coordinate with the anchoring and hollow metal supplier prior to frame installation by placing a strip of insulation, wood, or foam, on the back of the hollow metal frame behind the rabbet section for continuous hinges, as well as at rim panic hardware strike locations, silencers, coordinators, and door closer arm locations. When the frame is grouted in place, the backing will allow drilling and tapping without dulling or breaking the installer's bits.
5. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.
6. Coordinate: flush top rails of doors at outswinging exteriors, and throughout where adhesive-mounted seals occur.
7. Manufacturers' templates to door and frame fabricators.

C. Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

D. Environmental considerations**:** segregate unused recyclable paper and paper product packaging, uninstalled metals, and plastics, and have these sent to a recycling center.

1.7 WARRANTY**:**

A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' written warranties.

B. Include factory order numbers with close-out documents warranty information:

C. Minimum warranties:

1.	Locksets**:**	Three years
2.	Extra Heavy Duty Cylindrical Lock:	Seven Years
3.	Exit Devices**:**	Three years mechanical One year electrical
4.	Closers**:**	Thirty years mechanical Two years electrical
5.	Hinges**:**	One year
6.	Other Hardware	Two years

1.8 COMMISSIONING**:**

A. Conduct these tests prior to request for certificate of substantial completion**:**

1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
2. With installer, access control contractor and electrical contractor present, test electrical and electronic hardware systems for satisfactory operation.
3. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Listed acceptable alternate manufacturers: these will be considered; submit for review products with equivalent function and features of scheduled products.

ITEM:	MANUFACTURER:	ACCEPTABLE ALTERNATE:
Hinges	(IVE) Ives	Bommer
Pivots	(IVE) Ives	Rixson
Overhead Concealed Closers	(RIX) Rixson	Dorma
Key System	(SCH) Schlage	Owner standard
Mechanical Locks	(SCH) Schlage	Owner standard
Electronic Locks	(ALA) Alarm Lock Trilogy	Owner standard
Exit Devices	(VON) Von Duprin	Owner standard
Closers	(LCN) LCN	Owner standard
Auto Flush Bolts	(IVE) Ives	DCI
Coordinators	(IVE) Ives	DCI
Silencers	(IVE) Ives	Rockwood, Trimco
Push & Pull Plates	(IVE) Ives	Rockwood, Trimco
Kickplates	(IVE) Ives	Rockwood, Trimco
Stops & Holders	(IVE) Ives	Rockwood, Trimco
Thresholds	(ZER)Zero	NGP, Reese
Seals & Bottoms	(ZER)Zero	NGP, Reese
Aluminum Door Locks	(ADA) Adams Rite	None

2.2 HINGING METHODS:

A. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise architect if 8-inch width is insufficient.

B. Doors 3'6" or wider use 41/2" heavy weight hinges

C. Doors 8'0" use 4 hinges and add 1 hinge for every foot thereafter

D. Conform to manufacturer's published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled. Where manufacturer's standard exceeds the scheduled product, furnish the heavier of the two choices, notify Architect of deviation from scheduled hardware.

E. Conventional Hinges: Steel or stainless steel pins and approved bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.

1. Outswinging exterior doors: stainless steel hinges with non-removable (NRP) pins and security studs.
2. Stainless steel material exteriors and at doors subject to corrosive atmospheric conditions.

F. Pivots: high-strength forged bronze or stainless steel, tilt-on precision bearing and bearing pin.

1. Bottom and intermediate pivots: adjustability of minus 0.063 inch, plus 0.125 inch.

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

A. Mortise Locksets and Latchsets: as scheduled.

1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
2. Universal lock case – 10 functions in one case.
3. Floating mounting tabs automatically adjusts to fit a beveled door edge.
4. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
5. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.
    a) Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
    b) Inside lever applied by screwless shank mounting – no exposed trim mount screws.
    c) Levers rotate up or down for ease of use.
6. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.
7. Turnpieces: accessible offset turn-lever design not requiring pinching or twisting motions to operate.
8. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
9. Scheduled Lock Series and Design: Schlage L series, Design to be 06A
10. Certifications:
    a) ANSI A156.13, 1994, Grade 1 Operational,

b) ANSI/ASTM F476-84 Grade 31 UL Listed.

11. Accessibility: Require not more than 5 lb to retract the latchbolt or deadbolt, or both, per CBC 2019 11B-404.2.7 and 11B-309.4.

B. Electronic locks and exit device trim as scheduled.

1. Alarm Lock Trilogy as specified and to match Owners existing system
2. Specified as stand alone system. Integrated system would be covered elsewhere

2.4 EXIT DEVICES / PANIC HARDWARE

A. General features**:**

1. Independent lab-tested 1,000,000 cycles.
2. Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
3. Deadlocking latchbolts, 0.75 inch projection.
4. End caps**:** impact-resistant, flush-mounted. No raised edges or lips to catch carts or other equipment.
5. No exposed screws to show through glass doors.
6. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
7. Releasable in normal operation with 15-pound maximum operating force per UBC Standard 10-4, and with 32-pound maximum pressure under 250-pound load to the door.
8. Lever design to match locksets
9. Accessibility: Require not more than 5 lb to retract the latchbolt, per CBC 2019 11B-404.2.7 and 11B-309.4.

a) Mechanical method: where touchpad directly retracts the latchbolt with 5 lb or less of force.

B. Specific features**:**

1. Non-Fire Rated Devices**:** standard dogging
2. Lever Trim**:** breakaway type, forged brass or bronze escutcheon min. 0.130 inch thickness, compression spring drive, match lockset lever design.
3. Fire-Labeled Devices**:** UL label indicating “Fire Exit Hardware”. Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.

2.6 CLOSERS

A. Surface Closers**:** 4040-XP

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.

6. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2019 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.

    a) Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.

7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers**:** tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors**:** seasonal adjustments not required for temperatures from 120 degrees F to -30 degrees F, furnish checking fluid data on request.
11. Non-flaming fluid, will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV) not permitted.

2.7 OTHER HARDWARE

A. Automatic Flush Bolts**:** Low operating force design.

B. Kick Plates**:** Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

C. Door Stops**:** Provide stops to protect walls, casework or other hardware.

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.
2. Locate overhead stops for maximum possible opening. Consult with Owner for furniture locations. Minimum**:** 90deg stop / 95deg deadstop. Note degree of opening in submittal.

D. Automatic door bottoms**:** low operating force units.

1. Include automatic type door bottoms, as opposed to fixed sweeps, at stairs and elevator lobbies to allow fine-tuning of pressurization systems.

E. Thresholds**:** As scheduled and per details. Comply with CBC 2019 11B-404.2.5. Substitute products**:** certify that the products equal or exceed specified material's thickness. Proposed substitutions**:** submit for approval.

2. Saddle thresholds**:** 0.125 inches minimum thickness.
3. Exteriors**:** Seal perimeter to exclude water and vermin. Use sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Minimum 0.25 inch diameter fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors. National Guard Products' "COMBO" or Pemko Manufacturing's "FHSL".
4. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.

5. Fasteners**:** Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws**:** full-thread. Sleeve nuts**:** full length to prevent door compression.

F. Through-bolts**:** Do not use. Coordinate with wood doors; ensure provision of proper blocking to support wood screws for mounting panic hardware and door closers. Coordinate with metal doors and frames; ensure provision of proper reinforcement to support machine screws for mounting panic hardware and door closers.

1. Exception**:** surface-mounted overhead stops, holders, and friction stays.

G. Silencers**:** Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Leave no unfilled/uncovered pre-punched silencer holes. Intent**:** door bears against silencers, seals make minimal contact with minimal compression – only enough to effect a seal. Provide where seals are not used

2.8 FINISH**:**

1. Generally**:** BHMA 622 Matte Black

H. Door closers**:** factory powder coated to match other hardware, unless otherwise noted.

2.9 KEYING REQUIREMENTS**:**

A. KEYING REQUIREMENTS**:**

B. Key System**:** Existing Schlage system. Meet with Owner for keyways and exact keing instructions prior to ordering locks or cylinders. Keying to be done at the factory

C. Keys

1. Factory registered master key system
2. Non-I.C. construction keying**:** furnish inserted type partial key. At substantial completion, remove inserts in Owner's presence; demonstrate consequent non-operability of construction key. Give all removed inserts and all construction keys to Owner, provide accounting for all the pieces.
3. Temporary cylinders/cores remain supplier's property.
4. Furnish 10 construction keys.
5. Furnish 2 construction insert extractor tool 35-057.
6. Furnish 2 construction control keys.

D. Key Cylinders**:** furnish, 6-pin solid brass construction.

E. Cylinders/Cylinder cores**:** furnish keyed at factory of lock manufacturer where permanent records are maintained. Locks and cylinders same manufacturer.

F. Permanent keys**:** furnish secured shipment direct from point of origination to Owner.

1. For estimate**:** 3 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.
2. For estimate**:** VKC stamping plus "DO NOT DUPLICATE".

G. Bitting List**:** furnish secured shipment direct from point of origination to Owner upon completion.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS**:**

A. Can read and understand manufacturers' templates, suppliers' hardware schedule and printed installation instructions. Can readily distinguish drywall screws from manufacturers' furnished fasteners. Available to meet with manufacturers' representatives and related trades to discuss installation of hardware.

3.2 PREPARATION**:**

A. Ensure that walls and frames are square and plumb before hardware installation. Make corrections before commencing hardware installation. Installation denotes acceptance of wall/frame condition.

B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.

1. Notify Architect of code conflicts before ordering material.
1. Locate latching hardware between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1010.1.9.2 and 11B-404.2.7.
2. Locate panic hardware between 36 inches to 44 inches above the finished floor.
3. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

C. Overhead stops**:** before installing, determine proposed locations of furniture items, fixtures, and other items to be protected by the overhead stop's action.

3.3 INSTALLATION

A. Install hardware per manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.

1. Gaskets**:** install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
3. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
4. Replace fasteners damaged by power-driven tools.

B. Locate floor stops no more that 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths, door should be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.

C. Core concrete for exterior door stop anchors. Set anchors in approved non-shrink grout.

D. Locate overhead stops for minimum 90 degrees at rest and for maximum allowable degree of swing.

E. Drill pilot holes for fasteners in wood doors and/or frames.

F. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

3.4. ADJUSTING

A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.

1. Hardware damaged by improper installation or adjustment methods**:** repair or replace to Owner's satisfaction.
2. Adjust doors to fully latch with no more than 1 pound of pressure.

a) Door closer valves: turn valves clockwise until at bottom – do not force. Turn valves back out one and one-half turns and begin adjustment process from that point. Do not force valves beyond three full turns counterclockwise.

3. Adjust delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
4. Adjust door closers per 1.9 this section.

B. Fire-rated doors**:**

1. Wood doors**:** adjust to 0.125 inches clearance at heads, jambs, and meeting stiles.
2. Steel doors**:** adjust to 0.063 inches minimum to 0.188 inches maximum clearance at heads, jambs, and meeting stiles.
3. Adjust wood and steel doors to 0.75 inches maximum clearance (undercut) above threshold or finish floor material under door.

C. Final inspection**:** Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following**:**

1. Has re-adjusted hardware.
2. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner's personnel.
3. Has identified items that have deteriorated or failed.
4. Has submitted written report identifying problems.

3.5 DEMONSTRATION**:**

A. Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

3.6 PROTECTION/CLEANING**:**

A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.

B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

3.7 SCHEDULE OF FINISH HARDWARE

A. See door schedule in drawings for hardware set assignments.

HW SET: 01
DOOR NUMBER:
114A 114B 114C 114D 114E 114F

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	622	IVE
1	EA	PRIVACY W/INDICATOR	L9440-L583-363-L283-722 06A	622	SCH
1	EA	WALL STOP	WS401CCV	BLK	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 02
DOOR NUMBER:
217A

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	622	IVE
1	EA	PRIVACY W/INDICATOR	L9440-L583-363-L283-722 06A	622	SCH
1	EA	CLOSER	4040XP	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	BLK	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	BLK	IVE
1	SET	PERIMETER SEALS	328D HEAD AND JAMBS	DUR	ZER
1	EA	DOOR SWEEP	339D	DUR	ZER

HW SET: 03
DOOR NUMBER:
102A 108A 110A 204A 205A 216A
219A

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	622	IVE
1	EA	ELECTRONIC LOCK	DL2700MORT	BLK	ALA
1	EA	CYLINDER	AS REQ'D	622	SCH
1	EA	CLOSER	4040XP-H	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	BLK	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	BLK	IVE
1	SET	PERIMETER SEALS	328D HEAD AND JAMBS	DUR	ZER
1	EA	DOOR SWEEP	339D	DUR	ZER

HW SET: 04
DOOR NUMBER:
206A

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	622	IVE
1	EA	ELECTRONIC LOCK	DL2700MORT	BLK	ALA
1	EA	CYLINDER	AS REQ'D	622	SCH
1	EA	CLOSER	4040XP S-H-CUSH	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	BLK	IVE
1	SET	PERIMETER SEALS	328D HEAD AND JAMBS	DUR	ZER
1	EA	DOOR SWEEP	339D	DUR	ZER

HW SET: 05
DOOR NUMBER:
103A 108C

EACH TO HAVE:

6	EA	HINGE	3CB1 4.5 X 4.5	622	IVE
1	SET	AUTO FLUSH BOLT	FB31/41 AS REQ'D	BLK	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	BLK	IVE
1	EA	ELECTRONIC LOCK	DL2700MORT	BLK	ALA
1	EA	COORDINATOR	COR2-COMPLETE	628	IVE
2	EA	CLOSER	4040XP-H	693	LCN
2	EA	DOME STOP	FS436/438 AS REQ'D	BLK	IVE
1	SET	PERIMETER SEALS	328D HEAD AND JAMBS	DUR	ZER
2	EA	DOOR SWEEP	339D	DUR	ZER
1	EA	ASTRAGAL	44STST X 188	600	ZER

HW SET: 06
DOOR NUMBER:
104A

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	631	IVE
1	EA	PRIVACY LOCKSET W/IND	L9496P L283-722 06A	622	SCH
1	EA	CLOSER	4040XP	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	BLK	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	BLK	IVE
1	SET	PERIMETER SEALS	328D HEAD AND JAMBS	DUR	ZER
1	EA	AUTO DOOR BOTTOM	355	DUR	ZER
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

HW SET: 07
DOOR NUMBER:
102B 112A

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5 NRP SEC STUD	631	IVE
1	EA	ELECTRONIC LOCK	DL2700MORT	BLK	ALA
1	EA	CYLINDER	AS REQ'D	622	SCH
1	EA	CLOSER	4040XP S-CUSH	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	BLK	IVE
1	SET	PERIMETER SEALS	328D HEAD AND JAMBS	DUR	ZER
1	EA	AUTO DOOR BOTTOM	355	DUR	ZER
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

HW SET: 08
DOOR NUMBER:
109A

EACH TO HAVE:

6	EA	HINGE	3CB1HW 4.5 X 4.5 NRP SEC STUD	631	IVE
1	SET	AUTO FLUSH BOLT	FB31/41 AS REQ'D	BLK	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	BLK	IVE
1	EA	ELECTRONIC LOCK	DL2700MORT	BLK	ALA
1	EA	COORDINATOR	COR2-COMPLETE	628	IVE
2	EA	CLOSER	4040XP S-CUSH	693	LCN
1	SET	PERIMETER SEALS	328D HEAD AND JAMBS	DUR	ZER
2	EA	DOOR SWEEP	339D	DUR	ZER
1	EA	ASTRAGAL	44STST X 188	600	ZER
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

HW SET: 09
DOOR NUMBER:
113A

EACH TO HAVE:

6	EA	HINGE	3CB1HW 4.5 X 4.5 NRP SEC STUD	631	IVE
1	SET	AUTO FLUSH BOLT	FB31/41 AS REQ'D	BLK	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	BLK	IVE
1	EA	ELECTRONIC LOCK	DL2700MORT	BLK	ALA
1	EA	COORDINATOR	COR2-COMPLETE	628	IVE
2	EA	CLOSER	4040XP H-EDA	693	LCN
2	EA	FLOOR STOP	FS441/442 AS REQUIRED	BLK	IVE
1	SET	PERIMETER SEALS	328D HEAD AND JAMBS	DUR	ZER
2	EA	DOOR SWEEP	339D	DUR	ZER
1	EA	ASTRAGAL	44STST X 188	600	ZER
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

HW SET: 10
DOOR NUMBER:
107B 108B

EACH TO HAVE:

		ALL HARDWARE BY ROLL UP DOOR MANUFACTURER		B/O

HW SET: 11
DOOR NUMBER:
101Q

EACH TO HAVE:

		ALL HARDWARE BY FOLDING DOOR MANUFACTURER			B/O

HW SET: 12
DOOR NUMBER:
301A 301B

EACH TO HAVE:

		ALL HARDWARE BY DOOR MANUFACTURER			B/O

HW SET: 13
DOOR NUMBER:

107A	202A	203A	207A	208A	209A
210A	211A	212A	213A	214A	218A

EACH TO HAVE:

1	EA	TOP CENTER PIVOT	COMPLY WITH MFG'S (CRL) RECOMMENDATIONS	626	MIC
1	EA	BOTTOM CENTER PIVOT	COMPLY WITH MFG'S (CRL) RECOMMENDATIONS	BLK	MIC
1	EA	RIM CYLINDER	20-057	622	SCH
1	EA	PERMANENT CORE	23-030	622	SCH
1	SET	LPPA48BS	LADDER PULL SET	622	CRL
1	EA	FLOOR STOP	FS439	BLK	IVE
1	EA	PATCH-BOTTOM	COMPLY WITH MFG'S (CRL) RECOMMENDATIONS	BLK	MIC
1	EA	PATCH-TOP	COMPLY WITH MFG'S (CRL) RECOMMENDATIONS	BLK	MIC

SEALS BY ALL GLASS/FRAMELESS MANUFACTURER

HW SET: 14
DOOR NUMBER:

101C	101D	101E	101F	101G	101H
101I	101J	101K	101L	101M	101N

EACH TO HAVE:

1	EA	O.H.CONC.CLOSER	800 SERIES COMPLETE	BLK	RIX
1	EA	DEADLOCK	MS1850S	BLK	ADA
1	EA	CYLINDER T-TURN	09-904	622	SCH

1	EA	MORTISE CYLINDER	20-001	622	SCH
1	EA	EXIT INDICATOR	4089	BLK	ADA
1	EA	ARMOR COLLAR	MS4043	BLK	ADA
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

SEALS AND SWEEPS BY DOOR MANUFACTURER
PER ARCHITECT PULL NOT REQUIRED

HW SET: 15
DOOR NUMBER:
106A 106B 215A

EACH TO HAVE:

1	EA	PIVOT SET	7215	622	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT	622	IVE
1	EA	ELECTRONIC LOCK	DL2700MORT	BLK	ALA
1	EA	CLOSER	4040XP EDA	693	LCN
1	EA	FLOOR STOP	FS441/442 AS REQUIRED	BLK	IVE
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

SEALS AND SWEEPS BY DOOR MANUFACTURER

HW SET: 16
DOOR NUMBER:
101B 101O

EACH TO HAVE:

1	EA	PIVOT SET	7215	622	IVE
2	EA	INTERMEDIATE PIVOT	7215 INT	622	IVE
1	EA	EXIT DEVICE	AX-98-EO	711	VON
1	EA	ELECTRONIC EXIT DEVICE TRIM	ETDL2700	BLK	ALA
1	EA	CYLINDER	AS REQ'D	622	SCH
1	EA	CLOSER	4040XP S-CUSH	693	LCN
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

SEALS AND SWEEPS BY DOOR MANUFACTURER
DOORS MUST BE MEDIUM STILE TO MOUNT PANIC HARDWARE
CARD READER AND WIRING BY OTHERS

HW SET: 17
DOOR NUMBER:
107C

EACH TO HAVE:

2	EA	PIVOT SET	7215	622	IVE
2	EA	INTERMEDIATE PIVOT	7215 INT	622	IVE
1	SET	AUTO FLUSH BOLT	FB31/41 AS REQ'D	BLK	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	BLK	IVE
1	EA	ELECTRONIC LOCK	DL2700MORT	BLK	ALA

1	EA	CYLINDER	AS REQ'D	622	SCH
1	EA	COORDINATOR	COR2-COMPLETE	628	IVE
2	EA	CLOSER	4040XP EDA	693	LCN
2	EA	FLOOR STOP	FS441/442 AS REQUIRED	BLK	IVE
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

SEALS AND SWEEPS BY DOOR MANUFACTURER
DOORS MUST BE MEDIUM STILE TO MOUNT LOCK

HW SET: 18
DOOR NUMBER:
101P

EACH TO HAVE:

2	EA	PIVOT SET	7215	622	IVE
2	EA	INTERMEDIATE PIVOT	7215 INT	622	IVE
1	EA	MULLION	5654	DUR	VON
2	EA	EXIT DEVICE	AX-98-EO	711	VON
2	EA	ELECTRONIC EXIT DEVICE TRIM	ETDL2700	BLK	ALA
2	EA	CYLINDER	AS REQ'D	622	SCH
2	EA	CLOSER	4040XP S-CUSH	693	LCN
1	EA	THRESHOLD	102D OR AS DETAILED	DUR	ZER

SEALS AND SWEEPS BY DOOR MANUFACTURER
DOORS MUST BE WIDE STILE TO MOUNT PANICS

HW SET: 19
DOOR NUMBER:
101A

FOR THIS HARDWARE SET, PLEASE REFER TO
SECTION 08120 – FIRE RATED ALUMINUM
DOORS AND FRAMED

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows.
   2. Doors.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
   1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300.

1.3 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For each glazing products, in the form of 12-inch- square Samples for glass and of 12-inch- long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
   1. List by windows and door types scheduled on Drawings.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

E. Qualification Data: For installers.

F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Product Test Reports: For each types of glazing products specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain glazing products through one source from a single manufacturer for each glass type as practical.

C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
   1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
   1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
   2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

F. Safety Glazing Products:
   1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
   2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications:
      a. GANA's "Glazing Manual."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Glass Products:
   1. Warranty Period: 10 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass and Frosted Glass Manufacturers: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Vitro (formerly PPG). (Basis of Design)
   2. Guardian.
   3. Pilkington.
   4. Visteon.
   5. Or equal.

B. Fire-Rated Glass Manufacturers: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Safti First.
   2. Technical Glass Products (TGP).
   3. Vetrotech Saint-Gobain NA
   4. Or equal.

2.2 GLASS PRODUCTS

A. Heat-Treated Float Glass (Safety Glass): ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
   1. For uncoated glass, comply with requirements for Condition A.
   2. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
   3. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

B. Clear Insulating-Glass Units: Insulated glass units. Low-e with glass to elastomer edge seal. Outer pane of clear glass, inner pane of clear glass. Place reflective coating on No.2 surface within the unit.
   1. Product: Solarban 70 (low -e coating) by Vitro (Basis of Design).

a. Transmittance:
   1) Ultraviolet: 6%.
   2) Visible: 64%.
   3) Total Solar Energy: 25%.
b. Reflectance:
   1) Visible Light: 12%.
   2) Total Solar Energy: 52%.
c. U-Value:
   1) Winter Nighttime: 0.28.
   2) Summer Daytime: 0.26.
d. Shading Coefficient (SC): 0.32.
e. Solar Heat Gain Coefficient (SHGC): 0.27.
f. Light to Solar Gain (LSG): 2.37.

2. Glazing Assembly:
   a. Overall Unit Thickness: 1 inch.
   b. Interspace Content: 1/2 inch of Air.
   c. Outdoor Lite: 1/4 inch thick, tempered glass where required.
   d. Indoor Lite: 1/4 inch thick, tempered glass where required.

2.3 FROSTED GLASS

A. Vitro Pavia Acid Etch to create frosted look.

2.4 FIRE-RESISTANCE-RATED GLAZING

A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing according to ASTM E 119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that the glazing is approved for use in walls, and the fire-resistance rating in minutes.

C. Tempered Glazing Units with Clear Intumescent Interlayer: Double glazing units made from two lites of uncoated, fully tempered, ultraclear float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent interlayer; and complying with 16 CFR 1201, Category II.

D. SuperLite II-XL by Safti First or equal
   1. Fire-rating: As indicated on Drawings.
   2. Thickness: 1-1/8” standard and 1” thin profile.
   3. Weight: 9 lbs./sq. ft. in 1-1/8” standard profile.
   4. Sound Transmission Rating: STC 42 rating in 1-1/8” standard profile.
   5. Outdoor-Indoor Transmission Class: OITC 39 rating in 1-1/8” standard profile.
   6. Fire Rating: 60 minutes with hose stream Meets ASTM E119 and NFPA 251.
   7. Impact Safety Rating: CPSC 16 CFR 1201 Cat. I and II.
   8. Hard Body Impact Classification: ASTM C1629/C1629M Level 3.
   9. Soft Body Impact Classification: ASTM E695 Level 3.

10. Surface Abrasion Resistance: ASTM D4977 Level 3.

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
   1. Silicone complying with ASTM C 1115.

2.6 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:
   1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
   1. Silicone complying with ASTM C 1115.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
   1. Silicone complying with ASTM C 1115.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
   1. Silicone complying with ASTM C 1115.

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
   1. Silicone complying with ASTM C 1115.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep system.
   3. Minimum required face or edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant where indicated.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Fixed, extruded-aluminum louvers.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Samples for Initial Selection: For units with factory-applied color finishes.

C. Samples for Verification: For each type of metal finish required.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of louvers and vents that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Louvers: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Dayton. (Basis of Design)
   2. Ruskin Company. (Basis of Design)
   3. Industrial Louvers, Inc.
   4. Greenheck.
   5. Construction Specialties, Inc.
   6. Or equal

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26, alloy 319.

D. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use screws for exposed fasteners, unless otherwise indicated.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
   1. Caulking and sealants applied on the interior of the building envelope shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

2.3 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
   1. Frame Type: Channel, unless otherwise indicated.

C. Include supports, anchorages, and accessories required for complete assembly.

D. Provide subsills made of same material as louvers or extended sills for recessed louvers.

E. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 METAL LOUVERS

A. Products: As indicated on Drawings.

2.5 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic-Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Fluoropolymer Two-Coat Coating System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
      a. Color and Gloss: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Vandal Protection: Louvers located in accessible areas shall use special vandal resistant hardware for installation.

D. Form closely fitted joints with exposed connections accurately located and secured.

E. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

F. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
   1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.

B. Related Sections include the following:
   1. Division 7 Section "Building Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
   2. Division 9 Section “Painting” for primers and finishes applied to gypsum board surfaces.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
   2. Finishes: Level 4 and 5 of gypsum board finish indicated for use in exposed locations. 4 by 4 foot sample.
      a. Finishes: For each finish indicated and on same backing indicated for Work.

1.3 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency acceptable to authorities having jurisdiction.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Install mockups for the following:
      a. Each level of gypsum board finish indicated for use in exposed locations.
      b. Each finish indicated.
      c. Each areas such as walls, ceilings, and soffits.
   2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
   3. Simulate finished lighting conditions for review of mockups.
   4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gypsum board that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Interior Gypsum Board: Subject to compliance with requirements, provide products by one of the following:
   1. USG Corporation.
   2. National Gypsum Company.
   3. G-P Gypsum.
   4. Or equal.

B. Steel Trim Accessories: Subject to compliance with requirements, provide products by one of the following:
   1. USG Corporation.
   2. Amico.
   3. Or equal.

2.2 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36 or ASTM C 1396, as applicable to type of gypsum board indicated and whichever is more stringent.

B. Type X:
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

C. Water-Resistant Gypsum Backing Board: ASTM C 630 or ASTM C 1396.
   1. Core: 5/8 inch, Type X.
   2. Products:
      a. USG Mold Tough Firecode Core Gypsum Panels by USG.
      b. Gold Bond Brand Moisture-Resistant Fire Resistant Gypsum Board by National Gypsum.
      c. Or equal.
   3. When Water-Resistant Gypsum Backing Boards are not available (gradual phasing out by manufacturers), provide Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
      a. ToughRock Mold Guard by Georgia Pacific.
      b. Mold Tough Firecode Core Gypsum Panels by USG.
      c. XP Wallboard by National Gypsum.
      d. Or equal.

2.4 TRIM ACCESSORIES

A. Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      d. L-Bead: L-shaped; exposed long flange receives joint compound.
      e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      f. Expansion (control) joint.
      g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim and Reveal: As specified in Division 9 Section “Portland Cement Plaster”.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Sealants shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

C. Acoustical Sealant: Sheetrock Acoustical Sealant by USG or equal.
   1. Sealants shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

D. Thermal and Acoustical Insulation: As specified in Division 7 Section "Building Insulation."

E. Gypsum Board Adhesives:
   1. High performance latex-based construction adhesive designed for gypsum board applications.
   2. Adhesives shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.
   3. Products:
      a. Green Series SW-325 Shear & Drywall Adhesive by OSI.
      b. Drywall Adhesive GDWA by Grabberman.
      c. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

3.3 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Owner’s Representative for visual effect.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners, unless otherwise indicated.
   2. LC-Bead: Use at exposed panel edges.
   3. L-Bead: Use where indicated.
   4. U-Bead: Use at exposed panel edges.
   5. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.4 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Comply with GA 214 for Level definitions.
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for ceramic tile or acoustical tile.
   3. Level 3: Where indicated on Drawings.
   4. Level 4: At panel surfaces that will be exposed to view with paint finish.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.
   5. Level 5: At panel surfaces that will be exposed to view with non-flat paint finish.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.

3.5 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Tile.
   2. Waterproof membrane for tile installations.
   3. Cementitious backer units installed as part of tile installations.

1.2 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

D. Handbook for Ceramic Tile Installation published by the Tile Council of North America (TCNA).

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
   1. Propose locations of expansion, contraction, control, and isolation joints if not indicated on Drawings.

C. Installation Method: Show TCNA installation method number for each tiled area in tabulated form.

D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

E. Product Certificates: For each type of product, signed by product manufacturer.

F. Qualification Data: For Installer.

G. Material Test Reports: For each tile-setting and -grouting product.

1.4 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
   1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

D. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of ceramic tile and accessories that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tile: Subject to compliance with requirements, provide products by one of the following manufacturers.
   1. FireClay. (Basis of Design)
   2. Daltile; Div. of Dal-Tile International Inc.
   3. American Olean; Div. of Dal-Tile International Corp.
   4. Crossville Ceramics Company, L.P.
   5. Interceramic.
   6. Bedrosians.
   7. Emser Tile.
   8. Or equal.

B. Setting, Grouting Materials: Subject to compliance with requirements, provide products by one of the following manufacturers.
   1. Custom Building Products.
   2. LATICRETE International Inc.
   3. MAPEI Corporation.
   4. Sienna.
   5. Tec by H.B. Fuller.
   6. Or equal.

C. Fluid Applied Waterproofing and Crack Suppression for Tile Installation: Subject to compliance with requirements, provide products by one of the following manufacturers.
   1. RedGard by Custom Building Products.
   2. Mapelastic 315 by Mapei.
   3. Laticrete 9235 Waterproof Membrane by LATICRETE International Inc.
   4. Or equal.

D. Cementitious Backer Board: Subject to compliance with requirements, provide products by one of the following manufacturers.
   1. USG Corporation; DUROCK Cement Board.
   2. National Gypsum Company; PermaBase.
   3. C-Cure; C-Cure Board 990.
   4. Custom Building Products; Wonderboard.
   5. Or equal.

E. Glass Mat Gypsum Backer Board:
   1. Georgia Pacific (GP); DensArmor Plus.
   2. USG Corporation; Sheetrock Glass-Mat-Mold-Tough.
   3. National Gypsum Company.
   4. Or equal.

F. Metal Edge Strips and Transitions: Subject to compliance with requirements, provide products by one of the following manufacturers.
   1. Schluter Systems (Basis of Design).
   2. Blanke.
   3. Or equal.

2.2 PRODUCTS, GENERAL

A. Tile Flooring shall be stable, firm, and slip resistant.

B. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements.

C. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

A. Tile: As indicated on Drawings.

B. Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

2.5 FLUID-APPLIED WATERPROOFING AND CRACK SUPPRESION FOR TILE INSTALLATIONS

A. General: Manufacturer's standard product that complies with ANSI A118.10.

B. Fabric-Reinforced, Fluid-Applied Product: System consisting of liquid-latex rubber, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and fabric reinforcement.

2.6 SETTING AND GROUTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
   1. Prepackaged dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive.
      a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.
   2. Products:
      a. Custom Building Products: MegaFlex.
      b. MAPEI: Ultraflex 2, Walls: MAPEI Ultralite.
      c. 254 Platinum by Laticrete.
      d. Or equal.

B. Chemical-Resistant, Water-Cleanable, Grouting Epoxy: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by manufacturer for intended use.
   2. Products:
      a. Custom Building Products: 100% Solids Epoxy Grout.
      b. MAPEI: Kerapoxy IEG.
      c. SpectraLock Pro by Laticrete.
      d. Or equal.

2.7 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."
   1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

2.8 TILE BACKER UNITS

A. Cementitious Back Units:
   1. Aggregated portland cement board with coated glass-mesh reinforcement scrim.
   2. Comply with ANSI A118.9.
   3. Pass ASTM E136 for non-combustibility.
   4. Thickness: As indicated on Drawings.
   5. Lengths: Maximum lengths available to minimize end-to-end butt joints.

2.9 FINISHING AND EDGE-PROTECTION PROFILES FOR WALLS AND COUNTERTOPS

A. Schluter-DESIGNBASE: SL: E: Prefabricated Baseboard Brushed Stainless Steel profile comprised of a symmetrically rounded top, flat exposed face, and 7/16 inch radius lower section.
   1. Corners: Matching inside corners.
   2. Corners: Matching outside corners.
   3. Corners: Matching connectors.
   4. Corners: Matching end caps.
   5. Corners: Matching Sealing Lip.
   6. Material and Finish: EB: Brushed Stainless Steel Type 304 equals V2A
      a. Profile Height: 6-3/8 inch.

2.10 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: ADA compliant, angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, in aluminum finishes selected by Architect.
   1. Outside Corners: ECK-E by Schluter or equal.
   2. Exposed Edges: JOLLY by Schluter or equal.

C. Transitions: ADA compliant, various shapes, height to match tile and setting-bed thickness, metallic designed specifically for flooring applications, in aluminum finishes selected by Architect.
   1. Reno, Reno-T, Reno-U, Reno-TK, and Reno-Ramp by Schluter or equal.

2.11 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
      a. Sub-floor and Vertical Surfaces: 1/4 inch in 10 feet.
   2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
   3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors installed with mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
   1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
   2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Substrate Flatness Requirements: ANSI A108.02 / Section 4.0 General Requirements.
   1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
   2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCNA Installation Guidelines: TCNA’s "Handbook for Ceramic Tile Installation." Comply with TCNA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates.

H. Grout tile to comply with requirements of the following tile installation standards:
   1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.

B. Do not install tile over waterproofing until waterproofing has been tested to determine that it is watertight.

3.6 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

B. Joint Widths: 1/16 inch unless specified otherwise.

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.7 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: 1/16 inch unless specified otherwise.

3.8 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove epoxy grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.9 FLOOR TILE INSTALLATION, TCNA ASSEMBLY

A. Tile Installation: Interior floor installation on waterproof membrane over concrete; thin-set mortar; TCNA F122 and ANSI A108.5.
1. Mortar: Latex-portland cement mortar.
2. Grout: Chemical-resistant, water-cleanable, tile-grouting epoxy.

3.10 WALL TILE INSTALLATION, TCNA ASSEMBLY

A. Ceramic Tile Installation TCNA W244E: Exterior Wall Installations, Wood or Metal Studs, thinset mortar over waterproof membrane on cementitious backer units.
1. Thinset Mortar: Modified dry-set portland cement mortar.
2. Grout: High-performance sanded grout.

B. Tile Installation: Interior wall installation over cementitious backer units; thin-set mortar; TCNA B415, TCNA W244 (W244C), and ANSI A108.5.
1. Mortar: Latex-portland cement mortar.
2. Grout: Chemical-resistant, water-cleanable, tile-grouting epoxy.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes acoustical panels and suspension systems for ceilings.

1.2 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For components with factory-applied color finishes.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

E. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

F. Maintenance Data: For finishes to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical panel ceilings that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acoustical Panels, Clouds, and Baffles: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Armstrong World Industries, Inc. (Basis of Design)
2. USG Interiors, Inc.
3. Rockfon.
4. Tectum Inc.
5. Or equal.

B. Architectural Audio Absorption Panels:
1. Polysorb. (Basis of Design)
2. Or equal.

C. Suspension Systems: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Armstrong World Industries, Inc. (Basis of Design)
2. USG Interiors, Inc.
3. Chicago Metallic Corporation.
4. Or equal.

2.2 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Products: As indicated on Drawings.

2.4 ARCHITECTURAL AUDIO ABSORPTION PANELS

A. Product: Standard Colors Polysorb or equal.
1. Thickness: 1 inch standard.
2. Core Density: 6 PCF.
3. NRC: 0.70.
4. SAA: 0.70.
5. FSI: Class A Flame Spread Index.

6. Attachment: Type A mounting method.
7. Face type: Ironed smooth face.
8. Color: Cloud.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

H. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

I. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.6 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; heavy-duty.
   1. Product: 7301 Prelude XL by Armstrong or equal.
      a. Profile: Tee; 15/16 inch wide face.
      b. Construction: Double web.
      c. Structural Classification: ASTM C 635 Heavy-Duty.
      d. Finish: Factory painted white.

2.7 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic

design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.

2.8 ACOUSTICAL SEALANT

A. Comply with requirement of Division 7 “Joint Sealants”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. Install suspension system and panels in accordance with manufacturer’s written instructions.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Luxury Vinyl Tile (LVT).
   2. Rubber Stair Treads.
   3. Resilient wall base and accessories.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include concrete moisture and alkalinity limits.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification:
   1. Full-size units of each color and pattern of resilient floor tile required.
   2. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches long, of each resilient product color and pattern required.

D. Maintenance Data: For resilient products to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

1.5 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install resilient products after other finishing operations, including painting, have been completed.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of resilient floor tile that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer's Warranty: 1 year.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
   2. Resilient Wall Base and Accessories: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Luxury Vinyl Tile (LVT): Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Shaw Contract. (Basis of Design)
   2. Armstrong World Industries, Inc.
   3. Lightwood by TOLI International.
   4. Marley Flexco (USA), Inc.
   5. Roppe Corporation.
   6. VPI, LLC, Floor Products Division.
   7. Urban Surfaces.
   8. Or equal.

B. Type TS Resilient Wall Base and Accessories: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Johnsonite. (Basis of Design)
   2. Tarkett.
   3. Burke Mercer Flooring Products.

4. Flexco.
5. Nora.
6. Roppe.
7. Or equal.

C. Stair Accessories: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. VPI. (Basis of Design)
2. Norament by Nora Rubber Flooring, Freudenberg Building Systems, Inc.
3. Burke Mercer Flooring Products.
4. Johnsonite.
5. Roppe Corporation.
6. Or equal.

2.2 LUXURY VINYL TILE (LVT)

A. Product: As indicated on Drawings.

2.3 RESILIENT TILE

A. Product: As indicated on Drawings.

2.4 RESILIENT TRADITIONAL RUBBER DURACOVE WALL BASE

A. Products: As indicated on Drawings.

2.5 RESILIENT MOLDING ACCESSORY

A. Types:
1. Reducer strip for resilient floor covering
2. Joiner for tile and carpet.

B. Material: Rubber.

C. Profile and Dimensions: As indicated.

2.6 RESILIENT STAIR ACCESSORIES

A. Product: As indicated on Drawings.

2.7 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed resilient tile and as recommended/ required by the manufacturer for warrantee acceptance or provided by resilient tile manufacturer for the type of carpet being installed.
   1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. VCT and Asphalt Tile Adhesives: 50 g/L.
      b. Cove Base Adhesives: 50 g/L.
      c. Rubber Floor Adhesives: 60 g/L.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
   1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Concrete Substrates:
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Independent moisture and alkalinity testing prior to installation of resilient flooring.
   3. Provide barrier if testing fails.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
   1. Do not install resilient products until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
   2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.5 RESILIENT ACCESSORY INSTALLATION

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.6 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.
      a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
   1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
      a. Use commercially available product acceptable to manufacturer.
   2. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096519

SECTION 096723 – RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Resinous Flooring.

1.2 SUBMITTALS

A. Product Data: Descriptive data and specific recommendations for surface preparation, mixing, and application of materials.

B. Acceptance Sample: As required by owner, one foot square (1 ft. by 1 ft.) sample of the specified flooring system applied to hardboard or similar backing for rigidity and ease of handling.

C. Maintenance data: Give instructions for general maintenance and repair of surfaces and finishes.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Pre-qualification requirements: Only approved applicators, licensed by manufacturer shall be considered for qualification.
   2. Each approved applicator shall have been qualified by the manufacturer as knowledgeable in all phases of surface preparation.
   3. Each approved applicator must have three (3) years experience of installing resinous flooring systems and submit a list of five projects/references as a prequalification requirement. At least one of the five projects/ references must be of equal size, quantity, and magnitude to this project as a prequalification requirement. Owner has the option to personally inspect the projects/references to accept or reject any of the Contractors prior to bid time as a prequalification requirement.

B. Subcontractor Qualifications:
   1. The only approved and specified subcontractors for this resurfacing work shall be for shot-blast cleaning of the concrete substrate.

C. Acceptance Sample:
   1. Representative sample of the specified flooring system shall be submitted to the Owner prior to the bidding phase of the project. All bidders shall inspect the “acceptance sample” before submitting their bids.
   2. The installed flooring system shall be similar to the acceptance sample in thicknesses of respective film layers, color, texture, overall appearance and finish.

D. Bond Testing: Surface preparation efforts shall be evaluated by conducting Bond Tests at the site prior to application of the flooring system(s).

E. Pre-Job Meeting
   1. Owner requires a Pre-Job Meeting with representatives of Owner, Contractor/Applicator, and Material Manufacturer in attendance. The agenda shall include a review and clarification of this specification, application procedures, quality control, inspection and acceptance criteria, and production schedules.
   2. Applicator is not authorized to proceed until this meeting is held or waived by Owner.

1.4 DELIVERY, STORAGE, AND HADLING

A. All material shall be delivered in original Manufacturer's sealed containers with all pertinent labels intact and legible.

B. Follow all Manufacturer's specific label instructions and prudent safety practices for storage and handling.

1.5 PROJECT / SITE CONDITIONS

A. Material, air, and surface temperatures shall be in the range recommended by resinous flooring manufacturer.

B. Relative humidity in the specific location of the application shall be as recommended by resinous flooring manufacturer.

C. Concrete shall have a moisture emission rate of no more than recommended by resinous flooring manufacturer.

D. Vapor barriers and/or suitable means shall have been installed beneath grade slabs to prevent vapor transmission.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace flooring that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Resinous Flooring:
   1. Dex-O-Tex. (Basis of Design)
   2. Polycoat.
   3. Stonhard.
   4. Key Resin Company.
   5. Or equal.

2.2 RESINOUS FLOORING

A. Product: Weatherwear by Dex-O-Tex or equal.

1. The trowel applied waterproof neoprene composition traffic bearing roof deck surfacing system shall be composed of a slip-sheet, waterproof membrane, traffic surfacing and finish coats, and shall conform to the following standards:
    a. Traffic deck binder and all rubber emulsions shall be compounded with neoprene liquid and shall have a minimum neoprene solids content of 35% when tested by the dry cup method.
    b. Aggregate for traffic surface coating shall be suitably graded, fine trap-rock passing a #20 mesh sieve and retained on a #40 mesh sieve.
    c. Slip-Sheet shall consist of an asphalt-saturated glass fiber matting weighing not less than 20 lbs. per 100 square feet and no more than 30 lbs. per 100 square feet and contain no rag or organic fibers.
    d. Fabric used as reinforcement for waterproof flashing shall be 7-1/2 oz. woven polypropylene fabric.
    e. Fabric used as reinforcement for waterproof membrane on horizontal surfaces shall be a minimum 1 oz. per square foot non-directional glass fiber matting.
    f. Final Finish dressing shall be a single component, water-phase acrylic latex emulsion material, pigmented and of a consistency suitable for roller application.
2. Colors: As indicated, or if not otherwise indicated, as selected by Architect from manufacturer's standard colors.
3. Physical Properties:
    a. Provide a waterproof deck covering system that meets or exceeds the listed minimum physical property requirements when tested according to the referenced standard test methods in parentheses.
    b. Weight: 2.5 lbs. per sq. ft..
    c. Accelerated Weathering (ASTM G23): No cracking, blistering, delamination, chalking, (Atlas Twin-Arc Weatherometer) crazing or color change under 5X magnification.
    d. Cycles Wet/Dry 2000 hours:
        1) Dry: 1450 F, 120 mins.
        2) Wet: 600 F, 18 mins.
    e. Accelerated Aging (ASTM D756)No cracking, blistering, delamination, (Procedure D & E - 6 cycles) chalking, crazing or color change.
    f. Freeze-Thaw (ASTM C97): No breakage or weight loss > 1.0%.
    g. Abrasion (ASTM D1242): 4.3% Thickness Reduction (1,000 revolutions, 1,000 gr. No. 80 TP load aluminum oxide grit).
    h. Percolation (ICC standard): Complies to ICC Test Method for this Standard.
    i. Water Absorption (ASTM D570): <6.09% No warping or cracking
    j. Wind Uplift (ICC Factory Mutual 1-52): Qualifying Wind Velocity with Safety Factor of 3. Wind Velocity 131 MPH.
    k. Flammability (ASTM E108, UL 790, NFPA 256):
        1) Intermittent Flame Exposure: Class A.
        2) Spread of Flame: Class A.
        3) Burning Brand: Class A.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where the urethane cement composition flooring is to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Architect.

3.2 Moisture Test: Perform moisture test in conformance with ASTM F 1869 and ASTM F 2170

3.3 SUBSTRATE PREPARATION

A. Substrate: Perform preparation and cleaning procedures according to flooring manufacturer's instructions for particular substrate conditions involved, and as specified. Provide clean, dry, and neutral substrate for flooring application.

B. Concrete - Provide a substrate that is free from any curing compounds, sealers, hardeners, grease, oil or any other contaminates. Shot blast (brush blast) or diamond grind substrate to provide an acceptable surface profile for subsequent application.

C. Materials: Mix resin hardener and aggregate as required, and prepare materials according to flooring system manufacturer's instructions.

3.4 FLOOR APPLICATION

A. General: Apply each component of urethane cement composition flooring system according to manufacturer's directions to produce a uniform monolithic flooring surface of thickness indicated.

B. Body Coat: Over prepared surface, Screed mortar mix at nominal 3/16” – ¼” inch thickness as specified. Allow material flow out and begin to settle. Back roll with a spike roller or looped roller as appropriate to distribute material to a smooth even finish.

C. Cove Base: Apply cove base mix to wall surfaces at locations shown to form cove base height of 4 inches unless otherwise indicated. Follow manufacturer's printed instructions and details including taping, mixing, troweling, and sanding, of cove base.

D. Apply 2 coats of polyaspartic topcoat with nonslip aggregate as approved by Architect.

3.5 CURING, PROTECTION AND CLEANING

A. Cure epoxy resin composition flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.

B. Protect finished floor with wax paper. Use Masonite, if rolling load traffic exists.

C. Clean with manufacturer recommended cleaner.

END OF SECTION 096723

SECTION 096813 – TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes modular, carpet tile.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
   1. Include concrete moisture and alkalinity limits.

B. Shop Drawings: Show the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
   2. Existing flooring materials to be removed.
   3. Existing flooring materials to remain.
   4. Carpet tile type, color, and dye lot.
   5. Type of subfloor.
   6. Type of installation.
   7. Pattern of installation.
   8. Pattern type, location, and direction.
   9. Pile direction.
   10. Type, color, and location of insets and borders.
   11. Type, color, and location of edge, transition, and other accessory strips.
   12. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   1. Carpet Tile: Full-size Sample.
   2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
   1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

H. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

B. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
   1. Review delivery, storage, and handling procedures.
   2. Review ambient conditions and ventilation procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.6 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, and delamination.
   3. Warranty Period: Lifetime.

B. Installer’s Warranty: 1 year.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Carpet Tile: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Shaw. (Basis of Design)
   2. Tarkett; formerly Tandus Centiva.
   3. Interface.
   4. Mohawk.
   5. Or equal.

2.2 CARPET TILE

A. Products: As indicated on Drawings.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and as recommended/ required by the manufacturer for warrantee acceptance or provided by carpet tile manufacturer for the type of carpet being installed.
   1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:
      a. Total VOCs: 50g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Substrates:
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.

2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Surface Preparation.
   2. Field application of paints, stains, varnishes, and other coatings.

1.2 SUBMITTALS

A. Product data - Submit product data sheets for each product.

B. Samples:
   1. Submit two painted samples, illustrating selected colors and textures for each color and systems selected with specified coats cascaded.
   2. Submit on suitable backing, 8x10 inch size.

1.3 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

C. Environment Requirements:
   1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.
   2. Do not paint when there is a threat of rain within 24 hours or when surface or air temperatures are at or below 40 degrees.

1.5 WARRANTY

A. Installer Warranty: 1 year.

1.6 EXTRA STOCK

A. Minimum 1 gallon each product in original or new 1 gallon cans.
   1. Color spot each lid.
   2. Identify with formula, location, product and date.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Paints: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Dunn-Edwards (Basis of Design)
   2. PPG.
   3. Sherwin Williams.
   4. Vista Paint.
   5. Or equal.

2.2 PAINTS AND COATINGS

A. Ready mixed, except field-catalyzed coatings.

B. Prepare pigments:
   1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogenous coating.
   2. For good flow and brushing properties.
   3. Capable of drying or curing free of streaks or sags.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application. Do not proceed unless substrate is suitable.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent
   3. Interior Wood: 15 percent, measured in accordance with ASTMD4442.
   4. Exterior Wood: 15 percent, measured in accordance with ASTMD4442.

3.2 PREPARATION OF SURFACE

A. General:
   1. Clean all exterior walls and surfaces of loose and scaly paint, dirt, dust, chalk, and other foreign matter by water-blasting using care not to damage substrate followed by hand scraping, sanding or wire brushing after surfaces are dry. Mildew must be treated with household bleach solution and rinsed thoroughly.
   2. Patch, caulk, set protruding nails and repair all surfaces and cracks where necessary with suitable patching materials and smooth off to match adjacent surfaces.
   3. Sand Glossy surfaces to dull surface and remove residue.
   4. Remove mildew from affected surfaces with a solution of Tri-Sodium Phosphate and bleach. Rinse with clean water and allow to dry completely.
   5. Existing surfaces to be recoated shall be thoroughly cleaned and de-glossed by sanding or other means prior to priming and painting. Patched and bare areas shall be spot primed with the same primer as specified for new work.
   6. Rusty metal: Scrape, sand or wire wheel, feathering edges to sound coating. Dust surfaces. Topcoat.
   7. Remove soil and body oils completely from surfaces, including handrails, door edges and posts. Treat with Liquid Sandpaper or Dull-N-Bond.
   8. Remove hardware, accessories, plates, fixtures and similar items not to be finished. Reinstall at completion.
   9. Paint edges of sink cut-outs.

B. Galvanized Surfaces: Remove all oils and contamination from galvanized surfaces scheduled to be painted by washing with a compliant solvent wash.

C. Ferrous Metal: Remove grease, rust, scale, dirt and dust from ferrous metal surfaces. Primer coat shall be applied not less than 30 minutes, nor more than 3 hours after preparation of surface.

D. Primed Metal: Sand and scrape shop primed metal to remove loose primer and rust. Touch-up bare, abraded and damaged areas with metal primer. Feather edges to make touch-up patches inconspicuous.

E. Gypsum Board: Gypsum board shall be dusted clean and free from encrustations and other foreign matter.

F. Preparation of other surfaces shall be performed following specific recommendations of the coating manufacturer.

3.3 PREVISOUSLY COATED SURFACES

A. Maintenance painting will frequently not permit or require complete removal of all old coatings prior to repainting. However, all surface contamination such as oil, grease, loose paint, mill scale dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers must be removed to assure sound bonding to the tightly adhering old paint. Glossy surfaces of old paint films must be clean and dull before repainting. Thorough washing with an abrasive cleanser will clean and dull in one operation, or, wash thoroughly and dull by sanding. Spot prime any bare areas with an appropriate primer. Recognize that any surface preparation short of total removal of the old coating may compromise the service length of the system. Check for compatibility by applying a test patch of the recommended coating system, covering at least 2 to 3 square feet. Allow to dry

one week before testing adhesion per ASTM D3359. If the coating system is incompatible, complete removal is required per ASTM D4259.

3.4 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust particles just prior to applying next coat.

F. Stipple all edges and corners to conceal brush marks.

G. Paint entire trim element with like color. Painting of faces only is unacceptable. Trim surfaces must be wrapped with the trim color and not "faced off" or "Hollywooded".

H. Doors: Paint entire door unless otherwise noted, including door top and bottom edge surfaces.

I. Tinting: Tint each primer a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint primer to match the color of the finish coat, but provide sufficient differences in shade of primer to distinguish each separate coat.

3.5 PROTECTION

A. Protect work of other trades and items not intended to receive paint. Install "wet paint" signs to protect newly painted surfaces.

3.6 CLEANING

A. Protection - Carefully protect areas where work is in progress from damage.
   1. Provide and spread clean drop cloths when and where required to provide the necessary protection.
   2. Immediately clean-up all accidental spatter, spillage, misplaced paint and restore the affected surface to its original condition.

B. Clean-up:
   1. Clean up debris daily per OSHA requirements.
   2. At completion of work, remove all materials, supplies, debris and rubbish and leave each area in a clean, acceptable condition.
   3. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.7 SURFACES TO BE FINISHED

A. Paint all new work and areas affected by new work, unless noted otherwise.

B. Do not paint or finish the following items:
   1. Items fully factory-finished unless specifically noted.
   2. Fire rating labels, equipment serial number and capacity labels.

C. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
   1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
   2. Paint shop primed items occurring in finished areas.
   3. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint.
   4. Paint dampers exposed behind louvers, grilles and convector and baseboard cabinets to match face panels.

3.8 PAINT SYSTEMS – EXTERIOR

A. Concrete and Plaster:
   1. Flat – Modified Copolymer / 100% Acrylic:
      a. First Coat: FLEX-PRIME Select, Flexible Crack-Resistant Primer (FPSL00) or EFF-STOP SELECT Interior /Exterior Primer Sealer (ESSL00).
      b. Second Coat: SPARTASHIELD Exterior Flat Paint (SSHL10).
      c. Third Coat: SPARTASHIELD Exterior Flat Paint (SSHL10).

B. Concrete Block – CMU:
   1. Flat –Acrylic Copolymer / 100% Acrylic:
      a. First Coat: SMOOTH BLOCFIL SELECT Concrete Block Filler (SBSL00).
      b. Second Coat: SPARTASHIELD Exterior Flat Paint (SSHL10).
      c. Third Coat: SPARTASHIELD Exterior Flat Paint (SSHL10).

C. Wood – Paint Finish:
   1. Flat:
      a. First Coat: EZ-PRIME Premium, Exterior Wood Primer (EZPR00).
      b. Second Coat: SPARTASHIELD Exterior Flat Paint (SSHL10).
      c. Third Coat: SPARTASHIELD Exterior Flat Paint (SSHL10).
   2. Velvet:
      a. First Coat: EZ-PRIME Premium, Exterior Wood Primer (EZPR00).
      b. Second Coat: SPARTASHIELD Exterior Velvet Paint (SSHL20).
      c. Third Coat: SPARTASHIELD Exterior Velvet Paint (SSHL20).
   3. Eggshell:
      a. First Coat: EZ-PRIME Premium, Exterior Wood Primer (EZPR00).
      b. Second Coat: SPARTASHIELD, Exterior Eggshell Paint (SSHL30).
      c. Third Coat: SPARTASHIELD, Exterior Eggshell Paint (SSHL30).
   4. Low Sheen:
      a. First Coat: EZ-PRIME Premium, Exterior Wood Primer (EZPR00).
      b. Second Coat: SPARTASHIELD, Exterior Low Sheen Paint (SSHL40).
      c. Third Coat: SPARTASHIELD, Exterior Low Sheen Paint (SSHL40).
   5. Semi-Gloss:

a. First Coat: EZ-PRIME Premium, Exterior Wood Primer (EZPR00).
b. Second Coat: SPARTASHIELD, Exterior Semi-Gloss Paint (SSHL50).
c. Third Coat: SPARTASHIELD, Exterior Semi-Gloss Paint (SSHL50).

6. Gloss:
a. First Coat: EZ-PRIME Premium, Exterior Wood Primer (EZPR00).
b. Second Coat: SPARTASHIELD, Exterior Gloss Paint (SSHL60).
c. Third Coat: SPARTASHIELD, Exterior Gloss Paint (SSHL60).

D. Wood Rough Sawn – Stain Finish – Opaque:
1. Two Coats: SPARTASHIELD Exterior Flat Paint (SSHL10).

E. Wood – Stain Finish – Semi-Transparent:
1. Two Coats: OKON WEATHER PRO, 100% Acrylic Semi-Transparent Stain (WPT3).

F. Ferrous Metal:
1. Semi-Gloss – Water-Based / 100% Acrylic:
a. First Coat: Spot Prime - BLOC-RUST Red Oxide or White (BRPR00-1-RO or BRPR00-1-WH. Full Prime - ENDURAPRIME Metal Primer (ENPR00).
b. Second Coat: SPARTASHIELD Exterior Semi-Gloss Paint (SSHL50).
c. Third Coat: SPARTASHIELD Exterior Semi-Gloss Paint (SSHL50).

G. Non-Ferrous (Galvanized) Metal:

1. Semi-Gloss – Water-Based / 100% Acrylic:
a. Pretreatment: KRUD KUTTER Metal Clean & Etch (SC-ME-01-1).
b. First Coat: ULTRASHIELD Galvanized Metal Primer (ULGM00).
c. Second Coat: SPARTASHIELD Exterior Semi-Gloss Paint (SSHL50).
d. Third Coat: SPARTASHIELD Exterior Semi-Gloss Paint (SSHL50).

3.9 PAINT SYSTEMS -INTERIOR - ZERO VOC

A. Gypsum Board:

1. Flat, Modified Copolymer, Low-Odor/Zero-VOC:
a. First Coat: VINYLASTIC Select Low odor Zero VOC Sealer (VNSL00).
b. Two Coats: SPARTAZERO Low-Odor/Zero-VOC Interior Flat Paint (SZRO10).
2. Eggshell, Modified Copolymer, Low-Odor/Zero-VOC:
a. First Coat: VINYLASTIC Select Low odor Zero VOC Sealer (VNSL00).
b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Eggshell Paint (SWLL30).
3. Semi-Gloss, 100% Acrylic, Low-Odor/Zero-VOC:
a. First Coat: First Coat: VINYLASTIC Select Low odor Zero VOC Sealer (VNSL00).
b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Semi-Gloss Paint (SWLL50).
4. Flat, Modified Copolymer, Low-Odor/Zero-VOC:
a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
b. Two Coats: SPARTAZERO Low-Odor/Zero-VOC Interior Flat Paint (SZRO10).
5. Eggshell, Modified Copolymer, Low-Odor/Zero-VOC:
a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Eggshell Paint (SWLL30).

6. Semi-Gloss, 100% Acrylic, Low-Odor/Zero-VOC:
    a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
    b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Semi-Gloss Paint (SWLL50).

B. Masonry (CMU) with Block Filler:
1. Flat, Modified Copolymer, Low-Odor/Zero-VOC:
    a. First Coat: Concrete Block Filler - Smooth BLOCFIL Select Interior /Exterior Smooth Block Filler (SBSL00).
    b. SPARTAZERO Low-Odor/Zero-VOC Interior Flat Paint (SZRO10).
2. Eggshell, Modified Copolymer, Low-Odor/Zero-VOC:
    a. First Coat: Concrete Block Filler – Smooth BLOCFIL Select Interior /Exterior Smooth Block Filler (SBSL00).
    b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Eggshell Paint (SWLL30).
3. Semi-Gloss, 100% Acrylic, Low-Odor/Zero-VOC:
    a. First Coat: Concrete Block Filler - Smooth, BLOCFIL Select Interior /Exterior Smooth Block Filler (SBSL00).
    b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Semi-Gloss Paint (SWLL50).

C. Wood:
1. Flat, Modified Copolymer, Low-Odor/Zero-VOC:
    a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
    b. Two Coats: SPARTAZERO Low-Odor/Zero-VOC Interior Flat Paint (SZRO10).
2. Eggshell, Modified Copolymer, Low-Odor/Zero-VOC:
    a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
    b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Eggshell Paint (SWLL30).
3. Semi-Gloss, 100% Acrylic, Low-Odor/Zero-VOC:
    a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
    b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Semi-Gloss Paint (SWLL50).

D. Metals: Ferrous

1. Flat, Modified Copolymer, Low-Odor/Zero-VOC:
    a. First Coat: Spot Prime - BLOC-RUST Red Oxide or White (BRPR00-1-RO or BRPR00-1-WH). Full Prime - ENDURAPRIME Metal Primer (ENPR00).
    b. Two Coats: SPARTAZERO Low-Odor/Zero-VOC Interior Flat Paint (SZRO10).
2. Eggshell, Modified Copolymer, Low-Odor/Zero-VOC:
    a. First Coat: Spot Prime - BLOC-RUST Red Oxide or White (BRPR00-1-RO or BRPR00-1-WH). Full Prime - ENDURAPRIME Metal Primer (ENPR00).
    b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Eggshell Paint (SWLL30).
3. Semi-Gloss, 100% Acrylic, Low-Odor/Zero-VOC:
    a. First Coat: Spot Prime - BLOC-RUST Red Oxide or White (BRPR00-1-RO or BRPR00-1-WH). Full Prime - ENDURAPRIME Metal Primer (ENPR00)
    b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Semi-Gloss Paint (SWLL50).

E. Metals: Non-Ferrous.

1. Flat, Modified Copolymer, Low-Odor/Zero-VOC:
   a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
   b. Two Coats: SPARTAZERO Low-Odor/Zero-VOC Interior Flat Paint (SZRO10).
2. Eggshell, Modified Copolymer, Low-Odor/Zero-VOC:
   a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
   b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Eggshell Paint (SWLL30).
3. Semi-Gloss, 100%Acrylic, Low-Odor/Zero-VOC:
   a. First Coat: ULTRA-GRIP Select Low odor Zero VOC Primer (UGSL00).
   b. Two Coats: SPARTAWALL Low Odor/Zero VOC Interior Semi-Gloss Paint (SWLL50).

3.10 COLORS

A. As indicated on the Drawings.

END OF SECTION 099100

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Panel signs (room signs).
   2. Parking signs.
   3. Traffic signs.
   4. Exterior building signs.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
   1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.

C. Qualification Data: For Installer.

D. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of signage manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain each sign type through one source from a single manufacturer.

C. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1.4 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.5 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.
   1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signage fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Signs: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Best Sign Systems Inc. (Basis of Design)
   2. Apco Graphics Inc.
   3. ASI Sign Systems, Inc.
   4. Curcio Enterprises, Inc.
   5. Mohawk Sign Systems.
   6. Sign A Rama.
   7. Or equal.

B. Exterior Signs: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Gemini, Inc.
   2. A.R.K. Ramos Mfg. Co., Inc.
   3. La Haye Bronze.
   4. Metal Arts; Division of L & H Mfg.
   5. Mills Manufacturing. Inc.
   6. Southwell Co.
   7. Or equal.

2.2 PANEL SIGNS

A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.

B. Product: HC300 ADA Sign System by Best Sign Systems.
   1. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished.
   2. No Smoking signs.
   3. Room, Occupancy, Wayfinding Signs: As selected from 4 standard copy size signs.
      a. 4" x 2" with up to 4 characters each.
      b. 6" x 2" with up to 8 characters each.
      c. 8" x 2" with up to 12 characters each.
      d. 10" x 2" with up to 14 characters each.
   4. Toilet Room Signs: As selected from manufacturer's standard.
   5. Symbols of Accessibility: Provide 6-inch- high symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.
   6. Material:
      a. 1/4 inch thick (thicker than standard) "MP", acrylic sheet, ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
   7. Copy: Contracted grade 2 Braille all capital letter on tactile sign.
      a. Font and Size: As indicated on Drawings.

2.3 PARKING SIGNS

A. Material: 0.063" aluminum, screen printed copy on engineer grade reflective vinyl sheeting.
   1. Text: Symbols of accessibility, accessible direction, etc. as indicated on Drawings.

B. Accessible signs are blue with white symbol.

C. Post: 2 inch diameter, schedule 40 galvanized pipe.

2.4 TRAFFIC SIGNS

A. Material: 0.080" aluminum, screen printed copy on engineer grade reflective vinyl sheeting.
   1. Text: Stop, Yield, Do Not Enter, etc. as indicated on Drawings.

B. Post: 2 inch diameter, schedule 40 galvanized pipe.

2.5 EXTERIOR BUILDING SIGNS

A. Product: Fabricated Stainless Steel Letters and Logos Gemini or equal.
   1. Letters shall be letter style and shall be inches high and inches deep, as indicated on drawings.
   2. Mounting shall be and a mounting template designating stud hole locations.

B. Materials
   1. High-Grade, Pre-Finished Stainless Steel Alloy #316.

C. General Construction:
   1. Material Gauge:
      a. Fabricated letters up to 24" are produced with 16 gauge faces and 24 gauge returns; letters greater than 24"are produced with 16 gauges faces and 22 gauge returns.

2. Cutting: Computer guided lasers cut letters, logos or shapes.
3. Construction: Letter returns are cut to size based on the desired letter depth and bent to the contour of the laser cut faces to produce a hollow-backed letter with 90º angle edges. Inside joints are hand-soldered with a continuous bead of lead-free silver solder.
4. Testing: Solder joints indicate the ability to withstand temperatures from -40ºF to 220ºF. Salt Fog tested to ASTM B- 117-95 for corrosion resistance.
5. Edges: The edges of all letter faces will have thin line of exposed silver stainless steel.

D. Letters and Sizes: As indicated on Drawings.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items, including anchor inserts, provided under other sections of Work are sized and located to accommodate signs.

C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
2. Signs placed on glazed surfaces, backing sign of the same material and color shall be applied on the opposite glazed surface.
3. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent

walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Panel Signs:
   1. Interior Signs on Smooth Substrates:
      a. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.
   2. Exterior and Interior Signs on Rough Substrates:
      a. Mechanical Fasteners: Mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
         1) Fastener: Stainless steel screws, tamper-resistant flat head countersink.
         2) Anchors: Suitable for secure attachment to substrate.

C. Parking and Traffic Signs
   1. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
   2. Install sign level, plumb, and at height indicated.
   3. Cap post with galvanized cap.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

SECTION 10 22 26 OPERABLE PARTITIONS

Part 1 – General

1.1 Description

A. General:

1. Furnish and install operable partitions and suspension system. Provide all labor, materials, tools, equipment, and services for operable walls in accordance with provisions of contract documents.

1.2 Related work by others

A. Preparation of opening will be by General Contractor. Any deviation of site conditions contrary to approved shop drawings must be called to the attention of the architect.

B. All header, blocking, support structures, jambs, track enclosures, surrounding insulation, and sound baffles as required in 1.4 Quality Assurance.

C. Pre-punching of support structure in accordance with approved shop drawings.

D. Paint or otherwise finishing all trim and other materials adjoining head and jamb of operable partitions.

1.3 Submittals

A. Complete shop drawings are to be provided prior to fabrication indicating construction and installation details. Shop drawings must be submitted within 60 days after receipt of signed contract.

1.4 Quality Assurance

A. Installation shall be performed by an installer certified by the manufacturer.

B. Preparation of the opening shall conform to the criteria set forth by ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.

C. The partition STC (Sound Transmission Classification) shall be achieved per the standard test method ASTM E90-99 and E413-87. Test run under ASTM procedures prior to E90-99 shall not be permitted. All tests must be from an independent, currently operating, NVLAP-accredited laboratory available to verify results.

1.5 Product delivery, storage, and handling

A. Proper storage of partitions before installation, and continued protection during and after installation will be the responsibility of the General Contractor.

1.6 Warranty

A. Partition panels shall be guaranteed for a period of two years with all mechanical parts including track and carriers guaranteed for a period of five years. This guarantee is against defects in material or workmanship of manufacturer’s product, excluding abuse.

Part 2 – Products

2.1 Manufacturers

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
    1. Moderco Inc.

2.2 Operation

A. Signature 842 manually operated, top supported paired panels.

B. Initial seal (select one):
    1. Bulb seal.

C. Final closure (select one):
    1. Telescopic closure panel equipped with a telescopic jamb mounted to a rack and pinion mechanism and extended with a lever handle.
    2. Hinged closure panel (up to 12'-0" [3658mm] height).
        a. Same construction and face finish as partition panels.
        b. Standard hardware:
            (i). Flush pulls and roller latch.

2.2 Panel construction

A. Nominal 4" [102mm] thick panels, up to 48 1/2" [1230mm] width. Framing members to be steel-braced mechanically fastened 6065-T5 aluminum alloy extrusions. Thinnest extrusion section to be no less than 3/32" [2.5mm]. Trolley pipes welded to 1 1/2" X 1 1/2" X 3/32" [38mm X 38mm X 2.5mm] steel tube mechanically fastened to top frame extrusion. Panel cavity to be filled with acoustical insulation. Panel faces to be removable and replaceable on site to accommodate changes in room function, interior finishes, etc.

B. Acoustical rating (select one):
    6. 55 STC.

C. Panel face construction (select one):
    4. STC 47, 49, 52, 53, 55 with optional plastic laminate or wood veneer finish: 1/2" [13mm] Particle board with galvannealed steel liner. Steel thickness based on STC rating.

D. Hinges:
    1. (With protective trims) Discreet steel hinges blend into the shape of the frame extrusion.

E. Vertical trims (select one):
    1. Protective trims cover and protect all edges of the panel faces and face finish.

F. Panel weight:
    1. Between 6 to 10.5 lbs/sq.ft [29.5 to 51.5 kg/sq.m] (based on STC rating).

2.4 Panel finishes

A. Face finish shall be (select as required):
    5. Customer's specified material (C.S.M.) procured and applied by manufacturer. (Subject to approval.) See architectural drawings for specified material

B. Panel frame finish shall be (select one):
1. Clear satin anodized.

2.5 Sound seals

A. Vertical seals:
1. Dual aluminum and pvc tongue and groove interlocking seals in each panel edge.

B. Horizontal seals (select one):
4. Type AA: Automatically operated top and bottom seals. Top and bottom seals extend and retract simultaneously without use of a tool. Top and bottom seals retract automatically when panel is pulled away from wall or adjacent panel. (Optional)
a. AA-1.5: 1" [25mm] track clearance. 1 1/2" [38mm] floor clearance with 3/4" [19mm] operating range.

2.6 Suspension system

A. Track and trolleys (select one):
2. #72 steel track: 11 ga. roll-formed steel with integral soffit trim supported by pairs of 3/8" [10mm] dia. threaded rods connected to structural support with hanger brackets. (Optional)
a. #72 trolley: Each trolley shall have four precision ground ball bearing wheels with steel tires.
b. Usage: For panels up to 15'-3" [4648mm] height.
c. Each panel to be supported by one trolley.

B. Track finish (select applicable):
2. Steel track finish shall be (select one):
a. White powder coating.

Part 3 – Execution

3.1 Installation

A. The complete installation of the operable wall system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer's installation instructions.

3.2 Cleaning

A. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.

B. Packing and other installation debris shall be removed from the job site.

3.3 Training

A. Installer shall demonstrate proper operation and maintenance procedures to owner's representative.

B. Operating handle and owner's manuals shall be provided to owner's representative.

SECTION 102600 – WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Impact-resistant wall coverings.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.

B. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated.
   1. Include similar Samples of accent strips and accessories involving color selection.

C. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
   2. Warranty Period: 5 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Impact-Resistant Wall Protection:
   1. IPC Door and Wall Protection Systems; Division of InPro Corp. (Basis of Design)
   2. Construction Specialties (C/S), Inc.
   3. Balco, Inc.
   4. Korogard Wall Protection Systems; Koroseal Corporation.

5. Pawling Corporation.
6. ProTek Systems Inc.
7. Or equal.

2.2 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.
   1. Use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Plastic Sheet Wall Covering Material: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, semirigid, high-impact-resistant PVC or acrylic-modified vinyl plastic sheet with integral color throughout; thickness as indicated.
   1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
   2. Chemical and Stain Resistance: Tested according to ASTM D 543.
   3. Self-extinguishing when tested according to ASTM D 635.
   4. Flame-Spread Index: 25 or less.
   5. Smoke-Developed Index: 450 or less.

2.3 IMPACT-RESISTANT WALL GUARDS

A. Product: Palladium® Rigid Vinyl Sheet by Inpro or equal.
   1. Material: Vinyl: Palladium® Rigid Vinyl Sheet shall be manufactured from chemical and stain resistant unplasticized polyvinyl chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth). Accent strips when used shall be of polyvinyl chloride (PVC).
   2. Fire Performance Characteristics: Provide UL Classified Palladium® Rigid Vinyl Sheet conforming with the NFPA Class A fire rating. Surface burning characteristics as determined by UL-723 (ASTM E-84), for Palladium® Rigid Vinyl Sheet installed with 3M Fastbond 30, InPro Bond Adhesive, or Formulated Solutions, LLC “XT-2000+" Adhesive shall be a maximum flame spread of 20 and a maximum smoke developed of 350 for .060" (1.5mm) thick material. Provide ULC (Canada) listed Palladium® Rigid Vinyl Sheet conforming to the requirements of the National Building Code of Canada 2010, Subsection 3.1.13. Surface burning characteristics, as determined by CAN/ULC-S102.2, shall be flame spread of 15 and smoke developed of 30.
   3. Self Extinguishing: Provide Palladium® Rigid Vinyl Sheet with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988.

4. Provide sheet materials that have been tested and results filed in compliance with article 15, part 1120 of the New York State uniform fire prevention and building code. DOS # 09960-930.504.4001.
5. Impact Strength: Provide Palladium® Rigid Vinyl Sheet that has an Impact Strength of 30.4 ft-lbs/ inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
6. Chemical and Stain Resistance: Provide Palladium® Rigid Vinyl Sheet that shows resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
7. Color: As indicated on Drawings.

2.4 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Remove tool and die marks and stretch lines or blend into finish.
   2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
   2. For impact-resistant wall-protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
   1. Install impact-resistant wall-protection units in locations and at mounting heights indicated on Drawings.
   2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
      a. Provide anchoring devices to withstand imposed loads.
      b. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

A. Immediately after completion of installation, clean covers.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Toilet accessories.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:
   1. Construction details and dimensions.
   2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Material and finish descriptions.
   4. Features that will be included for Project.
   5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace toilet and bath accessories that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Toilet and Bath Accessories: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Bobrick Washroom Equipment, Inc. (Basis of Design)
   2. American Specialties, Inc.
   3. Bradley Corporation.
   4. Or equal.

B. Underlavatory Guards: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Handy-Shield by Plumberex Specialty Products, Inc. (Basis of Design)
   2. IPS Corp.
   3. TCI Products.
   4. Truebro, Inc.
   5. Or equal.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

C. Galvanized Steel Sheet: ASTM A 653, with G60 hot-dip zinc coating.

D. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.3 TOILET ACCESSORIES

A. As indicated on Drawings.

2.4 UNDERLAVATORY GUARDS

A. Product: Handy-Shield Maxx by Plumberex Specialty Products, Inc. or equal.
   1. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.
   2. PVC insulator shall be 1/8" thick.
   3. Meets Testing Standard ASTM E 84-07 per IBC Chapter 8.
      a. 25 flame spread.
      b. 450 smoke index.
   4. Surfaces to be soft, smooth, non-absorbent, easy to clean U/V inhibited, antimicrobial, antifungal properties.
   5. Insulator shall have a dual fastening system which consists of fusion bonded Velcro fastener strips for full slit enclosure and tamper resistant, smooth, non-abrasive snap-locking fasteners.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104400 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Portable fire extinguishers.
   2. Fire-protection cabinets for the following:
      a. Portable fire extinguishers.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
   1. Fire Extinguishers: Include rating and classification.
   2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Samples for Initial Selection: For fire-protection cabinets with factory-applied color finishes.

C. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on Samples of size indicated below.
   1. Size: 6 by 6 inches square.

D. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: 6 years.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguishers and Cabinets: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Activar/JL Industries, Inc. (Basis of Design)
   2. Babcock-Davis.
   3. Larsen's Manufacturing Company.
   4. Potter Roemer; Div. of Smith Industries, Inc.
   5. Ansul.
   6. Or equal.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B.

B. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick minimum.

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet indicated.
   1. Valves: Manufacturer's standard.
   2. Handles and Levers: Manufacturer's standard.
   3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and Title 19 CCR.
   4. Certification Tag: Provide fire extinguisher with valid certification test tag where fire extinguishers are fully charged and ready to be used.

B. Wet Chemical Type: Cast steel tank, pressurized, including hose and nozzle, with bracket.
   1. Class 2A-K.
   2. Size 2.5 gal.
   3. Finish: Factory baked enamel, red color.
   4. Use: At kitchens.

C. Dry Chemical Type: Cast steel tank, with pressure gage.
   1. Class 2A-10B:C, UL rated.
   2. Nominal Capacity: Provide largest capacity fire extinguisher that will fit in the cabinet, but 5 lbs. minimum.
   3. Finish: Baked enamel, red color.
   4. Use: General purpose.
   5. Products: Cosmic 5E or Galaxy by J.L. Industries.

2.4 FIRE-PROTECTION CABINET

A. Product: Cosmopolitan series - steel fire extinguisher cabinet by Activar/JL or equal.
   1. Door and Trim Construction: Flush cabinet doors with a 5/8" door stop are attached by a continuous hinge and equipped with zinc-plated handle and roller catch.
   2. Trim Style and Depth: Provide semi-recessed where recessed can’t be provided.
   3. Finish: #4 Stainless Steel.
   4. Tub: Constructed of cold rolled steel with white powder-coat finish standard. Surface mount tubs are No 4 stainless.
   5. Door Styles: View Door Styles at Right.
   6. Door Glazing: Laminated Safety Glass.

2.5 FABRICATION

A. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
   2. Miter and weld perimeter door frames.

B. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STEEL FINISHES

A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
   1. Color: As selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated on Drawings.

B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
   1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
   2. Provide inside latch and lock for break-glass panels.
   3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

END OF SECTION 104400

SECTION 113100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes kitchen appliances.

B. Related Sections include the following:
   1. Division 22 Sections for plumbing requirements.
   2. Division 26 Sections for electrical requirements.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.

B. Appliance Schedule: For appliances; use same designations indicated on Schedule.

C. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each product.

E. Maintenance Data: For each product to include in maintenance manuals.

F. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain residential appliances through one source from a single manufacturer.
   1. To the greatest extent possible, provide appliances by a single manufacturer for entire Project.

D. Regulatory Requirements: Comply with provisions of the following product certifications:
   1. NFPA: Provide electrical appliances listed and labeled as defined in California Electrical Code and NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

3. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
4. NAECA: Provide residential appliances that comply with NAECA standards.

E. Regulatory Requirements, Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
1. Operable Parts: Provide controls with forward reach no higher than 48 inches above the floor, horizontal front reach no more than 25 inches, horizontal side reach no more than 24 inches, and that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Range or Cooktop: Provide knee clearance for forward approach of 27 inches high, 30 inches wide, and 11 inches horizontally; toe space clearance of 9 inches high and 17 inches horizontally; with insulated underside of cooktop to prevent burns, shocks, or abrasions. Provide top surface 34 inches above the floor, with controls that do not require reaching across burners.
3. Refrigerator/Freezer: Provide 50 percent of freezer space within 54 inches of the floor.

F. AHAM Standards: Provide appliances that comply with the following AHAM standards:
1. Dishwashers: AHAM DW-DW1.
2. Electric Ranges: AHAM ER-1.
3. Clothes Dryers: AHAM HLD-1.
4. Household Refrigerators: AHAM HRF-1.

G. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.
1. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.4 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer of each appliance specified agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: As specified in each items but not less than 1 year.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 RESIDENTIAL APPLIANCES

A. Products: As indicated on Drawings.

2.2 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Stainless-Steel Finish: Provide appliances with manufacturer's standard finish complying with manufacturer's written instructions for surface preparation including ground and polished stainless-steel surfaces for uniform, directionally textured finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: Refer to Divisions 22 and 26 for plumbing and electrical requirements.

3.3 CLEANING AND PROTECTION

A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 113100

SECTION 122413
WINDOW SHADES - LUTRON CONTRACT ROLLER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Motorized roller shades.

B. Shade accessories.

1.02 RELATED REQUIREMENTS

A. Section 122509.13 - Window Shade Control System - Lutron Hyperion: Automated solar adaptive control system for motorized window shades.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. ASTM E903 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres; 2020.

C. DIN EN 14500 - Blinds and Shutters - Thermal and Visual Comfort - Test and Calculation Methods; 2021.

D. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Motorized Shades:
      a. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
      b. Coordinate the work with other trades to provide rough-in for electrical wiring as required for installation of motorized shades.
   2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken.
   2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications:
   1. Motorized Shades: Company with not less than twenty years of experience manufacturing low voltage motorized shading systems.
   2. Registered to ISO 9001, including in-house engineering for product design activities.
   3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.
   4. Maintains technical support available 24 hours per day, 7 days per week, excluding manufacturer holidays.

5. Maintains separate field service division responsible for startup, service, and troubleshooting of shading system and associated lighting control system, where applicable.

D. Shade Installer Qualifications: Qualified to install and troubleshoot specified products by prior factory training, experience, demonstrated performance, and acceptance of any requirement of the manufacturer, subsidiary of the manufacturer, or licensed agent.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.
   1. Basis of Design System Requirements - Lutron, Unless Otherwise Indicated:
      a. Ambient Temperature: Between 32 and 104 degrees F (0 and 40 degrees C).
      b. Relative Humidity: Less than 90 percent, non-condensing.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty; Lutron 8-Year Limited Warranty:
   1. Shade Control System Components (including shade electronic drive units, shade fabric, and shade hardware):
      a. Years 1-5: 100 percent replacement parts coverage, no manufacturer labor coverage.
      b. Years 6-8: 50 percent replacement parts coverage, no manufacturer labor coverage.
      c. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.
   2. External Shade Control System Components (including control stations, interfaces, and system accessories):
      a. One year 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a shade control issue.
      b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: Lutron Electronics Company, Inc ; Contract Roller; www.lutron.com/#sle.

2.02 WINDOW SHADE FABRIC APPLICATIONS

A. Fabric for Roller Shades:
   1. Shade Fabric:
      a. Fabric Family Name: Lutron M Screen.
      b. Color: White / Pearl.
      c. Façade/Orientation Name: ***Bldg. B***.
         1) Fabric Performance Requirements – General Purpose/ Solar Screen:
         (a) Openness Factor: 3%.
         (b) Visible Light Transmittance (Tv): 8%.
   2. Shade Fabric:
      a. Fabric Family Name: Lutron Luna Blackout.
      b. Color: Iron.
      c. Façade/Orientation Name: ***Bldg. A***.

1) Fabric Performance Requirements – General Purpose/Sustainable Solar Screen/Blackout:
(a) Openness Factor: 0%.

--Solar Screen Fabric General Requirements:

3. Fabric Performance Selection:
   a. Fabrics must be selected based on evaluation using a building model.
   b. Model must incorporate location, facade orientation(s), window size(s), glass properties, and interior layout and properties.
   c. Submit report documenting glare, daylight, and view performance results.

2.03 ROLLER SHADES

A. General Requirements:
   1. Provide fully-factory assembled window shades complete with mounting brackets, operating mechanisms, hembars, hardware and accessories.
   2. Size: As indicated on drawings.
   3. Mounting: Inside or outside mount as indicated on drawings.
   4. Roller Tube: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of shades.
      a. Material: Aluminum.
      b. Aluminum Recycled Content for Roller Tubes and Top Treatments:
         1) 50 percent post-industrial recycled content.
         2) 25 percent post-consumer recycled content.
         3) 25 percent primary aluminum.
      c. Designed to prevent rust stains.
   5. Fabric Drop: Regular roll.
   6. Fabric Attachment: Utilize double-sided adhesive strip with minimum of one turn of fabric on roller before working section of fabric starts.
   7. Hembars: Wall thickness designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.

B. Motorized Shades:
   1. Product(s):
   2. Listed as complying with UL 325.
   3. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
   4. Audible Noise: Capable of operating at or below 44 dBA measured 3 feet (1 m) from the center of the shade depending on the electronic drive unit selected; no audible clicks when motor starts and stops.
   5. Electronic Drive Units:
      a. Low-voltage, for connection to NFPA 70, Class 2 power source.
      b. Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated.
      c. Concealed from interior view.
   6. Integrated Wireless Communications: Communicates directly to compatible RF devices through use of a radio frequency communications link; does not require communication wiring; RF range of 30 feet (9 m).
   7. Coupling of Multiple Shades:
      a. Where possible, minimize number of electronic drive units by coupling adjacent shades.
      b. Utilize adjustable coupler that allows for precision adjustment of hembar levels without removing the installed roller or removing the fabric from the roller tube.
   8. Adjustment Provisions:
      a. Sub-brackets support shade during installation and allow for lateral position adjustment for consistent light gaps.

b. Level adjustment screws at each idler position allow for level adjustment without requiring shimming of shade brackets.

2.04 SHADE ACCESSORIES

A. Brackets and Mounting Hardware: Size as recommended by manufacturer for mounting configuration and span indicated.
   1. Universal wall/ceiling/pocket mounting brackets.

B. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

C. Top Treatments:
   1. Provide top treatments consistent across manual and motorized shade products.
   2. Pocket: Manufacturer's standard single (5 inch by 5.125 inch) 0.06 inch (1 mm) thick minimum aluminum pocket for recessed mounting.

2.05 MOTORIZED SHADE CONTROLS

A. Motorized shades to be controlled by automated solar adaptive window shade control system and associated control devices as specified in Section 122509.13.

2.06 SHADE FABRICATION

2.07 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Factory Testing; Lutron Standard Factory Testing:
   1. Perform full-function factory inspection and testing on all completed assemblies. Statistical sampling is not acceptable.
   2. Comprehensive factory inspection and testing on each shade includes, but is not limited to:
      a. Mount and operate shades; examine for fabric flaws, hembar levelness, telescoping.
      b. Verify shade/fabric dimensions.
      c. Verify synchronization/tracking within specified tolerance for motorized shades.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Shade Installation:
   1. Install in accordance with approved shop drawings, using mounting devices as indicated.
   2. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
   3. Adjust level, projection and shade centering from mounting bracket where applicable.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.05 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.06 CLOSEOUT ACTIVITIES

3.07 PROTECTION

A. Protect installed installed products from subsequent construction operations.

B. Touch-up, repair or replace damaged products before Substantial Completion.

SECTION 124813 – ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Entrance mats.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of product indicated.
   1. Floor Mat: 12-inch- square, assembled sections of floor mat.

D. Maintenance Data: For floor mats to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.

B. Flammability in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/m2.

1.4 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of floor mats that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Entrance Mats: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. BaseMat. (Basis of Design)
   2. American Floor Products Company, Inc. (AFCO-USA)
   3. C/S Group.
   4. Balco, Inc.
   5. Pawling Corporation; Architectural Products Division.
   6. Arden Architectural Specialties, Inc.
   7. Or equal.

2.2 ENTRANCE MATS

A. Product: MB-400 Series (vinyl hinge) by BaseMat or equal.
   1. Material: Extruded 6063-T6 alloy complete with extruded soft-durometer vinyl hinge for coupling rails together.
   2. Tread insert options for BaseMat MB-400:
      a. Vinyl Abrasive Inserts shall include a flexible abrasive grit tape, bonded to a rigid vinyl tread insert. Tread insert shall be supplied in black, complete with one of five abrasive colors as offered by Manufacturer.
   3. Framing for Aluminum BaseMat Series:
      a. B-2 - Beveled Aluminum Frame shall be 1-3/8” wide 6063-T5 aluminum alloy and permanently secures mat for surface mount applications. Frame color shall be supplied in mill finish unless otherwise indicated (anodized – clear, light bronze, medium bronze, dark bronze or black).

2.3 FABRICATION

A. Floor Mats: Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install mat frames to comply with manufacturer's written instructions.

END OF SECTION 124813

SECTION 129300 - SITE FURNISHINGS

1.00 GENERAL

1.01 GENERAL CONDITIONS

A. The requirements of the "General Provisions of the Contract" and of Division 1, "General Requirements", shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.02 SUMMARY

A. Work included: All labor, material, equipment and services necessary to install all site furnishings, complete in place, as shown on the drawings or specified herein.

1. Planters.
2. Ash/Trash Urns.
3. Benches.
4. Bollards.

B. Related work:

1. Site Concrete - Section 02510.
2. Irrigation System - Section 02810.
3. Landscape Planting - Section 02900.
4. Landscape Maintenance and Plant Establishment - Section 02970.

1.03 SUBMITTALS

A. Submit for acceptance manufacturers catalogue information or shop drawings indicating size, materials, finishes and quantities of items being supplied. Submit one sample of each clay pot specified and color sample for precast concrete planters.

1.04 COORDINATION

A. The Contractor shall notify all other Contractors, such as plumbers, electricians, etc., in ample time to install work including sleeves, before concrete is placed.

2.00 PRODUCTS

2.01 PLANTERS
SUPPLIER:

COLOR:
FINISH:
GENERAL:

2.02 ASH / TRASH URNS
SUPPLIER:
COLOR:
FINISH:
GENERAL:

2.03 BENCH
SUPPLIER:
COLOR:
FINISH:
GENERAL:

2.04 BOLLARDS
SUPPLIER:
COLOR:
FINISH:
GENERAL:

3.00 EXECUTION

3.01 Furnish all labor, material, equipment and services necessary to provide all concrete, complete in place, as shown on the drawings or specified herein.

3.02 Work shall be set plumb level, and true to line and shall present a neat and finished appearance. Include setting each item in its correct place, fastening it, connecting it, or incorporating it into other portions of the work, as each item may require; and testing and operating equipment to assure proper functioning.

3.03 The work of this Section shall include the furnishing of anchors and adhesives required for installing and attaching the equipment specified herein. All furnishings shall be installed per manufacturer's recommendations unless noted in drawing or herein.

3.04 Adequately protect all work from damage by subsequent construction operations. Damaged work shall be replaced.

3.05 The Contractor shall at all times keep the premises free from accumulation of waste materials and rubbish caused by his employees. Upon completion of work, rubbish and excess materials are to be removed from the site, leaving the areas acceptably clean.

END OF SECTION 129300

Contact:

Abraham Jimenez

Schindler Elevator Corporation

3585 Cadillac Avenue, Suite B

Costa Mesa, Ca 92626

Phone (818) 962-2153

SECTION 14 21 23 - HYDRAULIC PASSENGER ELEVATORS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Hydraulic passenger elevators: Complete system.

1.2 REFERENCES

A. ANSI/ASME A17.1 – Safety Code for Elevators and Escalators.

B. ISO 9001-2000 – Quality Management Systems – Requirements.

1.3 DESIGN REQUIREMENTS

A. Arrange elevator components in machine room so equipment can be removed for repairs or replaced without dismantling or removing other equipment components.

1.4 SUBMITTALS

A. Comply with Section 01330 (01 33 00) – Submittal Procedures.

B. Product Data: Submit manufacturer/installer’s product data, including installation instructions.

C. Shop Drawings: Submit manufacturer/installer’s shop drawings, including plans, elevations, sections, and details, indicating location of equipment, loads, dimensions, tolerances, materials, components, fabrication, fasteners, hardware, finish, options, accessories, and other information to render totally functional elevators.

D. Samples: Submit manufacturer/installer’s samples of standard colors and finishes of finish materials.

E. Operation and Maintenance Manual: Submit manufacturer/installer’s operation and maintenance manual; including operation, maintenance, adjustment, and cleaning instructions; trouble shooting guide; renewal parts catalogs; and electrical wiring diagrams.

F. Warranty: Submit manufacturer/installer’s standard warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer/Installer’s Qualifications: Specialize in manufacturing and installing elevator equipment, with a minimum of 5 years successful experience.

B. Regulatory Requirements:

a. Elevator design, clearances, construction, workmanship, materials, and installation, unless specified otherwise, shall be in accordance with ANSI/ASME A17.1, handicap accessibility, Americans with Disabilities Act, and other codes having legal jurisdiction.

b. ANSI/ASME A17.1 shall govern, except where codes having legal jurisdiction include more rigid requirements or conflict with ANSI/ASME A17.1.

c. Elevator shall follow design and manufacturing procedures certified in accordance with ISO 9001-2000 to meet product and service requirements for quality assurance for new products.

C. Pre-installation Meeting:

a. Convene pre-installation meeting before start of installation of elevators.

b. Require attendance of parties directly affecting work of this section, including Contractor, Architect, and elevator manufacturer/installer.

c. Review examination, installation, field quality control, adjusting, cleaning, protection, and coordination with other work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer/installer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer/installer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer/installer’s instructions.

C. Handling: Protect materials during handling and installation to prevent damage.

1.7 PROJECT CONDITIONS

A. Temporary Electricity:

a. Owner will arrange for temporary 3-phase electricity to be available for installation of elevator components.

b. Comply with Section 01510 (01 51 00) – Temporary Utilities.

B. Temporary Use of Elevator:

a. Owner will negotiate with manufacturer/installer for temporary use of elevator, if required.

b. Temporary use of elevator shall be in accordance with terms and conditions of manufacturer/installer’s temporary acceptance form.

1.8 SCHEDULING

A. Coordinate elevator work with work of other trades, for proper time and sequence to avoid construction delays.

1.9 WARRANTY

A. Manufacturer/installer shall guarantee materials and workmanship of equipment installed under these specifications and make good, defects not due to ordinary wear or to improper use, which may develop within 1 year after completion of installation or acceptance thereof by beneficial use, whichever is earlier.

1.10 MAINTENANCE SERVICE

A. Elevator maintenance service shall be performed by elevator manufacturer/installer.

Elevators shall receive regular maintenance on each unit for period of 12 months after completion of work specified herein or acceptance thereof by beneficial use, whichever is earlier.

B. Trained employees shall make periodic examinations and perform work including necessary adjusting, greasing, oiling, and replacing parts to keep elevators in operation, except parts that require replacement because of accidents, vandalism, misuse, or negligence by parties other than manufacturer/installer.

Manufacturer/installer shall perform all Work, except emergency minor adjustment call-back service, during regular work hours. Manufacturer/installer shall provide emergency minor adjustment call-back service, during regular work hours.

C. Should Owner request that examinations, cleaning, lubrication, adjustments, repairs, replacements, or emergency minor adjustment call-back service, unless specified herein, be performed on other than manufacturer/installer's regular working hours of regular working days, manufacturer/installer shall absorb straight-time labor charges and Owner will compensate manufacturer/installer for overtime premium, travel time, and expense at normal billing rates.

D. Elevator Control System:

a. Include built-in remote diagnostic module to relay constant status of elevators and control system to a 24-hour, 7-days-a-week central-monitoring facility.

Incorporate Schindler ahead/ safe call

b. Remote Monitoring Device: Transmit information on current status of elevators, including malfunctions, system errors, and shutdown.

E. Maintenance Options
Regular Maintenance: During Regular Work Hours
Callback Service: During Regular Work Hours
Maintenance Period: 12

PART 2 – PRODUCTS

2.1 MANUFACTURER/INSTALLER

A. Schindler Elevator Corporation, Website www.us.schindler.com.

B. Elevator shall be installed by elevator manufacturer.

2.2 ELEVATOR SYSTEM AND COMPONENTS

A. Hydraulic Passenger Elevators: Model 330A.

B. Elevator Equipment Summary:

a. Application: Holeless Dual Piston

b. Service: General Purpose Passenger- Class A Loading

c. Quantity: 1 Unit

d. Capacity: 3500 Lbs

e. Speed: 150 Fpm

f. Travel: 12' 11 1/2"

g. Landings: 2

h. Front Openings: 2

i. Rear Openings: 0

j. Operation: Microprocessor Single Car Automatic Operation

l. Machine Room: Adjacent To Elevator Hoistway at lowest landing

m. Platform Size: 7'-0" Wide X 6'-3" Deep

n. Door Type: Single Speed Side Opening

o. Cab Height: 8' 0"

p. Guide Rails: Equivalent to 16 lb. per foot

q. Hoistway Entrances: 3' 6" Wide X 7' 0" High doors

r. Power Supply: 208 Volts 3 Phase 60 Hz

C. Elevator Components:

a. Anti-stall feature.

b. Braille and audible signals.

C. Door open and close stall protection.

d. Emergency lighting.

e. Firefighter's Service.

f. Independent service feature.

g. Infrared light curtain door protection.

i. Overload sensors.

j. Phase protection.

k. Soft Start Electronic Starting

s. Heat Exchanger.

u. Locking Service Panel in Car Operating Panel.

w. Power Unit Noise Reduction.

x. Pressure Switch.

z. Remote Monitoring Capable.

aa. Battery powered lowering Rescue Feature.

ac. Telephone (ADA compliant).

ad. Vandal Resistant Hall Fixtures.

2.3 ELEVATOR MATERIALS

A. Finish:

a. Stainless Steel #4 satin.

b. Baked Enamel Colors: Manufacturer/installer's standard color selections.

c. Exposed Aluminum Frames in Suspended Ceilings: Anodized.

B. Plastic Laminates:

a. Type: General purpose.

b. Flame Spread Ratings: As required by code.

c. Pattern: Select from elevator manufacturer/installer’s standard selection.

C. UL or CSA Approved: Motors, pumps, valves, fluid tank, hydraulic fluid, microprocessor controller, controls, pushbuttons, and wiring.

D. Spring Buffers, Attachment Brackets, and Anchors: Design and size according to building code with safety factors.

E. Pump: Positive displacement screw type, design for steady discharge with minimal pulsations.

F. Muffler: Reduce noise transmission.

G. Telescopic Holeless Jack System:

a. Jack Cylinder: Two jacks, one located at each side of the car and mounted to the elevator car structure.

b. Synchronization of Jack Stages: Direct mechanical means to ensure elevator moves at steady speed and provides smooth ride.

2.4 ELEVATOR CABS

Height: 8' 0" from finished floor to underside of canopy.

A. Elevator Car Enclosure Wall Sections:

a. Cab Wall: Steel - Painted Finish.

b. Base, Frieze, and Reveals: None.

B. Ceiling:

a. Suspended with Exposed Frame With Plastic Lay-in Panels.

b. Lighting: Fluorescent Lighting.

F. Cab Returns: Integral construction.

Finish: #4 Stainless Steel.

G. Transoms:

a. Run full width of cab.

Finish: #4 Stainless Steel.

H. Cab Doors:

a. Flush design both sides.

b. Rib construction.

Finish: #4 Stainless Steel.

J. Exhaust Fan:

a. Single speed.

b. Mount in cab transom or canopy.

K. Handrail:

1/2" X 2" Flat In Brushed Aluminum.

Mount on Rear Wall.

Threshold: Aluminum.

L. Cab Finish Flooring: Standard resilient flooring.

a. Provide certificate frame.

2.5 HOISTWAY ENTRANCES

A. Hoistway Doors and Frames:

a. UL rated with required fire rating.

b. Doors: Rigid flush panel construction with sound-deadening material.

Frames: Securely fasten at corners to form unit frame. Frames shall be Bolted.

Exposed Areas of Corridor Frames: Painted Color - All Floors

Doors: Painted Color - All Floors

Sills: Aluminum

2.6 CAB FIXTURES

A. Main Car Operating Panel:

a. Mount in return.

b. Comply with handicap requirements.

c. Include pushbuttons and illuminating indications for each floor served.

d. Emergency Buttons and Switches: Provide in accordance with code.

e. Switches for car light and accessories.

f. Mount in return.

g. Comply with handicap requirements.

h. Include pushbuttons and illuminating indications for each floor served.

i. Emergency Buttons and Switches: Provide in accordance with code.

j. Switches for car light and accessories.

k. Mount in return.

l. Comply with handicap requirements.

m. Pushbuttons: Illuminate using long-lasting LED's included for each floor served.

n. Emergency Buttons and Switches: Provide in accordance with code.

o. Switches for car light and accessories.

B. Cab Fixtures:

a. Car Lantern(s).

b. Digital Car Position Indicator.

f. Certificate Frame.

g. Telephone (ADA compliant).

2.7 HALL FIXTURES

A. Pushbuttons:

a. Up button and down button at intermediate floors.

b. Single button at each terminal floor.

c. Height: Comply with handicap requirements.

Digital Hall Position Indicator: At floors 2.

Hall Fixture Finish: Black Lexan®.

B. Fixture Cover Plates: Mount with tamper-resistant screws in same finish as fixture.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine hoistways, hoistway openings, pits, and machine rooms before starting elevator installation.

B. Verify hoistway, pit, machine room, and openings are of correct size, within tolerances, and are ready for work of this section.

C. Verify walls and sill supports are plumb, where openings occur.

Verify hoistway is clear and plumb, with maximum variation of 1/2" at any point.

D. Verify minimum 2-hour fire-resistance rating of hatch walls.

E. Notify Architect in writing of dimensional discrepancies or other conditions detrimental to proper installation or performance of elevators.

F. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to manufacturer/installer.

3.2 INSTALLATION

A. Install elevators in accordance with manufacturer/installer’s instructions and ANSI/ASME A17.1.

B. Set entrances in vertical alignment with car openings, and aligned with plumb hoistway lines.

3.3 FIELD QUALITY CONTROL

A. Perform tests of elevator as required by ANSI/ASME A17.1 and governing codes.

3.4 ADJUSTING

A. Adjust elevators for proper operation in accordance with manufacturer/installer’s instructions.

B. Adjust elevators for smooth acceleration and deceleration of car so not to cause passenger discomfort.

C. Adjust doors to prevent opening of doors at landing on corridor side, unless car is at rest at that landing, or is in leveling zone and stopping at that landing.

D. Adjust automatic floor leveling feature at each floor to within 1/4 inch of landing.

E. Repair minor damages to finish in accordance with manufacturer/installer’s instructions and as approved by Architect.

F. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.5 CLEANING

A. Clean elevators promptly after installation in accordance with manufacturer/installer’s instructions.

B. Do not use harsh cleaning materials or methods that could damage finish.

3.6 PROTECTION

A. Protect installed elevators from damage during construction.

END OF SECTION

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

C. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: Interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Presealed Systems.

C. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves.
b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

    a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 (DN 150 and Larger: Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

    a. Piping Smaller Than [NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping [NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

    a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
    b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

    a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
    b. Piping NPS 6 (DN 150 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
   f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
   h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.
   i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
   j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.
   k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

2. Escutcheons for Existing Piping:

   a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated rough-brass finish.
h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated rough-brass finish.
j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.

B. Related Sections:

1. Division 21 Section "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
2. Division 21 fire-suppression piping Sections for fire-protection pressure gages.
3. Division 22 Section "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
4. Division 22 Section " Domestic Water Piping" for water meters inside the building.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Certificates: For each type of meter and gage, from manufacturer.

C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.
13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements,
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Ashcroft Inc.
b. Marsh Bellofram.
c. Miljoco Corporation.
d. Palmer Wahl Instrumentation Group.
e. REOTEMP Instrument Corporation.
f. Trerice, H. O. Co.
g. Weiss Instruments, Inc.

B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Ashcroft Inc.
b. Miljoco Corporation.
c. REOTEMP Instrument Corporation.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Marsh Bellofram.
    d. Miljoco Corporation.
    e. Palmer Wahl Instrumentation Group.
    f. REOTEMP Instrument Corporation.
    g. Trerice, H. O. Co.
    h. Weiss Instruments, Inc.
    i. WIKA Instrument Corporation - USA.

D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Miljoco Corporation.
    d. REOTEMP Instrument Corporation.
    e. Trerice, H. O. Co.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    Trerice, H. O. Co.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Tel-Tru Manufacturing Company.
    d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    e. Weiss Instruments, Inc.
    f. WIKA Instrument Corporation - USA.

3. Standard: ASME B40.200.

C. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Flo Fab Inc.
b. Miljoco Corporation.
c. Palmer Wahl Instrumentation Group.
d. Tel-Tru Manufacturing Company.
e. Trerice, H. O. Co.
f. Weiss Instruments, Inc.
g. Winters Instruments - U.S.

3. Standard: ASME B40.200.
4.

D. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Ernst Flow Industries.
b. Marsh Bellofram.
c. Miljoco Corporation.
d. Palmer Wahl Instrumentation Group.
e. REOTEMP Instrument Corporation.
f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
g. Weiss Instruments, Inc.
h. WIKA Instrument Corporation - USA.

3. Standard: ASME B40.200.

2.4 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Flo Fab Inc.
b. REOTEMP Instrument Corporation.
c. Trerice, H. O. Co.
d. Weiss Instruments, Inc.
e. WIKA Instrument Corporation - USA.
f. Winters Instruments - U.S.

B. Remote-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Miljoco Corporation.
b. Weiss Instruments, Inc.
c. Winters Instruments - U.S.

2.5 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES, CSA
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.6 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Ernst Flow Industries.
d. Flo Fab Inc.
e. Marsh Bellofram.
f. Miljoco Corporation.
g. Noshok.
h. Palmer Wahl Instrumentation Group.
i. REOTEMP Instrument Corporation.
j. Tel-Tru Manufacturing Company.

k. Trerice, H. O. Co.
l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
m. Weiss Instruments, Inc.
n. WIKA Instrument Corporation - USA.
o. Winters Instruments - U.S.

3. Standard: ASME B40.100.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Flo Fab Inc.
d. Marsh Bellofram.
e. Miljoco Corporation.
f. Noshok.
g. Palmer Wahl Instrumentation Group.
h. REOTEMP Instrument Corporation.
i. Tel-Tru Manufacturing Company.
j. Trerice, H. O. Co.
k. Weiss Instruments, Inc.
l. WIKA Instrument Corporation - USA.
m. Winters Instruments - U.S.

3. Standard: ASME B40.100.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on or comparable product by one of the following:

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Ernst Flow Industries.
d. Flo Fab Inc.
e. Marsh Bellofram.
f. Miljoco Corporation.
g. Noshok.
h. Palmer Wahl Instrumentation Group.
i. REOTEMP Instrument Corporation.
j. Tel-Tru Manufacturing Company.
k. Trerice, H. O. Co.
l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
m. Weiss Instruments, Inc.
n. WIKA Instrument Corporation - USA.
o. Winters Instruments - U.S.

3. Standard: ASME B40.100.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Miljoco Corporation.
d. Noshok.
e. Palmer Wahl Instrumentation Group.
f. REOTEMP Instrument Corporation.
g. Tel-Tru Manufacturing Company.
h. Trerice, H. O. Co.
i. Weiss Instruments, Inc.
j. WIKA Instrument Corporation - USA.
k. Winters Instruments - U.S.

3. Standard: ASME B40.100.

2.7 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass. Include extension for use on insulated piping.

B. Valves: Brass ball.

2.8 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

C. Description: Test-station fitting made for insertion into piping tee fitting.

D. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F

2.9 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

2.10 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.
8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending[to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C).

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Water Piping: 0 to 300 psi (0 to 2500 kPa).

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Iron ball valves.
5. Iron, single-flange butterfly valves.
6. Iron, grooved-end butterfly valves.
7. Bronze lift check valves.
8. Bronze swing check valves.
9. Iron swing check valves.
10. Iron swing check valves with closure control.
11. Iron, grooved-end swing check valves.
12. Iron, center-guided check valves.
13. Iron, plate-type check valves.
14. Bronze gate valves.
15. Iron gate valves.
16. Bronze globe valves.
17. Iron globe valves.
18. Lubricated plug valves.
19. Chainwheels.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron.

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

C. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Stockham Division.
b. Kitz Corporation.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron.

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Powell Valves.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: PTFE or TFE.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron.

2.3 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Kitz Corporation.

2. Description:

    a. Standard: MSS SP-110.
    b. CWP Rating: 400 psig (2760 kPa).
    c. Body Design: One piece.
    d. Body Material: Forged brass.
    e. Ends: Threaded.
    f. Seats: PTFE or TFE.
    g. Stem: Brass.
    h. Ball: Chrome-plated brass.
    i. Port: Reduced.

B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. DynaQuip Controls.
d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
e. Hammond Valve.
f. Jamesbury; a subsidiary of Metso Automation.
g. Jomar International, LTD.
h. Kitz Corporation.
i. Legend Valve.
j. Marwin Valve; a division of Richards Industries.
k. Milwaukee Valve Company.
l. NIBCO INC.
m. Red-White Valve Corporation.
n. RuB Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements,available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
d. Hammond Valve.
e. Jamesbury; a subsidiary of Metso Automation.
f. Kitz Corporation.
g. Marwin Valve; a division of Richards Industries.
h. Milwaukee Valve Company.
i. RuB Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.

f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Jamesbury; a subsidiary of Metso Automation.
c. Legend Valve.
d. Marwin Valve; a division of Richards Industries.
e. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Regular.

E. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Jamesbury; a subsidiary of Metso Automation.
b. Marwin Valve; a division of Richards Industries.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Brass or bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.

j. Port: Regular.

F. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Jomar International, LTD.
b. Kitz Corporation.
c. Red-White Valve Corporation.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

G. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Jomar International, LTD.
b. Kitz Corporation.
c. Marwin Valve; a division of Richards Industries.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.4 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. NIBCO INC.

2. Description:

    a. Standard: MSS SP-110.
    b. CWP Rating: 400 psig (2760 kPa).
    c. Body Design: One piece.
    d. Body Material: Bronze.
    e. Ends: Threaded.
    f. Seats: PTFE or TFE.
    g. Stem: Bronze.
    h. Ball: Chrome-plated brass.
    i. Port: Reduced.

B. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Conbraco Industries, Inc.; Apollo Valves.
    b. NIBCO INC.

2. Description:

    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig (4140 kPa).
    c. Body Design: One piece.
    d. Body Material: Bronze.
    e. Ends: Threaded.
    f. Seats: PTFE or TFE.
    g. Stem: Stainless steel.
    h. Ball: Stainless steel, vented.
    i. Port: Reduced.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Hammond Valve.
e. Lance Valves; a division of Advanced Thermal Systems, Inc.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

D. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

E. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. DynaQuip Controls.
    f. Hammond Valve.
    g. Lance Valves; a division of Advanced Thermal Systems, Inc.
    h. Milwaukee Valve Company.
    i. NIBCO INC.

2. Description:

    a. Standard: MSS SP-110.
    b. SWP Rating: 150 psig (1035 kPa).
    c. CWP Rating: 600 psig (4140 kPa).
    d. Body Design: Two piece.
    e. Body Material: Bronze.
    f. Ends: Threaded.
    g. Seats: PTFE or TFE.
    h. Stem: Bronze.
    i. Ball: Chrome-plated brass.
    j. Port: Regular.

F. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Conbraco Industries, Inc.; Apollo Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Hammond Valve.
    d. Milwaukee Valve Company.

2. Description:

    a. Standard: MSS SP-110.
    b. SWP Rating: 150 psig (1035 kPa).
    c. CWP Rating: 600 psig (4140 kPa).
    d. Body Design: Two piece.
    e. Body Material: Bronze.
    f. Ends: Threaded.
    g. Seats: PTFE or TFE.
    h. Stem: Stainless steel.
    i. Ball: Stainless steel, vented.

j. Port: Regular.

G. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. DynaQuip Controls.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

H. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.5 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Kitz Corporation.
    d. Sure Flow Equipment Inc.
    e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-72.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Split body.
    d. Body Material: ASTM A 126, gray iron.
    e. Ends: Flanged.
    f. Seats: PTFE or TFE.
    g. Stem: Stainless steel.
    h. Ball: Stainless steel.
    i. Port: Full.

2.6 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. DeZurik Water Controls.
    g. Flo Fab Inc.
    h. Hammond Valve.
    i. Kitz Corporation.
    j. Legend Valve.
    k. Milwaukee Valve Company.
    l. NIBCO INC.
    m. Norriseal; a Dover Corporation company.
    n. Red-White Valve Corporation.
    o. Spence Strainers International; a division of CIRCOR International, Inc.
    p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-67, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
    e. Seat: EPDM.
    f. Stem: One- or two-piece stainless steel.
    g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. DeZurik Water Controls.
    g. Flo Fab Inc.
    h. Hammond Valve.
    i. Kitz Corporation.
    j. Legend Valve.
    k. Milwaukee Valve Company.
    l. NIBCO INC.
    m. Norriseal; a Dover Corporation company.
    n. Red-White Valve Corporation.
    o. Spence Strainers International; a division of CIRCOR International, Inc.
    p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-67, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
    e. Seat: NBR.
    f. Stem: One- or two-piece stainless steel.
    g. Disc: Aluminum bronze.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
e. Crane Co.; Crane Valve Group; Center Line.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.
p. Spence Strainers International; a division of CIRCOR International, Inc.
q. Sure Flow Equipment Inc.
r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Coated ductile iron.

D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
e. Crane Co.; Crane Valve Group; Center Line.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.

p. Spence Strainers International; a division of CIRCOR International, Inc.
q. Sure Flow Equipment Inc.
r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Coated ductile iron.

E. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.
p. Red-White Valve Corporation.
q. Spence Strainers International; a division of CIRCOR International, Inc.
r. Sure Flow Equipment Inc.
s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

F. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABZ Valves and Controls; A div. of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; A div. of Cooper Cameron Corp.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Div.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.
p. Red-White Valve Corporation.
q. Spence Strainers International; a division of CIRCOR International, Inc.
r. Sure Flow Equipment Inc.
s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.7 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kennedy Valve; a division of McWane, Inc.
b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig (1200 kPa).
c. Body Material: Coated, ductile iron.
d. Stem: Two-piece stainless steel.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Kennedy Valve; a division of McWane, Inc.
c. Mueller Steam Specialty; a division of SPX Corporation.
d. NIBCO INC.
e. Shurjoint Piping Products.
f. Tyco Fire Products LP; Grinnell Mechanical Products.
g. Victaulic Company.

2. Description:

a. Standard: MSS SP-67, Type I.
b. NPS 8 (DN 200) and Smaller CWP Rating: 300 psig (2070 kPa).
c. NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
d. Body Material: Coated, ductile iron.
e. Stem: Two-piece stainless steel.
f. Disc: Coated, ductile iron.
g. Seal: EPDM.

2.8 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.

d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Flo Fab Inc.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. Mueller Steam Specialty; a division of SPX Corporation.
f. NIBCO INC.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

2.9 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.

b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

2.10 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Sure Flow Equipment Inc.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
m. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged.
    f. Trim: Bronze.
    g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged.
    f. Trim: Composition.
    g. Seat Ring: Bronze.
    h. Disc Holder: Bronze.
    i. Disc: PTFE or TFE.
    j. Gasket: Asbestos free.

C. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 500 psig (3450 kPa).
    c. Body Design: Clear or full waterway.

d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.

2.11 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. NIBCO INC.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed, exterior lever and weight.

2.12 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. Shurjoint Piping Products.
   c. Tyco Fire Products LP; Grinnell Mechanical Products.
   d. Victaulic Company.

2. Description:

   a. CWP Rating: 300 psig (2070 kPa).
   b. Body Material: ASTM A 536, ductile iron.
   c. Seal: EPDM.
   d. Disc: Spring-operated, ductile iron or stainless steel.

2.13 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. APCO Willamette Valve and Primer Corporation.
   c. Crispin Valve.
   d. DFT Inc.
   e. Flo Fab Inc.
   f. GA Industries, Inc.
   g. Hammond Valve.
   h. Metraflex, Inc.
   i. Milwaukee Valve Company.
   j. Mueller Steam Specialty; a division of SPX Corporation.
   k. NIBCO INC.
   l. Spence Strainers International; a division of CIRCOR International, Inc.
   m. Sure Flow Equipment Inc.
   n. Val-Matic Valve & Manufacturing Corp.
   o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-125.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Material: ASTM A 126, gray iron.
   d. Style: Compact wafer.

e. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flomatic Corporation.
e. Hammond Valve.
f. Metraflex, Inc.
g. Milwaukee Valve Company.
h. Mueller Steam Specialty; a division of SPX Corporation.
i. NIBCO INC.
j. Spence Strainers International; a division of CIRCOR International, Inc.
k. Sure Flow Equipment Inc.
l. Val-Matic Valve & Manufacturing Corp.
m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer.
e. Seat: Bronze.

D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APCO Willamette Valve and Primer Corporation.
    b. Crispin Valve.
    c. Val-Matic Valve & Manufacturing Corp.

2. Description:

    a. Standard: MSS SP-125.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
    d. Style: Globe, spring loaded.
    e. Ends: Flanged.
    f. Seat: Bronze.

E. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APCO Willamette Valve and Primer Corporation.
    b. Crispin Valve.
    c. DFT Inc.
    d. Flo Fab Inc.
    e. Hammond Valve.
    f. Metraflex, Inc.
    g. Milwaukee Valve Company.
    h. NIBCO INC.
    i. Sure Flow Equipment Inc.
    j. Val-Matic Valve & Manufacturing Corp.

2. Description:

    a. Standard: MSS SP-125.
    b. CWP Rating: 400 psig (2760 kPa).
    c. Body Material: ASTM A 126, gray iron.
    d. Style: Compact wafer, spring loaded.
    e. Seat: Bronze.

F. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APCO Willamette Valve and Primer Corporation.
    b. Crispin Valve.
    c. DFT Inc.

d. Flomatic Corporation.
e. Hammond Valve.
f. Metraflex, Inc.
g. Milwaukee Valve Company.
h. Mueller Steam Specialty; a division of SPX Corporation.
i. NIBCO INC.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

G. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: Bronze.

H. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Globe, spring loaded.

e. Ends: Flanged.
f. Seat: Bronze.

I. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flo Fab Inc.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Spence Strainers International; a division of CIRCOR International, Inc.
i. Sure Flow Equipment Inc.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Compact wafer.

J. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. APCO Willamette Valve and Primer Corporation.
c. Crispin Valve.
d. DFT Inc.
e. GA Industries, Inc.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Sure Flow Equipment Inc.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.

K. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APCO Willamette Valve and Primer Corporation.
    b. Crispin Valve.
    c. Val-Matic Valve & Manufacturing Corp.

2. Description:

    a. Standard: MSS SP-125.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
    d. Style: Compact wafer.

L. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APCO Willamette Valve and Primer Corporation.
    b. Crispin Valve.
    c. DFT Inc.
    d. Val-Matic Valve & Manufacturing Corp.

2. Description:

    a. Standard: MSS SP-125.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
    d. Style: Globe, spring loaded.
    e. Ends: Flanged.

M. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APCO Willamette Valve and Primer Corporation.
    b. Crispin Valve.
    c. DFT Inc.
    d. Flo Fab Inc.
    e. Hammond Valve.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Sure Flow Equipment Inc.
    i. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Compact wafer, spring loaded.

N. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.

O. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer, spring loaded.

P. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.

2.14 IRON, PLATE-TYPE CHECK VALVES

A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Flomatic Corporation.
d. Mueller Steam Specialty; a division of SPX Corporation.

2. Description:

a. Standard: API 594.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 126, gray iron.
e. Seat: Bronze.

B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Mueller Steam Specialty; a division of SPX Corporation.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.

C. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crane Co.; Crane Valve Group; Crane Valves.

2. Description:

   a. Standard: API 594.
   b. CWP Rating: 400 psig (2760 kPa).
   c. Body Design: Wafer, spring-loaded plates.
   d. Body Material: ASTM A 126, gray iron.
   e. Seat: Bronze.

D. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Mueller Steam Specialty; a division of SPX Corporation.
   d. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: API 594.
   b. CWP Rating: 500 psig (3450 kPa).
   c. Body Design: Wafer, spring-loaded plates.
   d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
   e. Seat: Bronze.

E. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Flo Fab Inc.
   b. Sure Flow Equipment Inc.

2. Description:

   a. Standard: API 594.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Design: Wafer, spring-loaded plate.
   d. Body Material: ASTM A 126, gray iron.

F. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APCO Willamette Valve and Primer Corporation.
    b. Cooper Cameron Valves TVB Techno.
    c. Crane Co.; Crane Valve Group; Crane Valves.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. NIBCO INC.
    f. Spence Strainers International; a division of CIRCOR International, Inc.
    g. Sure Flow Equipment Inc.
    h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: API 594.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Wafer, spring-loaded plates.
    d. Body Material: ASTM A 126, gray iron.

G. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APCO Willamette Valve and Primer Corporation.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Val-Matic Valve & Manufacturing Corp.

2. Description:

    a. Standard: API 594.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Design: Wafer, spring-loaded plates.
    d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.

H. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Sure Flow Equipment Inc.

2. Description:

    a. Standard: API 594.

b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: Wafer, spring-loaded plate.
d. Body Material: ASTM A 126, gray iron.

I. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Sure Flow Equipment Inc.

2. Description:

a. Standard: API 594.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 126, gray iron.

J. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.

2.15 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.

f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Hammond Valve.
    b. Kitz Corporation.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Powell Valves.
    f. Red-White Valve Corporation.
    g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: Solid wedge; bronze.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron, bronze, or aluminum.

D. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. Hammond Valve.
    d. Kitz Corporation.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Powell Valves.
    h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    i. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: Solid wedge; bronze.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron, bronze, or aluminum.

2.16 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Flo Fab Inc.
    e. Hammond Valve.
    f. Kitz Corporation.
    g. Legend Valve.
    h. Milwaukee Valve Company.
    i. NIBCO INC.
    j. Powell Valves.
    k. Red-White Valve Corporation.
    l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    m. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-70, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: Bronze.
    f. Disc: Solid wedge.
    g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Flo Fab Inc.
    e. Hammond Valve.
    f. Kitz Corporation.
    g. Legend Valve.
    h. Milwaukee Valve Company.
    i. NIBCO INC.
    j. Powell Valves.
    k. Red-White Valve Corporation.
    l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    m. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-70, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: Bronze.
    f. Disc: Solid wedge.
    g. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. NIBCO INC.

2. Description:

    a. Standard: MSS SP-70, Type I.
    b. CWP Rating: 500 psig (3450 kPa).
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: Bronze.
    f. Disc: Solid wedge.
    g. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Powell Valves.
    g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-70, Type I.
    b. CWP Rating: 500 psig (3450 kPa).
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: Bronze.

f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.17 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO INC.
d. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.

f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

2.18 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Powell Valves.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.19 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. CWP Rating: 200 psig (1380 kPa).

c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short .
e. Plug: Cast iron or bronze with sealant groove.

G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

2.20 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball, butterfly and plug valve stems.
3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball, butterfly, gate, globe and plug valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Globe, ball or butterfly valves.
4. Pump-Discharge Check Valves:

    a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
    c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One piece, full port, brass or bronze with brass trim.
3. Bronze Lift Check Valves: Class 125, bronze disc.
4. Bronze Swing Check Valves: Class 150, bronze disc.
5. Bronze Gate Valves: Class 150.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, ductile-iron disc.

3. Iron, Grooved-End Butterfly Valves: 300 CWP.
4. Iron Swing Check Valves: Class 250, metal seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 250, compact-wafer resilient seat.
7. Iron, Plate-Type Check Valves: Class 250; single plate; resilient seat.
8. Iron Gate Valves: Class, OS&Y.

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa))

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One piece, full port, brass or bronze with brass trim.
3. Bronze Lift Check Valves: Class 125, bronze disc.
4. Bronze Swing Check Valves: Class 150, bronze disc.
5. Bronze Gate ValvesClass 150, RS.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, ductile-iron disc.
3. Iron, Grooved-End Butterfly Valves: 300 CWP.
4. Iron Swing Check Valves: Class 250, metal seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 250, compact-wafer, resilient seat.
7. Iron, Plate-Type Check Valves: Class 250 ; single plate; resilient seat.
8. Iron Gate Valves: Class 250, OS&Y.

3.7 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, bronze disc.
3. Ball Valves: One piece, full port, brass o [bronze with brass trim.
4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
5. Bronze Gate Valves: Class 150, NRS.
6. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, ductile-iron disc.

4. Iron, Grooved-End Butterfly Valves: 300 CWP.
5. Iron Swing Check Valves: Class 250, metal seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
7. Iron, Grooved-End Swing Check Valves: 300 CWP.
8. Iron, Center-Guided Check Valves: Class 250, globe, metal seat.
9. Iron, Plate-Type Check Valves: Class 250; single plate; metal seat.
10. Iron Gate Valves: Class 250, OS&Y.
11. Iron Globe Valves: Class 250.

3.8 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, bronze disc.
3. Ball Valves: One piece, full port, brass or bronze with bronze trim.
4. Bronze Swing Check Valves: Class 150, bronze disc.
5. Bronze Gate Valves: Class 150, RS.
6. Bronze Globe Valves: Class 150, bronze nonmetallic disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron Gate Valves: Class 250, OS&Y.
7. Iron Globe Valves: Class 250.
8. Lubricated Plug Valves: Class 250, cylindrical, flanged.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation; Tyco International, Ltd.
    g. Wesanco, Inc.

3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
4. Standard: MFMA-4.
5. Channels: Continuous slotted steel channel with inturned lips.
6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Anvil International; a subsidiary of Mueller Water Products Inc.
    b. Empire Industries, Inc.
    c. ERICO International Corporation.
    d. Haydon Corporation; H-Strut Division.
    e. NIBCO INC.
    f. PHD Manufacturing, Inc.
    g. PHS Industries, Inc.

3. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
4. Standard: Comply with MFMA-4.
5. Channels: Continuous slotted steel channel with inturned lips.
6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.5 FIBERGLASS STRUT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Allied Tube & Conduit.
2. Champion Fiberglass, Inc.
3. Cooper B-Line, Inc.
4. SEASAFE, INC.; a Gibraltar Industries Company.

C. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.

1. Channels: Continuous slotted fiberglass channel with inturned lips.
2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of fiberglass.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa), Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) with 100-psig (688-kPa), Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa)] minimum compressive strength.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.10 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) <Insert size> and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

Q. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include

auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Seismic snubbers.
12. Restraining braces and cables.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC
2. Assigned Seismic Use Group or Building Category as Defined in the IBC

a. Component Importance Factor: 1.0.
b. Component Response Modification Factor: 1.5
c. Component Amplification Factor: 1.0

3. Design Spectral Response Acceleration at Short Periods (0.2 Second).
4. Design Spectral Response Acceleration at 1-Second Period.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.

4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

F. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

G. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

H. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick,

neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

I. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

J. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

K. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

L. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

D. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

E. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

F. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

G. Restraint Cables: ASTM A 603 galvanized, ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

H. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

I. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

J. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

K. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

L. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

M. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
11. Test and adjust air-mounting system controls and safeties.
12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment:

1. Equipment Location:
2. Pads:

    a. Material: Neoprene.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting] [High-Performance Coatings."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Low-Pressure, Compressed-Air Piping:

a. Background Color: White.

b. Letter Color: Black.

2. Medium-Pressure, Compressed-Air Piping:

a. Background Color: White.
b. Letter Color: Black.

3. Domestic Water Piping:

a. Background Color: White.
b. Letter Color: Black.

4. Sanitary Waste and Storm Drainage Piping:

a. Background Color: White.
b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Domestic chilled-water piping for drinking fountains.
5. Sanitary waste piping exposed to freezing conditions.
6. Storm-water piping exposed to freezing conditions.
7. Roof drains and rainwater leaders.
8. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Division 22 Section "Plumbing Equipment Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit EQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
2. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
3. Sheet Jacket Materials: 12 inches (300 mm) square.
4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

E. Qualification Data: For qualified Installer.

F. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

G. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

a. One 10-foot (3-m) section of NPS 2 (DN 50) straight pipe.
b. One each of a 90-degree threaded, welded, and flanged elbow.

c. One each of a threaded, welded, and flanged tee fitting.
d. One NPS 2 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) or larger valve.
e. Four support hangers including hanger shield and insert.
f. One threaded strainer and one flanged strainer with removable portion of insulation.
g. One threaded reducer and one welded reducer.
h. One pressure temperature tap.
i. One mechanical coupling.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Pittsburgh Corning Corporation; Foamglass

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation. Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR All-Service Duct Wrap.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000-Degree Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Phenolic:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
    b. Resolco International BV; Insul-phen.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.

K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armacell LLC; Tubolit.
    b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.

b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Corning Corporation; 739, Dow Silicone.
    b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
    b. Eagle Bridges - Marathon Industries; 501.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
    d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    b. Eagle Bridges - Marathon Industries; 570.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    b. Eagle Bridges - Marathon Industries; 550.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.

d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).

5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    b. Eagle Bridges - Marathon Industries; 405.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Pittsburgh Corning Corporation; Pittwrap.
    b. Polyguard Products, Inc.; Insulrap No Torch 125.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 428 AWF ASJ.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    c. Compac Corporation; 104 and 105.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 491 AWF FSK.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    c. Compac Corporation; 110 and 111.
    d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 370 White PVC tape.
    b. Compac Corporation; 130.
    c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 488 AWF.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    c. Compac Corporation; 120.
    d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ITW Insulation Systems; Gerrard Strapping and Seals.
    b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Engineered Brass Company.
    b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
    c. McGuire Manufacturing.
    d. Plumberex.
    e. Truebro; a brand of IPS Corporation.
    f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Truebro; a brand of IPS Corporation.
    b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.12 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3.

3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.
5. Water meters furnished by utility company for installation by Contractor.
6. Water meters.

B. Related Section:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.
5. Water meters.
6. Backflow preventers.
7. Water penetration systems.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Product Data for Credit EA 5: For specified metering equipment.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components.

C. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's written permission.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Elkhart Products Corporation; Industrial Division.
        2) NIBCO INC.
        3) Viega; Plumbing and Heating Systems.

    b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

6. Copper Push-on-Joint Fittings:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) NVent LLC.

    b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.

7. Copper-Tube Extruded-Tee Connections:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

        1) T-DRILL Industries Inc.

    b. Description: Tee formed in copper tube according to ASTM F 2014.

8. Grooved-Joint Copper-Tube Appurtenances:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Anvil International.
        2) Shurjoint Piping Products.
        3) Victaulic Company.

    b. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.

c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Copper Pressure-Seal-Joint Fittings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1) Elkhart Products Corporation; Industrial Division.
2) NIBCO INC.
3) Viega; Plumbing and Heating Systems.

b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
c. NPS 3 and NPS 4 (DN 80 and DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.

a. Gaskets: AWWA C111, rubber.

2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.

a. Gaskets: AWWA C111, rubber.

C. Plain-End, Ductile-Iron Pipe: AWWA C151.

1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Anvil International.
2) Shurjoint Piping Products.
3) Star Pipe Products.
4) Victaulic Company.

b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
c. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Standard Weight. Include ends matching joining method.

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
4. Flanges: ASME B16.1, Class 125, cast iron.
5. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Anvil International.
2) Shurjoint Piping Products.
3) Star Pipe Products.
4) Victaulic Company.

b. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
c. Grooved-End-Pipe Couplings for Galvanized-Steel Piping: AWWA C606 for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.5 CPVC PIPING

A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40 and Schedule 80.

1. CPVC Socket Fittings: ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80.
2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.

B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.

C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.6 PEX TUBE AND FITTINGS

A. PEX Distribution System: ASTM F 877, SDR 9 tubing.

1. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
2. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.7 PVC PIPE AND FITTINGS

A. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.

1. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.
2. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.8 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.9 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Form: Sheet or Tube.

C. Material: LLDPE film of 0.008-inch (0.20-mm)

2.10 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

C. CPVC Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc.
    b. Asahi/America, Inc.
    c. Colonial Engineering, Inc.
    d. Fischer, George Inc.
    e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
    f. IPEX Inc.
    g. NIBCO INC.
    h. Sloane, George Fischer, Inc.
    i. Spears Manufacturing Company.
    j. Thermoplastic Valves Inc.

2. Description:

    a. Standard: MSS SP-122.
    b. Pressure Rating: 150 psig (1035 kPa).
    c. Body Material: CPVC.
    d. Body Design: Union type.

e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, flanged.
g. Ball: CPVC; full port.
h. Seals: PTFE or EPDM-rubber O-rings.
i. Handle: Tee shaped.

D. PVC Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Asahi/America, Inc.
c. Colonial Engineering, Inc.
d. Fischer, George Inc.
e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
f. IPEX Inc.
g. Jomar International, LTD.
h. King Bros. Industries.
i. Legend Valve.
j. McDonald, A.Y. Mfg. Co.
k. NIBCO INC.
l. Sloane, George Fischer, Inc.
m. Spears Manufacturing Company.
n. Thermoplastic Valves Inc.

2. Description:

a. Standard: MSS SP-122.
b. Pressure Rating: 150 psig (1035 kPa) .
c. Body Material: PVC.
d. Body Design: Union type.
e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, flanged.
g. Ball: PVC; full port.
h. Seals: PTFE or EPDM-rubber O-rings.
i. Handle: Tee shaped.

E. CPVC Non-Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Asahi/America, Inc.

c. King Bros. Industries.
d. Legend Valve.
e. NIBCO INC.
f. Spears Manufacturing Company.
g. Thermoplastic Valves Inc.

2. Description:

a. Standard: MSS SP-122.
b. Pressure Rating: 150 psig (1035 kPa).
c. Body Material: CPVC.
d. Body Design: Non-union type.
e. End Connections: Socket or threaded.
f. Ball: CPVC; full or reduced port.
g. Seals: PTFE or EPDM-rubber O-rings.
h. Handle: Tee shaped.

F. PVC Non-Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. American Valve, Inc.
b. Asahi/America, Inc.
c. Colonial Engineering, Inc.
d. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
e. IPEX Inc.
f. Jomar International, LTD.
g. King Bros. Industries.
h. Legend Valve.
i. McDonald, A.Y. Mfg. Co.
j. NIBCO INC.
k. Sloane, George Fischer, Inc.
l. Spears Manufacturing Company.
m. Thermoplastic Valves Inc.

2. Description:

a. Standard: MSS SP-122.
b. Pressure Rating: 150 psig (1035 kPa).
c. Body Material: PVC.
d. Body Design: Non-union type.
e. End Connections: Socket or threaded.
f. Ball: PVC; full or reduced port.
g. Seals: PTFE or EPDM-rubber O-rings.
h. Handle: Tee shaped.

G. CPVC Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fischer, George Inc.
    b. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
    c. NIBCO INC.
    d. Sloane, George Fischer, Inc.
    e. Spears Manufacturing Company.
    f. Thermoplastic Valves Inc.

2. Description:

    a. Pressure Rating: 150 psig (1035 kPa) .
    b. Body Material: CPVC.
    c. Body Design: Lug or wafer type.
    d. Seat: EPDM rubber.
    e. Seals: PTFE or EPDM-rubber O-rings.
    f. Disc: CPVC.
    g. Stem: Stainless steel.
    h. Handle: Lever.

H. PVC Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc.
    b. Asahi/America, Inc.
    c. Colonial Engineering, Inc.
    d. Fischer, George Inc.
    e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
    f. IPEX Inc.
    g. Legend Valve.
    h. NIBCO INC.
    i. Sloane, George Fischer, Inc.
    j. Spears Manufacturing Company.
    k. Thermoplastic Valves Inc.

2. Description:

    a. Pressure Rating 150 psig (1035 kPa) .
    b. Body Material: PVC.
    c. Body Design: Lug or wafer type.
    d. Seat: EPDM rubber.
    e. Seals: PTFE or EPDM-rubber O-rings.
    f. Disc: PVC.
    g. Stem: Stainless steel.
    h. Handle: Lever.

I. CPVC Ball Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. American Valve, Inc.
b. Asahi/America, Inc.
c. Colonial Engineering, Inc.
d. Fischer, George Inc.
e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
f. IPEX Inc.
g. NIBCO INC.
h. Sloane, George Fischer, Inc.
i. Spears Manufacturing Company.
j. Thermoplastic Valves Inc.

2. Description:

a. Pressure Rating: 150 psig (1035 kPa).
b. Body Material: CPVC.
c. Body Design: Union-type ball check.
d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, flanged.
f. Ball: CPVC.
g. Seals: EPDM- or FKM-rubber O-rings.

J. PVC Ball Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Asahi/America, Inc.
c. Colonial Engineering, Inc.
d. Fischer, George Inc.
e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
f. IPEX Inc.
g. Legend Valve.
h. NIBCO INC.
i. Sloane, George Fischer, Inc.
j. Spears Manufacturing Company.
k. Thermoplastic Valves Inc.

2. Description:

a. Pressure Rating: 150 psig (1035 kPa).
b. Body Material: PVC.

c. Body Design: Union-type ball check.
d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, flanged.
f. Ball: PVC.
g. Seals: EPDM- or FKM-rubber O-rings.

K. CPVC Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Sloane, George Fischer, Inc.
b. Spears Manufacturing Company.

2. Description:

a. Pressure Rating: 150 psig (1035 kPa).
b. Body Material: CPVC.
c. Body Design: Nonrising stem.
d. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or Threaded.
e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.
f. Gate and Stem: Plastic.
g. Seals: EPDM rubber.
h. Handle: Wheel.

L. PVC Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Asahi/America, Inc.
b. King Bros. Industries.
c. Sloane, George Fischer, Inc.
d. Spears Manufacturing Company.

2. Description:

a. Pressure Rating: 150 psig (1035 kPa).
b. Body Material: PVC.
c. Body Design: Nonrising stem.
d. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or Threaded.
e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100) Flanged.
f. Gate and Stem: Plastic.
g. Seals: EPDM rubber.
h. Handle: Wheel.

2.11 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Dresser Piping Specialties.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc; a Sensus company.
g. Viking Johnson; c/o Mueller Co.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description: CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Colonial Engineering, Inc.
b. NIBCO INC.
c. Spears Manufacturing Company.

2.12 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Jomar International Ltd.
   e. Matco-Norca, Inc.
   f. McDonald, A. Y. Mfg. Co.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   h. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Pressure Rating: 150 psig (1035 kPa).
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Matco-Norca, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 150 psig (1035 kPa).
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig (1035 kPa).
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Elster Perfection.
b. Grinnell Mechanical Products.
c. Matco-Norca, Inc.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Description:

a. Standard: IAPMO PS 66
b. Electroplated steel nipple. complying with ASTM F 1545.
c. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Rubber Co.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. Tozen Corporation.
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.14 WATER METERS

A. Displacement-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AALIANT; a Venture Measurement Product Line.
b. ABB.
c. Badger Meter, Inc.
d. Carlon Meter.
e. Mueller Company; Water Products Division.
f. Schlumberger Limited; Water Division.
g. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C700.
b. Pressure Rating: 150-psig (1035-kPa) working pressure.
c. Body Design: Nutating disc; totalization meter.
d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility.
e. Case: Bronze.
f. End Connections: Threaded.

B. Turbine-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AALIANT; a Venture Measurement Product Line.
b. ABB.
c. Badger Meter, Inc.
d. Hays Fluid Controls.

e. Master Meter, Inc.
f. McCrometer.
g. Mueller Company; Water Products Division.
h. Schlumberger Limited; Water Division.
i. SeaMetrics Inc.
j. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C701.
b. Pressure Rating: 150-psig (1035-kPa) working pressure.
c. Body Design: Turbine; totalization meter.
d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company .
e. Case: Bronze.
f. End Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
g. End Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.

C. Compound-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB.
b. Badger Meter, Inc.
c. Master Meter, Inc.
d. Mueller Company; Water Products Division.
e. Schlumberger Limited; Water Division.
f. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C702.
b. Pressure Rating: 150-psig (1035-kPa) working pressure.
c. Body Design: With integral mainline and bypass meters; totalization meter.
d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
e. Case: Bronze.
f. Pipe Connections: Flanged.

D. Fire-Service-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Badger Meter, Inc.
b. Mueller Company; Water Products Division.
c. Schlumberger Limited; Water Division.
d. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C703 and UL listing.
b. Pressure Rating: 175-psig (1200-kPa) working pressure.
c. Body Design:

1) Proportional, Detector-Type Water Meters: With meter on bypass.

a) Bypass Meter: AWWA C701, turbine type with bronze case; size not less than one-half nominal size of main-line meter.

2) Turbine-Type Water Meters: With strainer, and with meter on bypass.

a) Strainer: Full size, matching water meter.
b) Bypass Meter: AWWA C701, turbine type with bronze case; not less than NPS 2 (DN 50).

d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
e. Case: Bronze.
f. Pipe Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
g. Pipe Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.

E. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

F. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

H. Install domestic water piping level without pitch and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping adjacent to equipment and specialties to allow service and maintenance.

O. Install piping to permit valve servicing.

P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

Q. Install piping free of sags and bends.

R. Install fittings for changes in direction and branch connections.

S. Install PEX piping with loop at each change of direction of more than 90 degrees.

T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

U. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

V. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

W. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

I. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.

J. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.

K. Steel-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

M. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Piping: Join according to ASTM D 2855.

N. PEX Piping Joints: Join according to ASTM F 1807.

O. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65)

and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 WATER METER INSTALLATION

A. Rough-in domestic water piping for water meter installation, and install water meters according to utility company's requirements.

B. Water meters will be furnished and installed by utility company.

C. Install water meters according to AWWA M6, utility company's requirements, and the following:

D. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

E. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

F. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.

G. Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.

H. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

3.9 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

F. Install supports for vertical copper tubing every 10 feet (3 m).

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

H. Install supports for vertical steel piping every 15 feet (4.5 m).

I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

J. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.

K. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.

L. Install hangers for vertical PEX piping every 48 inches (1200 mm).

M. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.

4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

N. Install supports for vertical PVC piping every 48 inches (1200 mm).

O. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.11 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.13 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.14 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.15 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building service piping, NPS 3 (DN 80) and smaller, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper solder-joint fittings; and brazed joints.
2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper solder-joint fittings; and brazed joints.
2. Mechanical-joint, ductile-iron pipe; standard or compact pattern mechanical-joint fittings; and mechanical joints.
3. Push-on-joint, ductile-iron pipe; standard or compact pattern push-on-joint fittings; and gasketed joints.
4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
5. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.

F. Under-building slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300), shall be one of the following:

1. Mechanical-joint, ductile-iron pipe; standard or compact pattern mechanical-joint fittings; and mechanical joints.
2. Push-on-joint, ductile-iron pipe standard or compact pattern push-on-joint fittings; and gasketed joints.
3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

G. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper solder-joint fittings; and brazed joints.
2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.

H. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
3. CPVC, Schedule 40 pipe; CPVC, Schedule 40 socket fittings; and solvent-cemented joints.
4. PEX Tube, NPS 1 (DN 25) and smaller; fittings for PEX tube; and crimped joints.

I. Aboveground domestic water piping, [NPS 2-1/2 to NPS 4 (DN 65 to DN 100)] <Insert pipe size range>, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); grooved-joint copper-tube appurtenances; and grooved joints.
4. CPVC, Schedule 40 pipe; CPVC, Schedule 40; CPVC socket fittings; and solvent-cemented joints.

3.16 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Division 22 Section "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
2. Division 22 Section "Sanitary Sewerage Pumps" for effluent and sewage pumps.
3. Division 22 Section "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
2. Waste, Force-Main Piping: 50 psig (345 kPa).

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements

of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

D. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ANACO-Husky.
    b. Dallas Specialty & Mfg. Co.
    c. Fernco Inc.
    d. Matco-Norca, Inc.
    e. MIFAB, Inc.
    f. Mission Rubber Company; a division of MCP Industries, Inc.
    g. Stant.
    h. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ANACO-Husky.
    b. Clamp-All Corp.
    c. Dallas Specialty & Mfg. Co.
    d. MIFAB, Inc.
    e. Mission Rubber Company; a division of MCP Industries, Inc.
    f. Stant.
    g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.

B. Cast-Iron Drainage Fittings: ASME B16.12, threaded.

C. Steel Pipe Pressure Fittings:

1. Galvanized Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Cast-Iron Flanges: ASME B16.1, Class 125.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Anvil International; a subsidiary of Mueller Water Products, Inc.
    b. Grinnell Mechanical Products.
    c. Shurjoint Piping Products.
    d. Victaulic Company.

2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.5 STAINLESS-STEEL PIPE AND FITTINGS

A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.

B. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

2.6 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber.

C. Ductile-Iron, Grooved-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Anvil International.
2) Shurjoint Piping Products.
3) Star Pipe Products.
4) Victaulic Company.

b. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.

c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.7 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M (ASTM B 88M, Type B and Type C), water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

E. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.8 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement: ASTM D 2235.

1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.9 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers"

2.10 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Dallas Specialty & Mfg. Co.
2) Fernco Inc.
3) Mission Rubber Company; a division of MCP Industries, Inc.
4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

b. Standard: ASTM C 1173.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Cascade Waterworks Mfg. Co.
        2) Mission Rubber Company; a division of MCP Industries, Inc.

    b. Standard: ASTM C 1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Cascade Waterworks Mfg. Co.
        2) Dresser, Inc.
        3) EBAA Iron, Inc.
        4) JCM Industries, Inc.
        5) Romac Industries, Inc.

    b. Standard: AWWA C219.
    c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
    d. Center-Sleeve Material: Manufacturer's standard.
    e. Gasket Material: Natural or synthetic rubber.
    f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Capitol Manufacturing Company.
        2) Central Plastics Company.
        3) Hart Industries International, Inc.
        4) Jomar International Ltd.
        5) Matco-Norca, Inc.
        6) McDonald, A. Y. Mfg. Co.
        7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.

8) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 150 psig (860 kPa) minimum at 180 deg F (82 deg C).
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca, Inc.
4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
5) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 150 psig (860 kPa) minimum at 180 deg F (82 deg C).
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig (1035 kPa).
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

2.11 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Horizontal Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Install steel piping according to applicable plumbing code.

P. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

R. Install aboveground ABS piping according to ASTM D 2661.

S. Install aboveground PVC piping according to ASTM D 2665.

T. Install underground ABS and PVC piping according to ASTM D 2321.

U. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

V. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

W. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

X. Install force mains at elevations indicated.

Y. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Division 22 Section "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."

Z. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

AA. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

BB. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

CC. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

    a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.

b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

I. Install supports for vertical steel piping every 15 feet (4.5 m).

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.

K. Install supports for vertical stainless-steel piping every 10 feet (3 m).

L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 and NPS 5 (DN 80 and DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

M. Install supports for vertical copper tubing every 10 feet (3 m).

N. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

O. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).

P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves, cleanout and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and sovent stack fittings; CISPI hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
5. Copper DWV tube, copper drainage fittings, and soldered joints.
6. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
7. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
8. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and sovent stack fittings; CISPI hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
6. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Stainless-steel pipe and fittings gaskets, and gasketed joints.
5. Copper DWV tube, copper drainage fittings, and soldered joints.

    a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90): Hard copper tube, Type M (Type C); copper pressure fittings; and soldered joints.

6. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
7. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
8. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; and coupled joints.
3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
4. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
6. Dissimilar Pipe-Material Couplings: nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; coupled joints.
3. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: nonpressure transition couplings.

H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) shall be any of the following:

1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.

I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 (DN 65 to DN 150) shall be any of the following:

1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.
3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

J. Underground sanitary-sewage force mains NPS 4 (DN 100) and smaller shall be any of the following:

1. Hard copper tube, Type L (Type B); wrought copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 (DN 40) and pressure transition coupling for NPS 1-1/2 (DN 40) and larger if dissimilar pipe materials.

K. Underground sanitary-sewage force mains NPS 5 (DN 125) and larger shall be any of the following:

1. Hard copper tube, Type L (Type B); wrought copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 221316

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.

B. Related Requirements:

1. Division 22 Section "Residential Plumbing Fixtures" for residential water closets.
2. Division 22 Section "Healthcare Plumbing Fixtures" for healthcare water closets.
3. Division 22 Section "Security Plumbing Fixtures" for security water closets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Credit WE 2, Credit WE 3.1, Credit WE 3.2: Documentation indicating compliance with requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Kohler Co.
c. TOTO USA, INC.
d. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: As indicated on drawings.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. (4.8 L per flush).
h. Spud Size and Location: NPS 1-1/2 (DN 40); top.
i. Color: White.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Sloan Valve Company.
b. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.

5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Consumption: 1.28 gal. (4.8 L) per flush.
10. Minimum Inlet: NPS 1 (DN 25).
11. Minimum Outlet: NPS 1-1/4 (DN 32).

B. Solenoid-Actuator, Diaphragm Flushometer Valves:

C.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Sloan Valve Company.
    b. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. (4.8 L) per flush.
12. Minimum Inlet: NPS 1 (DN 25).
13. Minimum Outlet: NPS 1-1/4 (DN 32).

D. Hydraulic-Actuator, Push-Button, Diaphragm Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Coyne & Delany Co.
    b. Sloan Valve Company.
    c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.

9. Consumption: 1.28 gal. (4.8 L) per flush.
10. Minimum Inlet: NPS 1 (DN 25).
11. Minimum Outlet: NPS 1-1/4 (DN 32).

E. Lever-Handle, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Zurn Industries, LLC; Commercial Brass and Fixtures.
    b. Sloan Valve Company.
    c. TOTO USA, INC.

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.
10. Consumption: 1.28 gal. (4.8 L) per flush.
11. Minimum Inlet: NPS 1 (DN 25).
12. Minimum Outlet: NPS 1-1/4 (DN 32).

F. Hard-Wired, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Gerber Plumbing Fixtures LLC.
    b. Moen Incorporated.
    c. Sloan Valve Company.
    d. TOTO USA, INC.
    e. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.
10. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
12. Consumption: 1.28 gal. (4.8 L) per flush.

13. Minimum Inlet: NPS 1 (DN 25).
14. Minimum Outlet: NPS 1-1/4 (DN 32).

G. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Coyne & Delany Co.
    b. Gerber Plumbing Fixtures LLC.
    c. Hydrotek International, Inc.
    d. Kohler Co.
    e. Moen Incorporated.
    f. Sloan Valve Company.
    g. TOTO USA, INC.
    h. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.
10. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
12. Consumption: 1.28 gal. (4.8 L) per flush.
13. Minimum Inlet: NPS 1 (DN 25).
14. Minimum Outlet: NPS 1-1/4 (DN 32).

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Standard America.
    b. Church Seats.
    c. Kohler Co.
    d. Olsonite Seat Co.
    e. TOTO USA, INC.
    f. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standard: IAPMO/ANSI Z124.5.
4. Material: Plastic.
5. Type: Commercial.
6. Shape: Elongated rim, open front.
7. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Division 22 Section "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Division 22 Section "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Division 22 Section "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Urinals.
2. Flushometer valves.

B. Related Requirements:

1. Division 22 Section "Security Plumbing Fixtures" for security urinals.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Credit WE 2, Credit WE 3.1 and Credit 3.2: Documentation indicating compliance with requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.
2. Waterless Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.
3. Waterless Urinal Trap-Seal Liquid: Equal to 1 gal. (3.8 L) for each urinal installed.

PART 2 - PRODUCTS

2.1 STALL URINALS

A. Urinals: Stall, washout type.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Standard America.
    b. Kohler Co.
    c. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

    a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    b. Material: Vitreous china.
    c. Type: Straight or sloped front.
    d. Seam Covers: For 21-inch (535-mm) urinal centers.
    e. Strainer: Separate; removable.
    f. Water Consumption: Water saving.

2.2 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, blowout.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Standard America.
    b. Capizzi.
    c. Kohler Co.

3. Fixture:

    a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    b. Material: Vitreous china.
    c. Strainer or Trapway: Manufacturer's standard strainer with integral trap.

4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.

5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

B. Urinals: Wall hung, back outlet, siphon jet, accessible.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Briggs Plumbing Products, Inc.
c. Ferguson Enterprises, Inc.; ProFlo Brand.
d. Gerber Plumbing Fixtures LLC.
e. Kohler Co.
f. Mansfield Plumbing Products LLC.
g. Peerless Pottery Sales, Inc.

3. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet with extended shields.
d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.

4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.

5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

C. Urinals : Wall hung, back outlet, washout, accessible.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Briggs Plumbing Products, Inc.
c. Capizzi.
d. Crane Plumbing, L.L.C.
e. Duravit USA, Inc.
f. Ferguson Enterprises, Inc.; ProFlo Brand.
g. Gerber Plumbing Fixtures LLC.
h. Kohler Co.
i. Mansfield Plumbing Products LLC.
j. Peerless Pottery Sales, Inc.

k. TOTO USA, INC.
l. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Washout with extended shields.
d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.

4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.

5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

D. Urinals: Wall hung, bottom outlet, washout.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Briggs Plumbing Products, Inc.
c. Ferguson Enterprises, Inc.; ProFlo Brand.
d. Kohler Co.
e. Mansfield Plumbing Products LLC.
f. Peerless Pottery Sales, Inc.

3. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Drain: Separate removable chrome-plated dome strainer with chrome-plated, NPS 1-1/2 (DN 40) tailpiece.
d. Strainer or Trapway: Manufacturer's standard strainer and NPS 1-1/2 (DN 40) tailpiece.

4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2.
b. Trap:
1) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall and chrome-plated brass or steel wall flange.

5. Support: ASME A112.6.1M, Type II, urinal carrier with hanger and bearing plates. Include rectangular, steel uprights.

E. Urinals: Wall hung, bottom outlet, wash down.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawing or comparable product by one of the following:

    a. Commercial Enameling Company.
    b. Kohler Co.

3. Fixture:

    a. Standards: ASME A112.19.1/CSA B45.2 and ASME A112.19.5.
    b. Material: Enameled cast iron.
    c. Style: Wash sink with back and without pedestal modified for use as urinal.
    d. Flushing Device: Manufacturer's standard self-closing valve with washdown pipe of length matching fixture.

4. Flushometer Valve:

    a. Standard: ASME A112.18.1/CSA B125.1.
    b. Flushing Device: Manufacturer's standard for NPS 1/2 (DN 15) supply; self-closing valve; and wash-down pipe of length matching fixture.

5. Waste Fitting:

    a. Standard: ASME A112.18.2/CSA B125.2.
    b. Trap:

        1) Size: NPS 1-1/2 (DN 50).
        2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
        3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

6. Support: ASME A112.6.1M, Type II, sink carrier.

2.3 WATERLESS URINALS

A. Urinals: Wall hung, back outlet, waterless, vitreous china, designed for liquid-trap-seal operation.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Duravit USA, Inc.
    b. Falcon Waterfree Technologies.
    c. Kohler Co.
    d. Sloan Valve Company.

e. Waterless Co.
f. Zero Flush.
g. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1, except without water supply.
b. Trap-Seal Method: Proprietary cartridge with liquid seal.
c. Outlet Size and Location: NPS 2 (DN 50) flange; back.
d. Trap-Sealing Liquid: Proprietary.

4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for transition coupling, trap, and waste pipe.
b. Size: [NPS 2 (DN 50).

5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

B. Urinals: Wall hung, back outlet, waterless, plastic, designed for liquid-trap-seal operation.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Waterless Co.

3. Fixture:

a. Standard: ANSI Z124.9, except without water supply.
b. Material: FRP.
c. Trap-Seal Method: Proprietary cartridge or trap system.
d. Outlet Size and Location: NPS 2 (DN 50); back. Include transition coupling.
e. Trap-Sealing Liquid: Proprietary.

4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for transition coupling, trap, and waste pipe.
b. Size: NPS 2 (DN 50).

5. Support: Metal plate in wall.

2.4 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements.

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Coyne & Delany Co.
    b. Gerber Plumbing Fixtures LLC.
    c. Sloan Valve Company.
    d. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.

B. Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Coyne & Delany Co.
    b. Gerber Plumbing Fixtures LLC.
    c. Sloan Valve Company.
    d. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: : Exposed
10. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
11. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.

C. Hydraulic-Actuator, Push-Button, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Coyne & Delany Co.
    b. Sloan Valve Company.

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).

5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.

D. Lever-Handle, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Coyne & Delany Co.
    b. Sloan Valve Company.
    c. TOTO USA, INC.
    d. Zurn Industries

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.

E. Hard-Wired, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Gerber Plumbing Fixtures LLC.
    b. Moen Incorporated.
    c. Sloan Valve Company.
    d. TOTO USA, INC.
    e. Zurn Industries

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.
10. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
11. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.

F. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Coyne & Delany Co.
    b. Gerber Plumbing Fixtures LLC.
    c. Hydrotek International, Inc.
    d. Kohler Co.
    e. Moen Incorporated.
    f. Sloan Valve Company.
    g. TOTO USA, INC.
    h. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standard: ASSE 1037.
4. Minimum Pressure Rating: 125 psig (860 kPa).
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.
10. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
11. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
5. Install trap-seal liquid in waterless urinals.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Division 22 Section "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Division 22 Section "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Division 22 Section "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lavatories.
2. Shampoo bowls.
3. Faucets.

B. Related Requirements:

1. Division 22 Section "Residential Plumbing Fixtures" for residential lavatories.
2. Division 22 Section "Healthcare Plumbing Fixtures" for healthcare lavatories.
3. Division 22 Section "Security Plumbing Fixtures" for security lavatories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Credit WE 2, Credit WE 3.1 and Credit WE 3.2: Documentation indicating compliance with requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 ENAMELED, CAST-IRON, COUNTER-MOUNTED LAVATORIES

A. Lavatory: Rectangular, flat rim, enameled, cast iron, flush counter mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Commercial Enameling Company.

3. Fixture:

a. Standard: ASME A112.19.1/CSA B45.2.
b. Type: For flush mounting with kit.
c. Faucet-Hole Location: Top.
d. Mounting Materials: With stainless-steel ring, and sealant.

B. Lavatory: Oval, self rimming, enameled, cast iron, counter mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Kohler Co.
b. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standard: ASME A112.19.1/CSA B45.2.
b. Type: Self-rimming for above-counter mounting.

C. Lavatory: Oval, enameled, cast iron, undercounter mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Kohler Co.

3. Fixture:

a. Standard: ASME A112.19.1/CSA B45.2.
b. Type: For undercounter mounting.

2.2 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory: Rectangular, self-rimming, vitreous china, counter mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Crane Plumbing, L.L.C.
c. Kohler Co.
d. TOTO USA, INC.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Self-rimming for above-counter mounting.

B. Lavatory: Round, self-rimming, vitreous china, counter mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Briggs Plumbing Products, Inc.
c. Capizzi.
d. Crane Plumbing, L.L.C.
e. Ferguson Enterprises, Inc.; ProFlo Brand.
f. Gerber Plumbing Fixtures LLC.
g. Kohler Co.
h. Mansfield Plumbing Products LLC.
i. Peerless Pottery Sales, Inc.
j. TOTO USA, INC.

k. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Self-rimming for above-counter mounting.

C. Lavatory: Oval, vitreous china, undercounter mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Capizzi.
c. Crane Plumbing, L.L.C.
d. Ferguson Enterprises, Inc.; ProFlo Brand.
e. Gerber Plumbing Fixtures LLC.
f. Kohler Co.
g. Mansfield Plumbing Products LLC.
h. Peerless Pottery Sales, Inc.
i. TOTO USA, INC.
j. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For undercounter mounting.

2.3 ENAMELED, CAST-IRON, WALL-MOUNTED LAVATORIES

A. Lavatory: Rectangular, enameled, cast iron, wall mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Commercial Enameling Company.
c. Gerber Plumbing Fixtures LLC.
d. Kohler Co.
e. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standard: ASME A112.19.1/CSA B45.2.
b. Type: Straight-front apron with straight back.
c. Mounting Material: Wall bracket.
4. Support: ASME A112.6.1M, Type III, lavatory carrier. Include rectangular, steel uprights.

B. Lavatory: Corner, enameled, cast iron, wall mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Kohler Co.

3. Fixture:

    a. Standard: ASME A112.19.1/CSA B45.2.
    b. Type: Three-sided-front apron with three-sided back.
    c. Mounting Material: Wall brackets.

4. Faucet: Manufacturer's standard; factory installed.
5. Support: ASME A112.6.1M, Type III, lavatory carrier with two hanger plates made for corner lavatories.

2.4 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Standard America.
    b. Briggs Plumbing Products, Inc.
    c. Crane Plumbing, L.L.C.
    d. Ferguson Enterprises, Inc.; ProFlo Brand.
    e. Gerber Plumbing Fixtures LLC.
    f. Kohler Co.
    g. Mansfield Plumbing Products LLC.
    h. Peerless Pottery Sales, Inc.
    i. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

    a. Standard: ASME A112.19.2/CSA B45.1.
    b. Type: For wall hanging.
    c. Mounting Material: Chair carrier.

4. Support: ASME A112.6.1M, Type I, exposed-arm lavatory carrier.

B. Lavatory: Ledge back, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Briggs Plumbing Products, Inc.
c. Crane Plumbing, L.L.C.
d. Ferguson Enterprises, Inc.; ProFlo Brand.
e. Gerber Plumbing Fixtures LLC.
f. Kohler Co.
g. Mansfield Plumbing Products LLC.
h. Peerless Pottery Sales, Inc.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Mounting Material: Chair carrier.

4. Support: ASME A112.6.1M, Type I, exposed-arm lavatory carrier.

C. Lavatory Slab type, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Kohler Co.
c. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Mounting Material: Chair carrier.

4. Support: ASME A112.6.1M, Type I, exposed-arm lavatory carrier.

D. Lavatory: Wheelchair, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Crane Plumbing, L.L.C.
c. Ferguson Enterprises, Inc.; ProFlo Brand.
d. Gerber Plumbing Fixtures LLC.
e. Kohler Co.
f. Mansfield Plumbing Products LLC.
g. Peerless Pottery Sales, Inc.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.

b. Type: Slab or wheelchair.
c. Mounting: For concealed-arm carrier.

4. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with rectangular, steel uprights.

E. Lavatory: Corner type, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Crane Plumbing, L.L.C.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Three-sided-front apron with three-sided back.
c. Mounting Materials: Wall brackets.

4. Faucet: Manufacturer's standard; solid brass; factory installed.
5. Support: ASME A112.6.1M, Type III, lavatory carrier with two hanger plates made for corner lavatories.

2.5 SHAMPOO BOWLS

A. Shampoo Bowls: Enameled, cast iron.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Belvedere, LLC.
b. Takara Belmont.

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Bowl: Shaped for head rest.

4. Faucet: Manufacturer's standard with vacuum breaker complying with ASME A112.18.3 and with hose spray head.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article except as follows:

a. Drain: Cup type with hair basket and tailpiece.

6. Mounting Material: Bracket or devices for attaching to counter.

B. Shampoo Bowls: Plastic.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Belvedere, LLC.
    b. Takara Belmont.

3. Fixture:

    a. Standard: ANSI Z124.3 or ANSI Z124.6.
    b. Material: Plastic.
    c. Bowl: Shaped for head rest.
    d. Mounting Material: Bracket or devices for attaching to counter or Wall bracket.

4. Faucet: Manufacturer's standard with vacuum breaker complying with ASME A112.18.3 and with hose spray head.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article except as follows:

    a. Drain: Cup type with hair basket and tailpiece.

C. Shampoo Bowls: Solid-surface material.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Willoughby Industries, Inc.

3. Fixture:

    a. Standard: ANSI/ICPA SS-1 for solid-surface materials.
    b. Material: Molded, cast polymer.
    c. Bowl: Shaped for head rest.
    d. Mounting Material: Bracket or devices for attaching to counter or Wall bracket.

4. Faucet: Manufacturer's standard with vacuum breaker complying with ASME A112.18.3 and with hose spray head.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article except as follows:

    a. Drain: Cup type with hair basket and tailpiece.

2.6 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucet: Manual-type solid-brass valve.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Bradley Corporation.
c. Chicago Faucets.
d. Delta Faucet Company.
e. Elkay Manufacturing Co.
f. Grohe America, Inc.
g. Just Manufacturing.
h. Kohler Co.
i. Moen Incorporated.
j. Speakman Company.
k. T & S Brass and Bronze Works, Inc.
l. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Material: Commercial, solid brass.

2.7 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, battery-powered or hard-wired, electronic-sensor-operated, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Bradley Corporation.
c. Chicago Faucets.
d. Gerber Plumbing Fixtures LLC.
e. Grohe America, Inc.
f. Hydrotek International, Inc.
g. Kohler Co.
h. Moen Incorporated.
i. Sloan Valve Company.
j. Speakman Company.
k. T & S Brass and Bronze Works, Inc.
l. TOTO USA, INC.
m. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
5. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

2.8 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.

B. Manufacturers: Subject to compliance with requirements.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. AM Conservation Group, Inc.
2. Chronomite Laboratories, Inc.; a division of Acorn Engineering Company.
3. NEOPERL, Inc.

D. Description: Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.9 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Division 22 Section "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07 Section "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Division 22 Section "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Division 22 Section "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Division 22 Section "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service basins.
2. Service sinks.
3. Utility sinks.
4. Handwash sinks.
5. Sacristy sinks.
6. Sink faucets.
7. Laminar-flow, faucet-spout outlets.
8. Supply fittings.
9. Waste fittings.

B. Related Requirements:

1. Division 22 Section "Residential Plumbing Fixtures" for residential sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics[, electrical characteristics,] and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Credit WE 2, Credit WE 3.1 and Credit WE 3.2: Documentation indicating compliance with requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins: Terrazzo, floor mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Acorn Engineering Company.
    b. Crane Plumbing, L.L.C.
    c. Florestone Products Co., Inc.
    d. Stern-Williams Co., Inc.

3. Fixture:

    a. Standard: IAPMO PS 99.
    b. Rim Guard: On top surfaces.
    c. Drain: Grid with outlet.

4. Mounting: On floor and flush to wall.

B. Service Basins: Plastic, floor mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Crane Plumbing, L.L.C.
    b. Ferguson Enterprises, Inc.; ProFlo Brand.
    c. Florestone Products Co., Inc.
    d. Mustee, E. L., & Sons, Inc.
    e. Swan Corporation (The).
    f. Zurn Industries, LLC; Light Commercial Specialty Plumbing Products.

3. Fixture:

    a. Standard: IAPMO/ANSI Z124.6.
    b. Material: Cast polymer.
    c. Rim Guard: On all top surfaces.
    d. Drain: Grid with outlet.

4. Mounting: On floor and flush to wall.

2.2 SERVICE SINKS

A. Service Sinks: Enameled, cast iron, trap standard mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Standard America.
    b. Commercial Enameling Company.
    c. Gerber Plumbing Fixtures LLC.
    d. Kohler Co.
    e. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

    a. Standard: ASME A112.19.1/CSA B45.2.
    b. Type: Service sink with back.
    c. Back: Two faucet holes.
    d. Mounting: P-trap standard with grid strainer inlet, cleanout, and floor flange.
    e. Rim Guard: On front and sides.
4. Support: ASME A112.6.1M, Type II, sink carrier.

B. Service Sinks: Vitreous china, trap standard mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Crane Plumbing, L.L.C.
    b. Kohler Co.
    c. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

    a. Standard: ASME A112.19.2/CSA B45.1.
    b. Type: Service sink with back.
    c. Back: Two faucet holes.
    d. Mounting: P-trap standard with grid strainer inlet, cleanout, and floor flange.
    e. Rim Guard: On front and sides.
4. Support: ASME A112.6.1M, Type II, sink carrier.

C. Service Sinks: Enameled, cast iron, floor mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Standard America.
    b. Commercial Enameling Company.
    c. Gerber Plumbing Fixtures LLC.
    d. Kohler Co.
    e. Zurn Industries, LLC; Commercial Brass and Fixtures.

3. Fixture:

    a. Standard: ASME A112.19.1/CSA B45.2.
    b. Style: With front apron and raised back.
    c. Drain: Grid with outlet.
    d. Rim Guard: Coated wire.

2.3 UTILITY SINKS

A. Utility Sinks: Stainless steel, counter mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Advance Tabco.
    b. Eagle Group; Foodservice Equipment Division.
    c. Elkay Manufacturing Co.
    d. Griffin Products, Inc.
    e. Just Manufacturing.

3. Fixture:

    a. Standard: ASME A112.19.3/CSA B45.4.
    b. Type: Ledge back.

4. Supply Fittings:

    a. Standard: ASME A112.18.1/CSA B125.1.
    b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

5. Waste Fittings:

    a. Standard: ASME A112.18.2/CSA B125.2.
    b. Trap(s):

6. Mounting: On counter with sealant.

B. Utility Sinks: Stainless steel, freestanding.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Advance Tabco.
    b. AERO Manufacturing Company.
    c. Amtekco Industries, Inc.
    d. Eagle Group; Foodservice Equipment Division.
    e. Elkay Manufacturing Co.
    f. Griffin Products, Inc.
    g. Just Manufacturing.

3. Fixture:

    a. Standard: ASME A112.19.3/CSA B45.4.
    b. Type: With backsplash.

4. Supports: Adjustable-length steel legs.

5. Supply Fittings:

    a. Standard: ASME A112.18.1/CSA B125.1.
    b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

6. Waste Fittings:

    a. Standard: ASME A112.18.2/CSA B125.2.

2.4 HANDWASH SINKS

A. Handwash Sinks: Stainless steel, wall mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Advance Tabco.
    b. AERO Manufacturing Company.
    c. Amtekco Industries, Inc.
    d. Eagle Group; Foodservice Equipment Division.
    e. Elkay Manufacturing Co.
    f. Griffin Products, Inc.
    g. Just Manufacturing.

3. Fixture:

    a. Standards: ASME A112.19.3/CSA B45.4 and NSF/ANSI 2.
    b. Type: Basin with radius corners, back for faucet, and support brackets.

4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
6. Support: ASME A112.6.1M, Type II, sink carrier.

2.5 SACRISTY SINKS

A. Sacristy Sinks: Stainless steel, two bowl, counter mounted.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Elkay Manufacturing Co.
    b. Just Manufacturing.

3. Fixture:

    a. Standard: ASME A112.19.3/CSA B45.4.
    b. Type: Self-rimming.
    c. Material: Stainless steel.

4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.

2.6 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, mixing valve.

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

    a. American Standard America.
    b. Bradley Corporation.
    c. Chicago Faucets.
    d. Delta Faucet Company.
    e. Elkay Manufacturing Co.
    f. GROHE America, Inc.
    g. Just Manufacturing.
    h. Kohler Co.
    i. Moen Incorporated.
    j. Speakman Company.
    k. T & S Brass and Bronze Works, Inc.
    l. Zurn Industries, LLC; Commercial Brass and Fixtures.
    m. Bradley Corporation.
    n. BrassTech Inc.
    o. Chicago Faucets.

p. Delta Faucet Company.
q. Elkay Manufacturing Co.
r. Hansgrohe USA.
s. Price Pfister, Inc.

3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.

2.7 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.

B. Manufacturers: Subject to compliance with requirements.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. AM Conservation Group, Inc.
2. Chronomite Laboratories, Inc.
3. NEOPERL, Inc.

D. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.8 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

2.9 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with offset and straight tailpiece.

2.10 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Division 22 Section "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07 Section "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Division 22 Section "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Division 22 Section "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Division 22 Section "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Dual-duct systems.
c. Variable-air-volume systems.
d. Multizone systems.
e. Induction-unit systems.

2. Balancing Hydronic Piping Systems:

a. Constant-flow hydronic systems.
b. Variable-flow hydronic systems.
c. Primary-secondary hydronic systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

A. LEED Submittal:

1. Air-Balance Report for LEED Prerequisite EQ 1: Documentation of work performed for ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

C. Contract Documents Examination Report: Within 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

D. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

E. Certified TAB reports.

F. Sample report forms.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB as a TAB technician.

B. TAB Conference: Meet with Construction Manager on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved Construction Manager.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.

4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-

heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

A. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.

B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

1. If insufficient static pressure exists, increase airflow at the fan.

C. Test and adjust the constant-volume mixing boxes as follows:

1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
2. Verify sufficient inlet static pressure before making volume adjustments.
3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.

D. Do not over-pressurize ducts.

E. Remeasure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

A. Set unit at maximum airflow through the cooling coil.

B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 PROCEDURES FOR INDUCTION-UNIT SYSTEMS

A. Balance primary-air risers by measuring static pressure at the nozzles of the top and bottom units of each riser to determine which risers must be throttled. Adjust risers to indicated airflow within specified tolerances.

B. Adjust each induction unit.

3.11 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.12 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

    a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Construction Manager.

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated pre-settings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.13 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.14 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first, and then balance the secondary circuits.

3.15 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.16 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.17 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.18 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.19 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

3.20 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.21 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.22 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.

3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.23 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.

2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.24 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent .
3. Heating-Water Flow Rate Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.25 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.26 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.

2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches (mm), and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches (mm), and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

    a. Total air flow rate in cfm (L/s).
    b. Total system static pressure in inches wg (Pa).
    c. Fan rpm.
    d. Discharge static pressure in inches wg (Pa).
    e. Filter static-pressure differential in inches wg (Pa).
    f. Preheat-coil static-pressure differential in inches wg (Pa).
    g. Cooling-coil static-pressure differential in inches wg (Pa).
    h. Heating-coil static-pressure differential in inches wg (Pa).
    i. Outdoor airflow in cfm (L/s).
    j. Return airflow in cfm (L/s).
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm) o.c.
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h (kW).
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches (mm), and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Entering-air temperature in deg F (deg C).
c. Leaving-air temperature in deg F (deg C).
d. Air temperature differential in deg F (deg C).
e. Entering-air static pressure in inches wg (Pa).
f. Leaving-air static pressure in inches wg (Pa).
g. Air static-pressure differential in inches wg (Pa).
h. Low-fire fuel input in Btu/h (kW).
i. High-fire fuel input in Btu/h (kW).
j. Manifold pressure in psig (kPa).
k. High-temperature-limit setting in deg F (deg C).
l. Operating set point in Btu/h (kW).
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h (kW).

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h (kW).
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm (L/s).
i. Face area in sq. ft. (sq. m).
j. Minimum face velocity in fpm (m/s).

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h (kW).
b. Air flow rate in cfm (L/s).
c. Air velocity in fpm (m/s).
d. Entering-air temperature in deg F (deg C).
e. Leaving-air temperature in deg F (deg C).
f. Voltage at each connection.
g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.

f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated air flow rate in cfm (L/s).
h. Indicated velocity in fpm (m/s).
i. Actual air flow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).

K. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.

i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary air flow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final air flow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Entering-water temperature in deg F (deg C).
c. Leaving-water temperature in deg F (deg C).
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in deg F (deg C).
f. Leaving-air temperature in deg F (deg C).

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.

p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.

N. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.27 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Construction Manager.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Construction Manager.

3. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.28 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Related Sections:

1. Division 23 Section "HVAC Equipment Insulation."
2. Division 23 Section "HVAC Piping Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit EQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches (300 mm) square.
2. Sheet Jacket Materials: 12 inches (300 mm) square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

E. Qualification Data: For qualified Installer.

F. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

G. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Ductwork Mockups:

a. One 10-foot (3-m) section each of rectangular and round straight duct.
b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.

d. One rectangular and round transition fitting.
e. Four support hangers for round and rectangular ductwork.
f. Each type of damper and specialty.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR All-Service Duct Wrap.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.

c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

J. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Armacell LLC; Tubolit.
b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a [1] [2]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with aluminum-foil facing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Polyguard Products, Inc.; Alumaguard 60.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M.
3. Aluminum: ASTM B 209 (ASTM B 209M).
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding,, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) GEMCO; Nylon Hangers.
        2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

    b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
    c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
        2) GEMCO; Peel & Press.
        3) Midwest Fasteners, Inc.; Self Stick.

    b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
    d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.; RC-150.
        2) GEMCO; R-150.
        3) Midwest Fasteners, Inc.; WA-150.
        4) Nelson Stud Welding; Speed Clips.

    b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

        1) GEMCO.
        2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. C & F Wire.

2.13 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Firestopping"firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for [100] [50] <Insert number> percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-

applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for [100] [50] <Insert number> percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.

2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

END OF SECTION 230713

SECTION 232301 – VRV/VRF REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for VRV/VRF air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction (low pressure gas) Lines: 550 psig, or per equipment manufacturers recommendation.
2. Hot-Gas (high pressure gas) and Liquid Lines: 550 psig, or per equipment manufacturers recommendation.

1.3 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, valve arrangements and locations, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

C. Installer Qualification: Only trained installers skilled in refrigeration pipe installation and brazing of copper tubing should be used.

1.5 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube:

1. Straight Lengths: ASTM B 75, UNS C12200, H55 Temper (Light Drawn), ACR Bending Quality; Cleaned, Eddy Current Tested, and Plugged per ASTM B 280.
   a. Reftekk “HHC”
2. Coiled: ASTM B 280, UNS C12200, O60 Temper (Soft Annealed), ACR, cleaned and capped
   a. Reftekk “CCE”

B. Brazing Filler Metals: AWS A5.8.
   a. Reftekk “BRG”

C. Field Swaged Brazing Cups: MSS-SP-73, ASME B 16.50

D. Field Bends (all angles): ASME B31.5

2.2 VALVES AND SPECIALTIES

A. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Socket ends.
5. Working Pressure Rating: 700 psig.
6. Maximum Operating Temperature 250 deg. F
7. Valves must be specifically rated for R-410A.

2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. ASHRAE 34, R-410A: R-32/R-125 (50.0/50.0)

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction (low pressure gas), Hot Gas (high pressure gas) and Liquid Lines OD 5/8” and Smaller for Conventional Air-Conditioning, Heat Pump, and Heat Recovery Applications: Copper, Type ACR, O60 (soft annealed)-temper tubing and field bent fittings with brazed joints.

B. Suction (low pressure gas), Hot Gas (high pressure gas), and Liquid Lines OD 2-1/8" and smaller for Conventional Air-Conditioning, Heat Pump, and Heat Recovery Applications: Straight Lengths, Copper, Type ACR Type L, H55 (light drawn)-temper tubing and field bent fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves as shown on plans or as required to isolate system components.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Field Bend changes in direction.

I. Select system components with pressure rating equal to or greater than maximum allowable working pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install insulated refrigerant piping in water-tight protective conduit where installed belowground.

M. Provide Jacketed insulation in locations where exposed to mechanical injury.

N. When brazing, remove solenoid-valve coils and sight glasses; also, remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

P. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

T. Provide proper compensation for pipe/tube expansion and contraction per equipment manufacturers recommendations.

3.4 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP-5 (15% Ag, 80% Cu, 5% P), copper-phosphorus alloy pre-formed brazing rings for joining copper swage fittings and copper socket fittings with copper pipe. Do NOT use flux.
2. Use Type Bag-5 (45% Ag), cadmium-free silver alloy for joining copper with bronze or steel. Use manufacturers recommended flux.

B. Field Swaged Brazing Cups: Fabricate brazing cup on one tubing end for each coupling. Only O60 (soft annealed) and H55 (light drawn) may be swaged. Do NOT swage H58 (drawn general purpose). Use swaging tool designed to provide a minimum of 0.0015” brazing gap and a maximum of 0.005” brazing gap. Brazing cup depth for each tube size shall be as follows.

1/4"	3/8”	1/2"	5/8”	3/4"	7/8”	1-1/8”	1-3/8”	1-5/8”	2-1/8”
0.250”	0.280”	0.310”	0.390”	0.420”	0.460”	0.510”	0.560”	0.600”	0.700”

C. Field Bends: Fabricate field bends with a center-line bend radius greater than or equal to 4 times the nominal OD of the pipe or tube. Tube shall be bent with a tubing bender sized for ACR OD tube sizes and shall not cause cracks or wrinkles in the tube or pipe. Do NOT use a conduit bender for bending ACR copper. The difference between maximum and minimum diameters for pipe bends should not exceed 8% of the nominal outside diameter of the pipe. Only O60 soft annealed-temper and H55 light drawn-temper shall be field bent. Do NOT field bend H58 drawn general purpose-temper copper tube.

D. BRAZING AND JOINING PROCEDURE

1. Tube ends shall be cut with a clean sharp tubing cutter.
2. Deburr the I.D. of the cut tube end with a clean deburring tool.
3. Visually inspect the interior of each tube for obstructions and debris before assembly. Protect the joint from contamination before brazing.
4. Method of pre-cleaning: Non-shedding abrasive pads (Scotch Bright) to remove all oxides in the brazing area followed by wiping with a clean lint-free white cloth. Do not groove the surfaces while cleaning.

5. Purge all tubing with oil free nitrogen while brazing and until cool to the touch. Use an oxygen analyzer to verify the absence of oxygen prior to brazing. The oxygen content shall be less than 1% before start of brazing.
6. Use a neutral to slightly reducing flame using oxy/acetylene or oxy/propane.
7. Use the proper torch tip based on tube size as recommended by the torch manufacturer. Use of Turbo-Torch or Rosebud is permitted.
8. Post Brazing Cleaning: Exterior of all completed joints shall be washed with a water soaked rag or sponge, followed by brushing with a stainless-steel hand wire brush to remove any residue for inspection.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs.
2. Rigid high compressive strength foam insulating pipe support at all support points. Comply with Section 230719 “DX Piping System Insulation”.
3. Do NOT attach hangers directly to pipe or tube.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. Up to 3/4" OD: Maximum span, 60 inches; minimum rod size, 3/8 inch.
2. Greater than 3/4" thru 1” OD: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. Greater than 1” thru 2-1/8” OD: Maximum span, 96 inches; minimum rod size, 3/8 inch.

D. Support multi-floor vertical runs every 10 feet and at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test as recommended by equipment manufacturers instructions.
3. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
    a. Fill system with 95/5 nitrogen/hydrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test all joints and fittings with hydrogen leak detector, at test pressure.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures and per equipment manufacturers instructions.

1. Evacuate (triple evacuation procedure) entire refrigerant system with a vacuum pump to obtain a steady state vacuum of less than 500 micrometers. If vacuum holds for 12 hours, system is ready for charging. Do NOT evacuate the system through a charging manifold. Use only suction rated hoses and core removal tools.
2. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
3. Charge system as recommended by equipment manufacturer.

END OF SECTION 232301

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealants and gaskets.
8. Hangers and supports.
9. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.

2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
4. Duct-Cleaning Test Report for Prerequisite EQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-Up."
5. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
6. Laboratory Test Reports for Credit EQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

E. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

F. Welding certificates.

G. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. McGill AirFlow LLC.
2. Sheet Metal Connectors, Inc.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature.

H. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.

I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.

d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse

Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent solid sheet steel.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

I. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.6 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. CertainTeed Corporation; Insulation Group.
    b. Johns Manville.
    c. Knauf Insulation.
    d. Owens Corning.
    e. Maximum Thermal Conductivity:

        1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
        2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Solvent Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

    a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

    a. Aeroflex USA Inc.
    b. Armacell LLC.
    c. Rubatex International, LLC

3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Bonded Logic, Inc.
    b. Reflectix Inc.

3. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature when tested according to ASTM C 518.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
5. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches (76 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.

5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
11. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.

5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.9 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet (6 m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
3. Test for leaks before applying external insulation.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
5. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.11 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233113

SECTION 233116 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fibrous-glass ducts and fittings.
2. Phenolic-foam ducts and fittings.
3. Thermoset FRP ducts and fittings.
4. PVC ducts and fittings.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for nonmetal ducts.
2. Division 23 Section "Metal Ducts" for single- and double-wall, rectangular and round ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including duct closure, reinforcements, and hangers and supports, shall comply with SMACNA's "Fibrous Glass Duct Construction Standards" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

a. Supply Ducts (except in Mechanical Rooms): 1-inch wg (250 Pa).
b. Supply Ducts (Upstream from Air Terminal Units): 2-inch wg (500 Pa).
c. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg (250 Pa).
d. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg (500 Pa).
e. Return Ducts (Negative Pressure): 1-inch wg (250 Pa).
f. Exhaust Ducts (Negative Pressure): 1-inch wg (250 Pa).

B. Structural Performance: Duct hangers and supports and seismic restraint shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions to comply

with ASCE/SEI 7. SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Fibrous-glass duct materials.
2. Phenolic-foam duct materials.
3. Thermoset FRP duct materials.
4. PVC duct materials.

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
4. Duct-Cleaning Test Report for Prerequisite EQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-Up."
5. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
6. Laboratory Test Reports for Credit EQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevation of top of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.

10. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

D. Delegated-Design Submittal:

1. Duct materials and thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

E. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

F. Welding certificates.

G. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 FIBROUS-GLASS DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CertainTeed Corporation; Insulation Group.
2. Johns Manville.
3. Knauf Insulation.
4. Owens Corning.

B. Fibrous-Glass Duct Materials: Resin-bonded fiberglass, faced on the outside surface with fire-resistive FSK vapor retarder and with a smooth fiberglass mat finish on the air-side surface.

1. Duct Board: Factory molded into rectangular boards.
2. Round Duct: Factory molded into straight round duct and smooth fittings.
3. Temperature Limits: 40 to 250 deg F (5 to 121 deg C) inside ducts; 150 deg F (66 deg C) ambient temperature surrounding ducts.
4. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F (0.035 W/m x K) at 75 deg F (24 deg C) mean temperature.
5. Moisture Absorption: Not exceeding 5 percent by weight at 120 deg F (49 deg C) and 95 percent relative humidity for 96 hours when tested according to ASTM C 1104/C 1104M.
6. Permeability: 0.02 perms (1.15 ng/Pa x s x sq. m) maximum when tested according to ASTM E 96/E 96M, Procedure A.
7. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems.
8. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C 423, Mounting A.
9. Required Markings: EI rating, UL label, and other markings required by UL 181 on each full sheet of duct board.

C. Closure Materials:

1. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-P," the manufacturer's name, and a date code.

a. Tape: Aluminum foil-scrim tape imprinted with listing information.
b. Minimum Tape Width: 2-1/2 inches (64 mm); 3 inches (76 mm) for duct board thicker than 1 inch (25 mm).

c. Staples: 1/2-inch (13-mm) outward clinching, 2 inches (51 mm) o.c. in tabs, one tab per joint.
d. Water resistant.
e. Mold and mildew resistant.

2. Heat-Activated Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-H," the manufacturer's name, and a date code.

a. Tape: Aluminum foil-scrim tape imprinted with listing information.
b. Minimum Tape Width: 3 inches (76 mm).
c. Heat-Sensitive Imprint: Printed indicator on tape to show proper heating during application has been achieved.
d. Water resistant.
e. Mold and mildew resistant.

3. Two-Part Tape Sealing System: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-M," the manufacturer's name, and a date code.

a. Tape: Woven glass fiber impregnated with mineral gypsum.
b. Minimum Tape Width: 3 inches (76 mm).
c. Sealant: Modified styrene acrylic.
d. Water resistant.
e. Mold and mildew resistant.
f. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
g. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Fabrication:

1. Select joints, seams, transitions, elbows, and branch connections and fabricate according to SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 2, "Specifications and Closure," and Chapter 4, "Fittings and Connections."
2. Fabricate 90-degree mitered elbows to include turning vanes.
3. Reinforcements: Comply with requirements in SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 5, "Reinforcement" for channel and tie-rod reinforcement materials, spacing, and fabrication.
4. Preformed Round Duct: Comply with NAIMA AH116, "Fibrous Glass Duct Construction Standards," Section VII, "Preformed Round Duct."

2.2 PHENOLIC-FOAM DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Knauf Insulation.

B. Duct Panel: CFC-free phenolic-foam bonded on both sides with factory-applied 0.001-inch-(0.025-mm-) thick, aluminum foil reinforced with fiberglass scrim.

1. Maximum Temperature: 158 deg F (70 deg C) inside ducts or ambient temperature surrounding ducts.
2. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F (0.019 W/m x K) at 75 deg F (24 deg C) mean temperature.
3. Permeability: 0.0002 perms (0.0115 ng/Pa x s x sq. m) maximum when tested according to ASTM E 96/E 96M, Procedure A.
4. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems.
5. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C 423, Mounting A.
6. Required Markings: UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for closure materials.

C. Closure Materials:

1. V-Groove Adhesive: Silicone.

    a. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-P," the manufacturer's name, and a date code.

    a. Tape: Aluminum foil tape imprinted with listing information.
    b. Minimum Tape Width: 3 inches (76 mm).
    c. Water resistant.
    d. Mold and mildew resistant.

3. Polymeric Sealing System:

    a. Structural Membrane: Woven glass fiber.
    b. Minimum Tape Width: 3 inches (76 mm).
    c. Sealant: Water based.
    d. Color: White.
    e. Water resistant.
    f. Mold and mildew resistant.
    g. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    h. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according to Knauf Insulation's "Knauf KoolDuct System Design Guide," Section 4, "Duct Construction," and Section 5, "Ductwork System General."
2. Fabricate 90-degree mitered elbows to include turning vanes.

2.3 THERMOSET FRP DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. McGill AirFlow LLC.
2. Perry Fiberglass Products, Inc.
3. Spunstrand Inc.

B. Duct and Fittings:

1. Thermoset FRP Resin: Manufacture duct with resin that complies with UL 181, Class 1, maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL according to ASTM E 84.
2. Inner Liner: FSK liner rated by an NRTL to comply with UL 181, Class 1.
3. Round Duct: ASTM D 2996, Type I, Grade 2, Class E, filament-wound duct, minimum 0.125-inch (3.2-mm) wall thickness, with tapered bell and spigot ends for adhesive joints, or plain ends with couplings.
4. Round Fittings: Compression or spray-up/contact, molded of same material, pressure class, and joining method as duct.
5. Rectangular Fittings: Minimum 0.125-inch- (3.2-mm-) thick flat sheet with fiberglass roving and resin-reinforced joints and seams.
6. Double-Wall Insulated Duct: Inner and outer duct complying with requirements for "Round Duct" description above. Polyurethane foam or isocyanurate insulation with maximum thermal conductivity of 0.14 Btu x in./h x sq. ft. x deg F (0.020 W/m x K) at 75 deg F (24 deg C) mean temperature.

C. Joining Materials: Roving and polyester resin.

1. Use fiberglass adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, and access doors and panels according to SMACNA's "Thermoset FRP Duct Construction Manual," Chapter 7, "Requirements."
2. Fabricate 90-degree rectangular mitered elbows to include turning vanes, 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.

E. Drains: Formed drain pockets with a minimum of NPS 1 (DN 25) threaded pipe connections.

2.4 PVC DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. General Plastics, Inc.
2. GPK Products, Inc.
3. Harvel Plastics, Inc.
4. Kroy Industries, Inc.
5. Northern Pipe Product Inc.; an Otter Tail company.
6. Plastinetics Inc.
7. Spears Manufacturing Company.

B. Duct and Fittings:

1. Round Duct: Comply with cell Classification 12454-B in ASTM D 1784, with external loading properties of ASTM D 2412.
2. Round Fittings: Socket end molded of same material, pressure class, and joining method as duct.
3. Rectangular Fittings: Minimum 0.125-inch- (3.2-mm-) thick flat sheet with heat-formed corners and continuous welded butt joints.

C. Joining Materials: PVC solvent cement complying with ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, and access doors and panels according to SMACNA's "Thermoplastic Duct (PVC) Construction Manual," Chapter 3, "Standards of Construction for PVC Duct Systems."
2. Fabricate 90-degree rectangular mitered elbows to include turning vanes, 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.

E. Drains: PVC drain pockets with a minimum of NPS 1 (DN 25) threaded PVC pipe connections.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables: ASTM A 603, galvanized steel with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

2.6 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Install ducts with fewest possible joints.

B. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

C. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

D. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

E. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

F. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

G. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

H. Install fibrous-glass ducts and fittings to comply with NAIMA AH116, "Fibrous Glass Duct Construction Standards."

I. Install foam ducts and fittings to comply with Knauf Insulation's "Knauf KoolDuct System Design Guide."

J. Install thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual."

K. Install PVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual."

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 6, "Hangers and Supports."

B. Install hangers and supports for phenolic-foam ducts and fittings to comply with Knauf Insulation's "Knauf KoolDuct System Design Guide," Section 5, "Ductwork System General."

C. Install hangers and supports for thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual," Chapter 7, "Requirements."

D. Install hangers and supports for PVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual," Chapter 3, "Standards of Construction for PVC Duct Systems."

E. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select sizes of components so strength will be adequate to carry present and future static and seismic loads within restraint device capacity.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints where ducts are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction].

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.4 PAINTING

A. Paint interior of thermoset FRP and PVC ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
3. Test for leaks before applying external insulation.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of nonmetal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch duct as recommended by duct manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
2. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of ducts or duct accessories.
3. Clean fibrous-glass duct with HEPA vacuuming equipment; do not permit duct to get wet. Replace fibrous-glass duct that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
5. Provide drainage and cleanup for wash-down procedures.
6. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.7 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233116

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Corridor dampers.
10. Flange connectors.
11. Duct silencers.
12. Turning vanes.
13. Remote damper operators.
14. Duct-mounted access doors.
15. Flexible connectors.
16. Flexible ducts.
17. Duct security bars.
18. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

E. Source quality-control reports.

F. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to **10** percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement, where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. Pottorff; a division of PCI Industries, Inc.
10. Ruskin Company.
11. SEMCO Incorporated.
12. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 2-inch wg (0.25 kPa).

E. Blade Action: Parallel.

F. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.

    a. Sleeve Thickness: 20-gage (1.0-mm) minimum.
    b. Sleeve Length: 6 inches (152 mm) minimum.

2.3 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. Pottorff; a division of PCI Industries, Inc.
10. Ruskin Company.
11. SEMCO Incorporated.
12. Vent Products Company, Inc.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Pottorff; a division of PCI Industries, Inc.
    h. Ruskin Company.
    i. Trox USA Inc.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Hat-shaped, **galvanized** steel channels, 0.064-inch (1.62-mm) minimum thickness.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Pottorff; a division of PCI Industries, Inc.
    h. Ruskin Company.
    i. Trox USA Inc.
    j. Vent Products Company, Inc.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Pottorff; a division of PCI Industries, Inc.
    h. Ruskin Company.
    i. Trox USA Inc.
    j. Vent Products Company, Inc.

2. Low-leakage rating**, with linkage outside airstream,** and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Pottorff; a division of PCI Industries, Inc.
    h. Ruskin Company.
    i. Trox USA Inc.
    j. Vent Products Company, Inc.

2. Low-leakage rating**, with linkage outside airstream,** and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.

E. Jackshaft:

1. Size: 1-inch (25-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. Lloyd Industries, Inc.
8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
9. McGill AirFlow LLC.
10. METALAIRE, Inc.
11. Metal Form Manufacturing, Inc.
12. Nailor Industries Inc.

13. NCA Manufacturing, Inc.
14. Ruskin Company.
15. Vent Products Company, Inc.
16. Young Regulator Company.

B. Low-leakage rating**, with linkage outside airstream,** and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

2.6 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. PHL, Inc.
10. Pottorff; a division of PCI Industries, Inc.
11. Prefco; Perfect Air Control, Inc.
12. Ruskin Company.
13. Vent Products Company, Inc.
14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: As indicated on plans; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.

D. Fire Rating: As indicated on plans.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

2.7 CEILING DAMPERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. McGill AirFlow LLC.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Prefco; Perfect Air Control, Inc.
7. Ruskin Company.
8. Vent Products Company, Inc.
9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. General Requirements:

1. Labeled according to UL 555C by an NRTL.
2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Heat-Responsive Device: Replaceable, [165 deg F (74 deg C)] [212 deg F (100 deg C)] <**Insert temperature**> rated, fusible links.

F. Fire Rating: As indicated on plans.

2.8 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. PHL, Inc.
6. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

E. Rated pressure and velocity to exceed design airflow conditions.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Ruskin Company.

B. Type: **Dynamic**; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.

D. Heat-Responsive Device: Replaceable, [165 deg F (74 deg C)] [212 deg F (100 deg C)] rated, fusible links.

E. Smoke Detector: Integral, factory wired for single-point connection.

F. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

I. Master control panel for use in dynamic smoke-management systems.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
3. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
5. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
6. Electrical Connection: 115 V, single phase, 60 Hz.

2.10 CORRIDOR DAMPERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Nailor Industries Inc.
4. Ruskin Company.

B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-1/2-hour rating by an NRTL.

C. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

D. Heat-Responsive Device: **Electric** resettable link and switch package, factory installed, rated.

E. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

F. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
3. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
5. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
6. Electrical Connection: 115 V, single phase, 60 Hz.

2.11 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

B. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

1. Industrial Noise Control, Inc.
2. McGill AirFlow LLC.

3. Ruskin Company.
4. Vibro-Acoustics.

C. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

E. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, galvanized sheet steel, 0.034 inch (0.85 mm) thick.

F. Round Silencer Outer Casing: ASTM A 653/A 653M, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches (600 mm) in Diameter: 0.034 inch (0.85 mm) thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches (660 through 1000 mm) in Diameter: 0.040 inch (1.02 mm) thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches (1060 through 1300 mm) in Diameter: 0.052 inch (1.3 mm) thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches (1370 through 1500 mm) in Diameter: 0.064 inch (1.62 mm) thick.

G. Inner Casing and Baffles: ASTM A 653/A 653M, galvanized sheet metal, 0.034 inch (0.85 mm) thick, and with 1/8-inch- (3-mm-) diameter perforations.

H. Special Construction:

1. Suitable for outdoor use.
2. High transmission loss **to achieve STC 45**.

I. Connection Sizes: Match connecting ductwork unless otherwise indicated.

J. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. **Dissipative** type with fill material.

a. Fill Material: **Inert and vermin-proof fibrous material, packed under not less than 5 percent compression**.
b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

K. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. **Lock form and seal or continuously weld joints**.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

2.12 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.13 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the**:

1. Pottorff; a division of PCI Industries, Inc.
2. Ventfabrics, Inc.
3. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

2.14 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Pottorff; a division of PCI Industries, Inc.
9. Ventfabrics, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: **Single wall** with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 10-inch wg (2500 Pa).
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.15 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following:**

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) **carbon** steel.

D. Fasteners: **Carbon** steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.16 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).

2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd. (542 g/sq. m).
2. Tensile Strength: 285 lbf/inch (50 N/mm) in the warp and 185 lbf/inch (32 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.17 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

C. Noninsulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).

D. Noninsulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).

E. Noninsulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).

F. Noninsulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil.

1. Pressure Rating: 8-inch wg (2280 Pa) positive or negative.
2. Maximum Air Velocity: 5000 fpm (25 m/s).
3. Temperature Range: Minus 100 to plus 435 deg F (Minus 73 to plus 224 deg C).

G. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; **polyethylene** vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

H. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; **polyethylene** vapor-barrier film.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).

I. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; **polyethylene** vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).

J. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; **polyethylene** vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).

K. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; **polyethylene** vapor-barrier film.

1. Pressure Rating: 8-inch wg (2280 Pa) positive or negative.
2. Maximum Air Velocity: 5000 fpm (25 m/s).
3. Temperature Range: Minus 20 to plus 250 deg F (Minus 29 to plus 121 deg C).

L. Flexible Duct Connectors:

1. Clamps: **Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action** in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
2. Non-Clamp Connectors: **Adhesive**.

2.18 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install **backdraft** dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire **and smoke** dampers according to UL listing.

H. Install duct security bars. Construct duct security bars from 0.164-inch (4.18-mm) steel sleeve, continuously welded at all joints and 1/2-inch- (13-mm-) diameter steel bars, 6 inches (150 mm) o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch (63-by-63-by-6-mm) steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch (300-by-300-mm) hinged access panel with cam lock in duct in each side of sleeve.

I. Connect ducts to duct silencers **with flexible duct connectors**.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream **and downstream** from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot (15-m) spacing.
8. Upstream **and downstream** from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Connect terminal units to supply ducts **directly or** with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

Q. Connect diffusers or light troffer boots to ducts **directly or** with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

R. Connect flexible ducts to metal ducts with **adhesive plus sheet metal screws**.

S. Install duct test holes where required for testing and balancing purposes.

T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Round ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Perforated diffusers.
4. Louver face diffusers.
5. Linear bar diffusers.
6. Linear slot diffusers.
7. Ceiling-integral continuous diffusers.
8. Light troffer diffusers.
9. Round induction diffusers.
10. Linear floor diffuser plenums.
11. Drum louvers.
12. Modular core supply grilles.
13. Continuous tubular diffusers.
14. Adjustable bar **registers and grilles**.
15. Security **registers and grilles**.
16. Fixed face **registers and grilles.**
17. Linear bar grilles.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

E. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Round Ceiling Diffuser:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. Anemostat Products; a Mestek company.
b. Carnes.
c. Hart & Cooley Inc.
d. METALAIRE, Inc.
e. Nailor Industries Inc.
f. Price Industries.
g. Titus.
h. Tuttle & Bailey.

3. Accessories:

a. Equalizing grid.
b. Plaster ring.
c. Safety chain.
d. Wire guard.
e. Sectorizing baffles.
f. Operating rod extension.

B. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Hart & Cooley Inc.
    e. Krueger.
    f. METALAIRE, Inc.
    g. Nailor Industries Inc.
    h. Price Industries.
    i. Titus.
    j. Tuttle & Bailey.

3. Accessories:

    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.
    d. Wire guard.
    e. Sectorizing baffles.
    f. Operating rod extension.

C. Perforated Diffuser:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. Air Research Diffuser Products, Inc.
    b. A-J Manufacturing Co., Inc.
    c. Anemostat Products; a Mestek company.
    d. Carnes.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. METALAIRE, Inc.
    h. Nailor Industries Inc.
    i. Price Industries.
    j. Titus.
    k. Tuttle & Bailey.
    l. Warren Technology.
    m. <Retain first subparagraph below for variable-air-volume operations.

3. Accessories:

    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.

d. Wire guard.
e. Sectorizing baffles.
f. Operating rod extension.

D. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. METALAIRE, Inc.
e. Nailor Industries Inc.
f. Price Industries.
g. Titus.
h. Tuttle & Bailey.

3. Accessories:

a. Square to round neck adaptor.
b. Adjustable pattern vanes.
c. Throw reducing vanes.
d. Equalizing grid.
e. Plaster ring.
f. Safety chain.
g. Wire guard.
h. Sectorizing baffles.
i. Operating rod extension.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. Titus.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.

B. Linear Slot Diffuser:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**.
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. Titus
    b. Air Research Diffuser Products, Inc.
    c. Anemostat Products; a Mestek company.
    d. Carnes.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. METALAIRE, Inc.
    h. Nailor Industries Inc.
    i. Price Industries.

C. Ceiling-Integral Continuous Diffuser :

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following:**
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. Air Research Diffuser Products, Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Hart & Cooley Inc.
    e. Krueger.
    f. METALAIRE, Inc.
    g. Nailor Industries Inc.
    h. Price Industries.
    i. Titus.
    j. Tuttle & Bailey.
3. Straight and curved sections as required to accommodate layout.
4. Mitered tees and corners.
5. Pattern Controllers: as shown on plans
6. Material: Aluminum, extruded, heavy wall.
7. Finishes:

    a. Exterior: Standard white.
    b. Interior: Standard black.
8. Other Features:

    a. Painted interior.
    b. Blank-offs.

D. Light Troffer Diffuser:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following:**

2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. Anemostat Products; a Mestek company.
    b. Carnes.
    c. Hart & Cooley Inc.
    d. Krueger.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Price Industries.
    h. Titus.
    i. Tuttle & Bailey.

2.3 UNDERFLOOR AIR DISTRIBUTION DIFFUSERS

A. Round Induction Diffusers:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following:**
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. Air Research Diffuser Products, Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Hart & Cooley Inc.
    e. Krueger.
    f. METALAIRE, Inc.
    g. Nailor Industries Inc.
    h. Price Industries.
    i. Titus.

3. Airflow Principle: Swirl-pattern induction.
4. Material: Plastic, high impact, and resistant to cart and foot traffic.

B. Linear Floor Diffuser Plenums:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. Air Research Diffuser Products, Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Hart & Cooley Inc.
    e. Krueger.
    f. METALAIRE, Inc.
    g. Nailor Industries Inc.
    h. Price Industries.

i. Titus.

3. Material: Steel.
4. Finish: White baked acrylic.
5. Components:

a. Aluminum diffuser core.
b. Diffuser frame.
c. Plenum, 0.034-inch (0.85-mm) steel.

2.4 HIGH-CAPACITY DIFFUSERS

A. Drum Louver:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. Air Research Diffuser Products, Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Hart & Cooley Inc.
e. Krueger.
f. METALAIRE, Inc.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

3. Airflow Principle: Extended distance for high airflow rates.
4. Material: Aluminum, heavy gage extruded.
5. Finish: White baked acrylic.
6. Border: 1-1/4-inch (32-mm) width with countersunk screw holes.
7. Gasket between drum and border.
8. Body: Drum shaped; adjustable vertically.
9. Blades: Individually adjustable horizontally.
10. Accessories:

a. Opposed-blade steel damper.
b. Duct-mounting collars with countersunk screw holes.

B. Modular Core Supply Grilles:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. Air Research Diffuser Products, Inc.

b. Anemostat Products; a Mestek company.
c. Carnes.
d. Hart & Cooley Inc.
e. Krueger.
f. METALAIRE, Inc.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

3. Throw: Extended distance for airflow rates.
4. Material: Steel.
5. Grilles per Unit: as shown on plans
6. Finish: White baked acrylic.
7. Border: 1-1/2-inch (38-mm) width with countersunk screw holes.
8. Blades:

a. Airfoil, individually adjustable horizontally.
b. Double deflection.
c. Set in modules.

9. Modules: Removable; rotatable.
10. Mounting: Surface.
11. Accessory: Opposed-blade steel damper.

2.5 FLEXIBLE DIFFUSION OUTLETS

A. Continuous Tubular Diffuser:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. DuctSox Corp.
b. Patron Products Inc.

3. Material: **Flame-retardant, woven polyethylene fabric**.
4. Duct Connection: Round.
5. Accessories:

a. Quick-connect joint.
b. Snap hooks.
c. Cleanout zipper.
d. Condensate drain.

2.6 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Dayus Register & Grille Inc.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. METALAIRE, Inc.
    h. Nailor Industries Inc.
    i. Price Industries.
    j. Titus.
    k. Tuttle & Bailey.

3. Material: **Steel**.
4. Finish: **Baked enamel, white** .
5. Face Blade Arrangement: As shown on plans
6. Core Construction: **Integral**
7. Damper Type: **Adjustable opposed blade**.

B. Adjustable Bar Grille:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Dayus Register & Grille Inc.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. METALAIRE, Inc.
    h. Nailor Industries Inc.
    i. Price Industries.
    j. Titus.
    k. Tuttle & Bailey.

3. Material: **Steel**.
4. Finish: **Baked enamel, white**.

C. Security Register:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Hart & Cooley Inc.
e. Krueger.
f. Nailor Industries Inc.
g. Price Industries.
h. Titus.
i. Tuttle & Bailey.

3. Security Level: **Maximum**.
4. Application: **Ducted return**.
5. Material: **Steel**.
6. Material Thickness: **0.19 inch (4.8 mm)**.
7. Finish: **Baked enamel, white**.

D. Security Grille:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Hart & Cooley Inc.
e. Krueger.
f. Nailor Industries Inc.
g. Price Industries.
h. Titus.
i. Tuttle & Bailey.

3. Security Level: **Maximum**.
4. Application: **Ducted return**.
5. Material: **Steel**.
6. Material Thickness: **0.19 inch (4.8 mm)**.
7. Finish: **Baked enamel, white**.

E. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.

f. Krueger.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

3. Material: **Steel.**
4. Finish: **Baked enamel, white**.

F. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

3. Material: **Steel**.
4. Finish: **Baked enamel, white**.

G. Linear Bar Grille:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

3. Material: **Steel**.
4. Finish: **Baked enamel, white**.

2.7 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 26 0519
POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Armored cable.

C. Metal-clad cable.

D. Wire and cable for 600 volts and less.

E. Wiring connectors.

F. Oxide inhibiting compound.

G. Wire pulling lubricant.

H. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 26 0526 - Grounding and Bonding: Additional requirements for grounding conductors and grounding connectors.

C. Section 26 0553 - Identification for Electrical: Identification products and requirements.

D. Section 28 3100 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.

E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers.

F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction.

H. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC).

I. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy.

J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

K. NFPA 70 - National Electrical Code.

L. UL 4 - Armored Cable.

M. UL 44 - Thermoset-Insulated Wires and Cables.

N. UL 83 - Thermoplastic-Insulated Wires and Cables.

O. UL 486A-486B - Wire Connectors.

P. UL 486C - Splicing Wire Connectors.

Q. UL 486D - Sealed Wire Connector Systems.

R. UL 1569 - Metal-Clad Cables.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
   3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. Not required.

B. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.
   1. Where not otherwise restricted, may be used:
      a. For branch circuit wiring in dry locations within one- and two-family dwellings and their attached or detached garages, and their storage buildings.
      b. For branch circuit wiring in dry locations within multifamily dwellings permitted to be of Types III, IV, and V construction.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.

1) Maximum Length: 6 feet (1.8 m).

b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.

1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.

c. For general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities, when provided with additional insulated grounding conductor for redundant grounding.

G. Metal-clad cable is permitted only as follows:

1. Where not otherwise restricted, may be used:

a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.

b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.

1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.

2. In addition to other applicable restrictions, may not be used:

a. Unless approved by Owner.

b. Where not approved for use by the authority having jurisdiction.

c. Where exposed to view.

d. Where exposed to damage.

e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

I. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.

J. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

K. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

L. Conductor Material:

1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.

a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:

1) Services: Copper conductors size 1/0 AWG and larger.

2) Feeders: Copper conductors size 1/0 AWG and larger.

b. Where aluminum conductors are substituted for copper, comply with the following:

1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
3) Provide aluminum equipment grounding conductor sized according to NFPA 70.
4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.
4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

M. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
a. Exceptions:
1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.
3) 20 A, 277 V circuits longer than 150 feet (46 m): 10 AWG, for voltage drop.
2. Control Circuits: 14 AWG.

N. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
3. Color Code:
a. 480Y/277 V, 3 Phase, 4 Wire System:
1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Neutral/Grounded: Gray.
b. 208Y/120 V, 3 Phase, 4 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.
c. Equipment Ground, All Systems: Green.
d. Travelers for 3-Way and 4-Way Switching: Pink.
e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
f. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com.
b. Encore Wire Corporation: www.encorewire.com.
c. Southwire Company: www.southwire.com.
d. Substitutions: See Section 01 6000 - Product Requirements.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
a. Encore Wire Corporation: www.encorewire.com.
b. Prysmian Power Cables and Systems: www.us.prysmian.com.
c. Southwire Company: www.southwire.com.

d. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
a. Size 4 AWG and Larger: Type XHHW-2.
b. Installed Underground: Type XHHW-2.
c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.04 ARMORED CABLE

A. Manufacturers:
1. AFC Cable Systems Inc: www.afcweb.com.
2. Encore Wire Corporation: www.encorewire.com.
3. Southwire Company: www.southwire.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN.

F. Grounding: Combination of interlocking armor and integral bonding wire.
1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.

G. Armor: Steel, interlocked tape.

2.05 METAL-CLAD CABLE

A. Manufacturers:
1. AFC Cable Systems Inc: www.afcweb.com.
2. Encore Wire Corporation: www.encorewire.com.
3. Southwire Company: www.southwire.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide oversized neutral conductors where indicated or required.

G. Provide dedicated neutral conductor for each phase conductor where indicated or required.

H. Grounding: Full-size integral equipment grounding conductor.
   1. Provide additional isolated/insulated grounding conductor where indicated or required.

I. Armor: Steel, interlocked tape.

J. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

K. Conductor: Copper.

L. Insulation Temperature Rating: 90 degrees C.

M. Insulation Material: Thermoplastic.

N. Metal Clad Cable shall only be used in concealed spaces such as walls.

O. Metal Clad Cable shall only be used above accessible ceilings for light fixture whips and for whips to furniture system power poles.

2.06 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
   5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   6. Aluminum Conductors: Use compression connectors for all connections.
   7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   8. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

H. Mechanical Connectors: Provide bolted type or set-screw type.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.

J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.07 WIRING ACCESSORIES

A. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

C. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that raceway installation is complete and supported.

E. Verify that field measurements are as shown on the drawings.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated and routing is not shown, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location shown.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.
      a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
      b. Increase size of conductors as required to account for ampacity derating.
      c. Size raceways, boxes, etc. to accommodate conductors.
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
   9. Provide oversized neutral/grounded conductors where required by NFPA 70.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

D. Install aluminum conductors in accordance with NECA 104.

E. Install armored cable (Type AC) in accordance with NECA 120.

F. Install metal-clad cable (Type MC) in accordance with NECA 120.

G. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.

2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

H. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

I. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

J. Terminate cables using suitable fittings.
1. Armored Cable (Type AC):
   a. Use listed fittings and anti-short, insulating bushings.
   b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
2. Metal-Clad Cable (Type MC):
   a. Use listed fittings.
   b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

K. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

N. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

P. Insulate ends of spare conductors using vinyl insulating electrical tape.

Q. Color Code Legend: Provide identification label identifying color code for ungrounded conductors at each piece of feeder or branch-circuit distribution equipment.

R. Provide wire and cable markers in accordance with Section 26 0553 identifying circuit number or other designation indicated at the following locations:
   1. At each source and load connection.
   2. Within boxes.
   3. Within equipment enclosures.
   4. In cable tray, at maximum intervals of 20 feet (6.1 m).

S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

U. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.

V. Route wire and cable as required to meet project conditions.
   1. Wire and cable routing indicated is approximate unless dimensioned.
   2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
   3. Include wire and cable of lengths required to install connected devices within 10 ft (3000 mm) of location shown on the drawings.

W. Use wiring methods indicated.

X. Pull all conductors into raceway at same time.

Y. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

Z. Protect exposed cable from damage.

AA. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

AB. Use suitable cable fittings and connectors.

AC. Neatly train and lace wiring inside boxes, equipment, and panelboards.

AD. Clean conductor surfaces before installing lugs and connectors.

AE. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

AF. Terminate aluminum conductors with tin-plated aluminum-bodied compression connectors only. Fill with anti- oxidant compound before installing conductor.

AG. Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.

AH. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

AI. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

AJ. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

AK. Identify and color code wire and cable under provisions of Section 26 0553. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform field inspection and testing in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
   1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

E. Correct deficiencies and replace damaged or defective conductors and cables.

F. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

F. Ground plate electrodes.

G. Ground access wells.

H. Grounding and bonding components.

I. Not all may apply.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.

B. Section 26 0536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.

C. Section 26 0553 - Identification for Electrical: Identification products and requirements.

D. Section 26 4113 - Lightning Protection for Structures.

E. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

E. NFPA 70 - National Electrical Code.

F. NFPA 99 - Health Care Facilities Code.

G. UL 467 - Grounding and Bonding Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms.

1.06 SUBMITTALS

A. Not required.

B. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
   3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.

c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Metal Building or Structure Frame:
   a. Provide connection to metal building or structure frame effectively grounded in accordance with NFPA 70 at nearest accessible location.
4. Concrete-Encased Electrode:
   a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
6. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
   b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
   c. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.
7. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

G. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

I. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
   a. Transformers (except autotransformers such as buck-boost transformers).
   b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
   c. Generators, when neutral is switched in the transfer switch.
2. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
3. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.

4. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
5. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
6. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

J. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
   b. Metal gas piping.
   c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame where not used as a grounding electrode.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

K. Pole-Mounted Luminaires: Also comply with Section 26 5600.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
   a. Exceptions:
      1) Use bare copper conductors where installed underground in direct contact with earth.
      2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use compression connectors for underground, concealed and other inaccessible connections.
   3. Unless otherwise indicated, use mechanical connectors or compression connectors for accessible connections.
   4. Manufacturers - Mechanical and Compression Connectors:
      a. Harger Lightning & Grounding: www.harger.com.
      b. Thomas & Betts Corporation: www.tnb.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.
   5. Manufacturers - Exothermic Welded Connections:
      a. Cadweld, a brand of Erico International Corporation: www.erico.com.
      b. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

D. Ground Bars:
   1. Description: Copper rectangular ground bars with mounting brackets and insulators.
   2. Size: As indicated.
   3. Holes for Connections: As indicated or as required for connections to be made.
   4. Manufacturers:
      a. Erico International Corporation: www.erico.com.
      b. Harger Lightning & Grounding: www.harger.com.
      c. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

E. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.
   4. Where rod lengths of greater than 10 feet (3.0 m) are indicated or otherwise required, sectionalized ground rods may be used.
   5. Manufacturers:
      a. Erico International Corporation: www.erico.com.
      b. Galvan Industries, Inc: www.galvanelectrical.com.
      c. Harger Lightning & Grounding: www.harger.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

F. Ground Plate Electrodes:
   1. Material: Copper.
   2. Size: 24 by 24 by 1/4 inches (610 by 610 by 6 mm), unless otherwise indicated.
   3. Manufacturers:
      a. Erico International Corporation: www.erico.com.
      b. Harger Lightning & Grounding: www.harger.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

G. Ground Access Wells:
   1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
      a. Areas Exposed to Vehicular Traffic: Rated for not less than heavy traffic vertical design load.
   2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
      a. Round Wells: Not less than 8 inches (200 mm) in diameter.
      b. Rectangular Wells: Not less than 12 by 12 inches (300 by 300 mm).
   3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches (250 mm).

4. Cover: Factory-identified by permanent means with word "GROUND".
5. Manufacturers:
    a. Erico International Corporation: www.erico.com.
    b. Harger Lightning & Grounding: www.harger.com.
    c. Substitutions: See Section 01 6000 - Product Requirements.

H. Oxide Inhibiting Compound: Comply with Section 26 0519.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as shown on the drawings.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches (150 mm) below finished grade.
2. Indoor Installations: Unless otherwise indicated, install with 4 inches (100 mm) of top of rod exposed.

D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches (750 mm).

E. Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

F. Identify grounding and bonding system components in accordance with Section 26 0553.

G. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

H. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.

I. Install 4 AWG bare copper wire in foundation footing .

J. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing . .

K. Provide bonding to meet requirements described in Quality Assurance.

L. Bond together metal siding not attached to grounded structure; bond to ground.

M. Bond together reinforcing steel and metal accessories in pool and fountain structures.

N. Provide isolated grounding conductor for circuits supplying electronic cash registers and personal computers as indicated on the drawings.

O. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on seperate lug.

P. Interface with site grounding system installed under Section 33 7900, if applicable.

Q. Interface with lightning protection system installed under Section 26 4113.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0534 - Conduit: Additional support and attachment requirements for conduits.

C. Section 26 0537 - Boxes: Additional support and attachment requirements for boxes.

D. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

E. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. MFMA-4 - Metal Framing Standards Publication.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction.

F. NFPA 70 - National Electrical Code.

G. UL 5B - Strut-Type Channel Raceways and Fittings.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.05 SUBMITTALS

A. Submittals not required.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.
   3. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
      b. Erico International Corporation: www.erico.com.
      c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      d. Thomas & Betts Corporation: www.tnb.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
   1. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
      b. Erico International Corporation: www.erico.com.
      c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      d. Thomas & Betts Corporation: www.tnb.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Comply with MFMA-4.
   2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
   3. Manufacturers:
      a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
      b. Thomas & Betts Corporation: www.tnb.com.
      c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.

d. Substitutions: See Section 01 6000 - Product Requirements.
e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2 inch (13 mm) diameter.
b. Single Conduit up to 1 inch (27mm) trade size: 1/4 inch (6 mm) diameter.
c. Single Conduit larger than 1 inch (27mm) trade size: 3/8 inch (10 mm) diameter.
d. Trapeze Support for Multiple Conduits: 3/8 inch (10 mm) diameter.
e. Outlet Boxes: 1/4 inch (6 mm) diameter.
f. Luminaires: 1/4 inch (6 mm) diameter.

F. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
3. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
4. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
b. Erico International Corporation: www.erico.com.
c. PHP Systems/Design: www.phpsd.com.
d. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are permitted only as follows:
a. Where approved by Architect.
11. Hammer-driven anchors and fasteners are permitted only as follows:
a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
a. Comply with MFMA-4.
b. Channel Material: Use galvanized steel.
c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
a. Hilti, Inc: www.us.hilti.com.

b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com.
c. Powers Fasteners, Inc: www.powers.com.
d. Simpson Strong-Tie Company Inc: www.strongtie.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

15. Manufacturers - Powder-Actuated Fastening Systems:
    a. Hilti, Inc: www.us.hilti.com.
    b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com.
    c. Powers Fasteners, Inc: www.powers.com.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com.
    e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
    4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 3000.
    5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Conduit Support and Attachment: Also comply with Section 26 0534.

J. Box Support and Attachment: Also comply with Section 26 0537.

K. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.

L. Exterior Luminaire Support and Attachment: Also comply with Section 26 5600.

M. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

N. Secure fasteners according to manufacturer's recommended torque settings.

O. Remove temporary supports.

P. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 0534

CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Intermediate metal conduit (IMC).

C. PVC-coated galvanized steel rigid metal conduit (RMC).

D. Flexible metal conduit (FMC).

E. Liquidtight flexible metal conduit (LFMC).

F. Electrical metallic tubing (EMT).

G. Rigid polyvinyl chloride (PVC) conduit.

H. Conduit fittings.

I. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.

B. Section 07 8400 - Firestopping.

C. Section 26 0519 - Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.

D. Section 26 0526 - Grounding and Bonding.
   1. Includes additional requirements for fittings for grounding and bonding.

E. Section 26 0529 - Hangers and Supports.

F. Section 26 0535 - Surface Raceways.

G. Section 26 0537 - Boxes.

H. Section 26 0553 - Identification for Electrical: Identification products and requirements.

I. Section 31 2316 - Excavation.

J. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

K. Section 31 2323 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT).

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC).

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).

F. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit.

G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).

H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.

K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

L. NFPA 70 - National Electrical Code.

M. UL 1 - Flexible Metal Conduit.

N. UL 6 - Electrical Rigid Metal Conduit-Steel.

O. UL 360 - Liquid-Tight Flexible Steel Conduit.

P. UL 514B - Conduit, Tubing, and Cable Fittings.

Q. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

R. UL 797 - Electrical Metallic Tubing-Steel.

S. UL 1242 - Electrical Intermediate Metal Conduit-Steel.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:
   1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
   2. Include proposed locations of roof penetrations and proposed methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use rigid PVC conduit.
   2. Exterior, Direct-Buried: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
   3. Exterior, Embedded Within Concrete: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit where emerging from underground.
   5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
   6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
   7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches (100 mm) on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:
   1. Within Slab on Grade: Not permitted.
   2. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
   3. Within Slab Above Ground: Not permitted.
   4. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
   5. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, electrical metallic tubing (EMT), or rigid PVC conduit.
   6. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit where emerging from concrete.
   7. Where electrical metallic tubing (EMT) emerges from concrete into salt air, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches (100 mm) on either side of where conduit emerges.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or electrical metallic tubing (EMT).

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, electrical metallic tubing (EMT), or rigid PVC conduit.

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
   1. Locations subject to physical damage include, but are not limited to:
      a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.
      b. Where exposed below 20 feet (6.1 m) in warehouse areas.

K. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.
   1. Corrosive locations include, but are not limited to:
      a. Cooling towers.

N. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

O. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet (1.8 m).

P. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

2.02 CONDUIT REQUIREMENTS

A. Electrical Service Conduits: Also comply with Section 26 2100.

B. Fittings for Grounding and Bonding: Also comply with Section 26 0526.

C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 1/2 inch (16 mm) trade size.
   2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   3. Control Circuits: 1/2 inch (16 mm) trade size.
   4. Flexible Connections to Luminaires: 1/2 inch (16 mm) trade size.
   5. Underground, Interior: 3/4 inch (21 mm) trade size.
   6. Underground, Exterior: 3/4 inch (21 mm) trade size.

F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com.
   2. Republic Conduit: www.republic-conduit.com.
   3. Wheatland Tube Company: www.wheatland.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      c. Thomas & Betts Corporation: www.tnb.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel.
    a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com.
2. Republic Conduit: www.republic-conduit.com.
3. Wheatland Tube Company: www.wheatland.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
1. Manufacturers:
    a. Bridgeport Fittings Inc: www.bptfittings.com.
    b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
    c. Thomas & Betts Corporation: www.tnb.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel.
    a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.
6. Conduits crossing each other: Not permitted.
7. Maximum Size Conduit in Slab: 3/4 inch (19 mm).
8. Provide a minimum 1 inch concrete cover over all conduits.

2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Thomas & Betts Corporation: www.tnb.com.
2. Robroy Industries: www.robroy.com.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil (1.02 mm).

D. Interior Coating: Urethane, minimum thickness of 2 mil (0.05 mm).

E. PVC-Coated Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil (1.02 mm).
6. Interior Coating: Urethane, minimum thickness of 2 mil (0.05 mm).

F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil (0.38 mm).

2.06 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      c. Thomas & Betts Corporation: www.tnb.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel.
      a. Do not use die cast zinc fittings.

2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      c. Thomas & Betts Corporation: www.tnb.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel, malleable iron, aluminum, or die cast zinc.

2.08 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com.
   2. Republic Conduit: www.republic-conduit.com.
   3. Wheatland Tube Company: www.wheatland.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com.

b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
c. Thomas & Betts Corporation: www.tnb.com.
d. Substitutions: See Section 01 6000 - Product Requirements.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel.
   a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use compression (gland) or set-screw type.
   a. Do not use indenter type connectors and couplings.
5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.09 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com.
   2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com.
   3. JM Eagle: www.jmeagle.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 or Schedule 80 as indicated; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil (0.51 mm).

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

G. Install electrical nonmetallic tubing (ENT) in accordance with NECA 111.

H. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

I. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated and routing is not shown, contractor shall determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   5. Unless otherwise approved, do not route conduits exposed:
      a. Across floors.
      b. Across roofs.
      c. Across top of parapet walls.
      d. Across building exterior surfaces.
   6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   7. Arrange conduit to maintain adequate headroom, clearances, and access.
   8. Arrange conduit to provide no more than the equivalent of three 90 degree bends between pull points.
   9. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
   10. Route conduits above water and drain piping where possible.
   11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   12. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
   13. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.

J. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.

K. Connections and Terminations:
   1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
   2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
   3. Use suitable adapters where required to transition from one type of conduit to another.
   4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.

5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

L. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

M. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 2316 and Section 31 2323.
2. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches (610 mm).
   b. Under Slab on Grade: 12 inches (300 mm) to bottom of slab.
3. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length for service entrance where not concrete-encased.

N. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 3000 with minimum concrete cover of 3 inches (76 mm) on all sides unless otherwise indicated.

O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

3. Where conduits penetrate coolers or freezers.

Q. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 24 inches (600 mm) at each end.

R. Provide grounding and bonding in accordance with Section 26 0526.

S. Identify conduits in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26-0537

BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).

C. Floor boxes.

D. Underground boxes/enclosures.

E. Wall and ceiling outlet boxes.

F. Pull and junction boxes.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 07 8400 - Firestopping.

C. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

D. Section 26 0526 - Grounding and Bonding.

E. Section 26 0529 - Hangers and Supports.

F. Section 26 0534 - Conduit:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

G. Section 26 0553 - Identification for Electrical: Identification products and requirements.

H. Section 26 2726 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

F. NFPA 70 - National Electrical Code.

G. SCTE 77 - Specification for Underground Enclosure Integrity.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

J. UL 508A - Industrial Control Panels.

K. UL 514A - Metallic Outlet Boxes.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. Submittals not required.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use nonmetallic boxes where exposed rigid PVC conduit is used.
   5. Use suitable concrete type boxes where flush-mounted in concrete.
   6. Use suitable masonry type boxes where flush-mounted in masonry walls.
   7. Use raised covers suitable for the type of wall construction and device configuration where required.
   8. Use shallow boxes where required by the type of wall construction.
   9. Do not use "through-wall" boxes designed for access from both sides of wall.

10. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
11. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
12. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
13. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
14. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Ceiling Outlets: 4 inch octagonal or square by 2-1/8 inch deep (100 by 54 mm) trade size.
15. Wall Plates: Comply with Section 26 2726.
16. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
    b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com.
    c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com.
    d. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
    e. Thomas & Betts Corporation: www.tnb.com.
    f. Substitutions: See Section 01 6000 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
    a. Provide screw-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet (0.56 sq m) and Larger: Provide sectionalized screw-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed same as panelboards unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
    b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com.
    c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.

D. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Use sheet-steel floor boxes within slab above grade.

4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
5. Manufacturer: Same as manufacturer of floor box service fittings.

E. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches (300 mm).
4. Provide logo on cover to indicate type of service.
5. Applications:
a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 8 load rating.
b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 15 load rating.
c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
a. Manufacturers:
1) Highline Products, a subsidiary of MacLean Power Systems: www.highlineproducts.com.
2) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com.
3) Oldcastle Precast, Inc: www.oldcastleprecast.com.
4) Substitutions: See Section 01 6000 - Product Requirements.
b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify locations of floor boxes and outlets in offices and work areas with Architect prior to rough-in.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.

3. Locate boxes as required for devices installed under other sections or by others.
4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    b. Do not install flush-mounted boxes with area larger than 16 square inches (0.0103 sq m) or such that the total aggregate area of openings exceeds 100 square inches (0.0645 sq m) for any 100 square feet (9.29 sq m) of wall area.
10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0534.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.

L. Floor-Mounted Cabinets: Mount on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 3000.

M. Install boxes as required to preserve insulation integrity.

N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

O. Underground Boxes/Enclosures:

1. Install enclosure on gravel base, minimum 12 inches (300 mm) deep.
2. Flush-mount enclosures located in concrete or paved areas.
3. Mount enclosures located in landscaped areas with top at 1 inch (25 mm) above finished grade.
4. Provide cast-in-place concrete collar constructed in accordance with Section 03 3000, minimum 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep), around enclosures that are not located in concrete areas.
5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

P. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

R. Close unused box openings.

S. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

T. Provide grounding and bonding in accordance with Section 26 0526.

U. Identify boxes in accordance with Section 26 0553.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Underground warning tape.

E. Floor marking tape.

F. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 09 9113 - Exterior Painting.

B. Section 09 9123 - Interior Painting.

C. Section 26 0519 - Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

D. Section 26 0573 - Overcurrent Coordination Study: Arc flash hazard warning labels.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

C. NFPA 70 - National Electrical Code.

D. NFPA 70E - Standard for Electrical Safety in the Workplace.

E. UL 969 - Marking and Labeling Systems.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location.
         4) Use identification nameplate to identify main overcurrent protective device.
         5) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
      b. Panelboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location.
         4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
         5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
         6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
      c. Transformers:
         1) Identify kVA rating.
         2) Identify voltage and phase for primary and secondary.
         3) Identify power source and circuit number. Include location.
         4) Identify load(s) served. Include location.
      d. Enclosed switches, circuit breakers, and motor controllers:
         1) Identify voltage and phase.
         2) Identify power source and circuit number. Include location.
         3) Identify load(s) served. Include location.
      e. Busway:
         1) Identify voltage and phase.
         2) Identify power source and circuit number. Include location.
         3) Provide identification at maximum intervals of 10 feet (3 m).
         4) Use identification nameplate to identify load(s) served for each plug-in unit. Include location.
      f. Time Switches:
         1) Identify load(s) served and associated circuits controlled. Include location.
      g. Enclosed Contactors:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
         4) Identify coil voltage.
         5) Identify load(s) and associated circuits controlled. Include location.
      h. Transfer Switches:
         1) Identify voltage and phase.
         2) Identify power source and circuit number for both normal power source and standby power source. Include location.
         3) Identify load(s) served. Include location.
   2. Service Equipment:

a. Use identification nameplate to identify each service disconnecting means.
b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
c. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.

3. Emergency System Equipment:
   a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
   b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
   c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
7. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
8. Use identification label on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
9. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
10. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
    a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches (76 mm) wide, painted in accordance with Section 09 9123 and 09 9113.
11. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.
12. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
13. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or as indicated on the drawings.

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Use identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
   a. At each source and load connection.
   b. Within boxes.
   c. Within equipment enclosures.

d. In cable tray, at maximum intervals of 20 feet (6.1 m).

4. Use underground warning tape to identify direct buried cables.

C. Identification for Raceways:

1. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
3. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
   a. For exposed boxes in public areas, do not color code.
3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
   a. For exposed boxes in public areas, use only identification labels.

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
2. Factory Pre-Marked Wallplates: Comply with Section 26 2726.
3. Use identification label to identify fire alarm system devices.
   a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
4. Use identification label to identify serving branch circuit for all receptacles.
   a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
5. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
6. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

F. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Manufacturers:
   a. Brimar Industries, Inc: www.brimar.com.
   b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
   c. Seton Identification Products: www.seton.com.
   d. Substitutions: See Section 01 6000 - Product Requirements.
2. Materials:
   a. Indoor Clean, Dry Locations: Use plastic nameplates.
   b. Outdoor Locations: Use plastic nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
4. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Manufacturers:
   a. Brady Corporation: www.bradyid.com.

b. Brother International Corporation: www.brother-usa.com.
c. Panduit Corp: www.panduit.com.
d. Substitutions: See Section 01 6000 - Product Requirements.

2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
3. Text: Use factory pre-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
2. Legend:
a. System designation where applicable:
1) Emergency Power System: Identify with text "EMERGENCY".
2) Fire Alarm System: Identify with text "FIRE ALARM".
b. Equipment designation or other approved description.
c. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
a. System Designation: 1 inch (25 mm).
b. Equipment Designation: 1/2 inch (13 mm).
c. Other Information: 1/4 inch (6 mm).
5. Color:
a. Normal Power System: White text on black background.
b. Emergency Power System: White text on red background.
c. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch (6 mm).
5. Color: Black text on white background unless otherwise indicated.
a. Exceptions:
1) Provide white text on red background for general information or operational instructions for emergency systems.
2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches (51 mm) by 4 inches (100 mm).
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch (13 mm).
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Control Device Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Black text on clear background.

G. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com.
2. Seton Identification Products: www.seton.com.
3. HellermannTyton: www.hellermanntyton.com.
4. Panduit Corp: www.panduit.com.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed text, all capitalized unless otherwise indicated.
1. Do not use handwritten text.

F. Minimum Text Height: 1/8 inch (3 mm).

G. Color: Black text on white background unless otherwise indicated.

2.04 UNDERGROUND WARNING TAPE

A. Manufacturers:
1. Brady Corporation: www.bradyid.com.
2. Brimar Industries, Inc: www.brimar.com.
3. Seton Identification Products: www.seton.com.
4. HellermannTyton: www.hellermanntyton.com.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Foil-backed Detectable Type Tape: 3 inches (76 mm) wide, with minimum thickness of 5 mil (0.1 mm), unless otherwise required for proper detection.

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.05 FLOOR MARKING TAPE

A. Manufacturers:
1. Brady Corporation: www.bradyid.com.
2. Brimar Industries, Inc: www.brimar.com.
3. Seton Identification Products: www.seton.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches (76 mm) wide, with alternating black and white stripes.

2.06 WARNING SIGNS AND LABELS

A. Manufacturers:
1. Brimar Industries, Inc: www.brimar.com.
2. Clarion Safety Systems, LLC: www.clarionsafety.com.

3. Seton Identification Products: www.seton.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
1. Materials:
a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic signs.
b. Outdoor Locations: Use factory pre-printed rigid aluminum or rigid plastic signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

D. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
a. Do not use labels designed to be completed using handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Enclosure front.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using rivets and to interior surfaces using epoxy cement.
1. Do not use adhesives on exterior surfaces except where substrate can not be penetrated.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 0573

OVERCURRENT COORDINATION STUDY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Short-circuit study.

B. Protective device coordination study.

C. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.

D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

E. Arc flash study and analysis.

1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical: Additional requirements for arc flash hazard warning labels.

B. Section 26 2413 - Switchboards.

C. Section 26 2416 - Panelboards.

D. Section 26 2501 - Low-Voltage Busways.

E. Section 26 2813 - Fuses.

F. Section 26 2817 - Enclosed Circuit Breakers.

G. Section 26 2818 - Enclosed Switches.

1.03 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

B. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants.

C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.

E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems.

F. IEEE 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations.

G. NEMA MG 1 - Motors and Generators.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

I. NFPA 70 - National Electrical Code.

J. NFPA 70E - Standard for Electrical Safety in the Workplace.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   2. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.

3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Study preparer's qualifications.

C. Field testing agency's qualifications.

D. Study reports, stamped or sealed and signed by study preparer.

E. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
   1. Include characteristic time-current trip curves for protective devices.
   2. Include impedance data for busway.
   3. Include impedance data for engine generators.
   4. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   5. Include documentation of listed series ratings upon request.
   6. Identify modifications made in accordance with studies that:
      a. Can be made at no additional cost to Owner.
      b. As submitted will involve a change to the contract sum.

F. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.

G. Field quality control reports.

H. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

I. Project Record Documents: Revise studies as required to reflect as-built conditions.
   1. Include hard copies with operation and maintenance data submittals.
   2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.06 POWER SYSTEM STUDIES

A. Scope of Studies:
   1. Perform analysis of new electrical distribution system.
   2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
   3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
      a. Known Operating Modes:
         1) Utility as source.

B. General Study Requirements:
   1. Comply with NFPA 70.
   2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
   1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
      a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
         1) Obtain up-to-date information from Utility Company.

2) Utility Company: As indicated on drawings.
b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
e. Protective Devices:
1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
a. Maximum utility fault currents.
b. Maximum motor contribution.
c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.
2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.

F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
a. Maximum and minimum utility fault currents.
b. Maximum and minimum motor contribution.
c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
1. General Requirements:
a. Identify date of study and study preparer.
b. Identify study methodology and software product(s) used.
c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
d. Identify base used for per unit values.

e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
f. Include conclusions and recommendations.

2. Short-Circuit Study:
   a. For each scenario, identify at each bus location:
      1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      2) Fault point X/R ratio.
      3) Associated equipment short circuit current ratings.
   b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
   a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
   b. For each graph include (where applicable):
      1) Partial single-line diagram identifying the portion of the system illustrated.
      2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
      3) Conductors: Damage curves.
      4) Transformers: Inrush points and damage curves.
      5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
      6) Motors: Full load current, starting curves, and damage curves.
   c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
      1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
      2) Include ground fault pickup and delay.
      3) Include fuse ratings.
      4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
   d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
   a. For each scenario, identify at each bus location:
      1) Calculated incident energy and associated working distance.
      2) Calculated arc flash boundary.
      3) Bolted fault current.
      4) Arcing fault current.
      5) Clearing time.
      6) Arc gap distance.
   b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
   c. Identify locations where the calculated maximum incident energy exceeds 40 calories per sq cm.

1.07 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in the preparation of studies of similar type and complexity using specified computer software.
   1. Study preparer shall be employed by the manufacturer of the electrical distribution equipment.

B. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years experience; NETA Accredited Company.
   1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.

C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
   1. Acceptable Software Products:
      a. EasyPower LLC: www.easypower.com.
      b. Power Analytics Corporation: www.poweranalytics.com.
      c. SKM Systems Analysis, Inc: www.skm.com.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
   1. Materials: Comply with Section 26 0553.
   2. Minimum Size: 4 by 6 inches (100 by 150 mm).
   3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
      a. Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
      b. Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
      c. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
      d. Include the following information:
         1) Arc flash boundary.
         2) Available incident energy and corresponding working distance.
         3) Site-specific PPE (personnel protective equipment) requirements.
         4) Nominal system voltage.
         5) Limited approach boundary.
         6) Restricted approach boundary.
         7) Equipment identification.
         8) Date calculations were performed.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Adjust equipment and protective devices for compliance with studies and recommended settings.

E. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

F. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.02 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

END OF SECTION

SECTION 26 0919
ENCLOSED CONTACTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General purpose contactors.

B. Lighting contactors.

1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports.

B. Section 26 0553 - Identification for Electrical: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

B. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.

C. NEMA ICS 6 - Industrial Control and Systems: Enclosures.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

E. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide dimensions, size, voltage ratings and current ratings.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Allen-Bradley/Rockwell Automation: ab.rockwellautomation.com.

B. Eaton Corporation: www.eaton.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens: www.seimens.com

E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GENERAL PURPOSE CONTACTORS

A. Description: NEMA ICS 2, AC general purpose magnetic contactor.

B. Coil operating voltage: As indicated on drawings.

C. Poles: As required to match circuit configuration and control function.

D. Enclosure: NEMA ICS 6, Type 1.

E. Accessories:
   1. Pushbutton: ON/OFF.

2. Selector Switch: ON/OFF/AUTOMATIC.
3. Indicating Light: RED.
4. Auxiliary Contacts: One, field convertible.

2.03 LIGHTING CONTACTORS

A. Description: NEMA ICS 2, magnetic lighting contactor.

B. Configuration: Electrically held.

C. Coil operating voltage: As indicated on drawings.

D. Poles: As required to match circuit configuration and control function.

E. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.

F. Enclosure: NEMA ICS 6, Type as required to meet conditions of installation.

G. Accessories:
1. Pushbutton: ON/OFF.
2. Selector Switch: ON/OFF/AUTOMATIC.
3. Indicating Light: RED.
4. Auxiliary Contacts: One, field convertible.

2.04 ACCESSORIES

A. Cover Mounted Pilot Devices: NEMA ICS 5, standard type.

B. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

C. Pushbuttons: Recessed type.

D. Indicating Lights: Transformer, LED type.

E. Selector Switches: Rotary type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install enclosed contactors where indicated, in accordance with manufacturer's instructions.

B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 0529.

C. Provide engraved plastic nameplates; refer to Section 26 0553 for product requirements and location.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform applicable inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION

SECTION 26 2200
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General purpose transformers.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding.

C. Section 26 0534 - Conduit: Flexible conduit connections.

D. Section 26 0553 - Identification for Electrical: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers.

B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers.

C. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers.

F. NEMA ST 20 - Dry-Type Transformers for General Applications.

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

I. NFPA 70 - National Electrical Code.

J. UL 506 - Standard for Specialty Transformers.

K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors required for mounting of transformers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
   1. Vibration Isolators: Include attachment method and rated load and deflection.
   2. K-factor Rated Transformers: Include K-factor ratings.
   3. Buck-boost Transformers: Include voltage selection tables and wiring diagrams for autotransformer configurations.
   4. Shielded Transformers: Include shielding method and noise attenuation performance.
   5. Small Power Centers: Include panelboard bus ampacity, integrated short circuit ampere rating, and circuit breaker sizes and ampere ratings.

C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
   1. Small Power Centers: Include panel arrangements.

D. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Maintenance Data: Include recommended maintenance procedures and intervals.

H. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. General Electric Company: www.geindustrial.com.

C. Schneider Electric: Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Substitutions: See Section 01 6000 - Product Requirements.

F. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
   1. Altitude: Less than 3,300 feet (1,000 m).
   2. Ambient Temperature:
      a. Greater than 10 kVA: Not exceeding 104 degrees F (40 degrees C).
      b. Less than 10 kVA: Not exceeding 77 degrees F (25 degrees C).

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. Insulation System and Allowable Average Winding Temperature Rise:
   1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
   2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

E. Coil Conductors: Continuous copper windings with terminations brazed or welded.

F. Winding Taps:
   1. Less than 3 kVA: None.
   2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
   3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
   4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

H. Sound Levels: Standard sound levels complying with NEMA ST 20.

I. Mounting Provisions:
   1. Less than 15 kVA: Suitable for wall mounting.
   2. 15 kVA through 75 kVA: Suitable for wall, floor, trapeze, or ceiling mounting.
   3. Larger than 75 kVA: Suitable for floor mounting.

J. Transformer Enclosure: Comply with NEMA ST 20.
   1. Environment Type per NEMA 250: As indicated on the drawings.
   2. Construction: Steel.
      a. Less than 15 kVA: Totally enclosed, non-ventilated.
      b. 15 kVA and Larger: Ventilated.
   3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
   4. Provide lifting eyes or brackets.

K. Accessories:
   1. Mounting Brackets: Provide manufacturer's standard brackets.
   2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA 250, type 3R assembly.
   3. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

2.04 SOURCE QUALITY CONTROL

A. Factory test transformers according to NEMA ST 20.

B. Sound Level Tests: Perform factory test designated in NEMA ST 20 as "design" test on each production unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install transformers in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 0534, 2 feet (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.

G. Mount floor-mounted transformers on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 3000.

H. Mount floor-mounted, trapeze-mounted, wall-mounted, and ceiling-mounted transformers using vibration isolators suitable for isolating the transformer noise from the building structure.

I. Provide grounding and bonding in accordance with Section 26 0526.

J. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

K. Where not factory-installed, install lugs sized as required for termination of conductors as shown on the drawings.

L. Install transformer identification nameplate in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2413
SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.

B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding.

C. Section 26 0529 - Hangers and Supports.

D. Section 26 0553 - Identification for Electrical: Identification products and requirements.

E. Section 26 2501 - Low-Voltage Busways.

F. Section 26 2813 - Fuses: Fuses for fusible switches.

G. Section 26 4300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA 400 - Standard for Installing and Maintaining Switchboards.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

F. NEMA PB 2 - Deadfront Distribution Switchboards.

G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

I. NFPA 70 - National Electrical Code.

J. UL 98 - Enclosed and Dead-Front Switches.

K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

L. UL 869A - Reference Standard for Service Equipment.

M. UL 891 - Switchboards.

N. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.

5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:
   1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
   2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
   3. Obtain Utility Company approval of switchboard prior to fabrication.
   4. Preinstallation Meeting: Convene one week prior to commencing work of this section to review requirements with Utility Company representative.
   5. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   4. Include documentation of listed series ratings upon request.
   5. Include documentation demonstrating selective coordination upon request.

D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.

E. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Field Quality Control Test Reports.

H. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.

I. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards - Other Acceptable Manufacturers:
   1. Eaton Corporation: www.eaton.com.
   2. General Electric Company: www.geindustrial.com.
   3. Schneider Electric; Square D Products: www.schneider-electric.us.
   4. Siemens Industry, Inc: www.usa.siemens.com.

B. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 SWITCHBOARDS

A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

D. Front-Connected Switchboards:
   1. Main Device(s): Individually-mounted.
   2. Feeder Devices: Panel/group-mounted.
   3. Arrangement: Front accessible only (not rear accessible), rear aligned.
   4. Gutter Access: Bolted covers.

E. Service Entrance Switchboards:
   1. Listed and labeled as suitable for use as service equipment according to UL 869A.
   2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
   3. Comply with Utility Company requirements for electrical service.
   4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
   5. See Section 26 2100 for additional requirements.

F. Switchboards With Fire Pump Taps: Provide separate bussed vertical section with suitable lugs for fire pump connection to line side of main service disconnect device(s).

G. Service Conditions:
   1. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

H. Short Circuit Current Rating:

1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
3. Label equipment utilizing series ratings as required by NFPA 70.

I. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

J. Bussing: Sized in accordance with UL 891 temperature rise requirements.
1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
4. Phase and Neutral Bus Material: Aluminum or copper.
5. Ground Bus Material: Copper.

K. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
   a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   b. Main and Neutral Lug Type: Mechanical.

L. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
   b. Outdoor Locations: Type 3R.
2. Finish: Manufacturer's standard unless otherwise indicated.
3. Outdoor Enclosures:
   a. Enclosure Type: Non-walk-in type unless otherwise indicated.
   b. Color: Manufacturer's standard.
   c. Access Doors: Lockable, with all locks keyed alike.

M. Future Provisions:
1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.
3. Arrange and equip through bus and ground bus to accommodate future installation of additional switchboard sections.

N. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list switchboards as a complete assembly including surge protective device.

O. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
   a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
   b. Provide test panel and field-adjustable ground fault pick-up and delay settings.

P. Instrument Transformers:

1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Devices:

B. Circuit Breakers:
   1. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
      c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
   2. Molded Case Circuit Breakers:
      a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
         1) Provide thermal magnetic circuit breakers unless otherwise indicated.
         2) Provide electronic trip circuit breakers where indicated.
      b. Minimum Interrupting Capacity:
         1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
         2) 14,000 rms symmetrical amperes at 480 VAC.
      c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
         1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 400 amperes and larger.
      d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
      e. Provide the following features and accessories where indicated or where required to complete installation:
         1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
         2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.04 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
   1. Dielectric tests.
   2. Mechanical operation tests.
   3. Grounding of instrument transformer cases test.
   4. Electrical operation and control wiring tests, including polarity and sequence tests.
   5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch (10 mm) between switchboard and wall.

E. Provide required support and attachment components in accordance with Section 26 0529.

F. Install switchboards plumb and level.

G. Unless otherwise indicated, mount switchboards on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with Section 03 3000.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Install all field-installed devices, components, and accessories.

J. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

K. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

L. Set field-adjustable circuit breaker tripping function settings as indicated.

M. Set field-adjustable ground fault protection pickup and time delay settings as directed.

N. Provide filler plates to cover unused spaces in switchboards.

O. Identify switchboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

C. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.

D. Inspect and test in accordance with NETA ATS, except Section 4.

E. Perform inspections and tests listed in NETA ATS, Section 7.1.

F. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

G. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.

H. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

I. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10.

J. Test shunt trips to verify proper operation.

K. Correct deficiencies and replace damaged or defective switchboards or associated components.

L. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

3.07 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding.

B. Section 26 0529 - Hangers and Supports.

C. Section 26 0553 - Identification for Electrical: Identification products and requirements.

D. Section 26 0573 - Overcurrent Coordination Study: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

E. Section 26 2200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.

F. Section 26 4300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA 407 - Standard for Installing and Maintaining Panelboards.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA PB 1 - Panelboards.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

H. NFPA 70 - National Electrical Code.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

K. UL 67 - Panelboards.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

M. UL 869A - Reference Standard for Service Equipment.

N. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. General Electric Company: www.geindustrial.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Substitutions: See Section 01 6000 - Product Requirements.

F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature:

a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

C. Short Circuit Current Rating:
1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
3. Label equipment utilizing series ratings as required by NFPA 70.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
3. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: As indicated on the drawings.
2. Boxes: Galvanized steel unless otherwise indicated.
a. Provide wiring gutters sized to accommodate the conductors to be installed.
3. Fronts:
a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
a. Use zero sequence ground fault detection method unless otherwise indicated.
b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.

L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

M. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs and feeders as indicated or as required to interconnect sections.

N. Load centers are not acceptable.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase and Neutral Bus Material: Aluminum.
   2. Ground Bus Material: Aluminum.

D. Circuit Breakers:
   1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
   2. Provide thermal magnetic circuit breakers unless otherwise indicated.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Aluminum.
   3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

3. Conductor Terminations:
   a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
7. Do not use tandem circuit breakers.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
10. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
    c. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
    d. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.

2.06 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 0529.

E. Install panelboards plumb.

F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

H. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

I. Provide grounding and bonding in accordance with Section 26 0526.
   1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.

J. Install all field-installed branch devices, components, and accessories.

K. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

L. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.

M. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

N. Provide filler plates to cover unused spaces in panelboards.

O. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
1. Emergency and night lighting circuits.
2. Fire detection and alarm circuits.
3. Communications equipment circuits.
4. Intrusion detection and access control system circuits.
5. Video surveillance system circuits.

P. Identify panelboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 225 amperes. Tests listed as optional are not required.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

E. Test GFCI circuit breakers to verify proper operation.

F. Test AFCI circuit breakers to verify proper operation.

G. Test shunt trips to verify proper operation.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 10 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2501
LOW-VOLTAGE BUSWAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Feeder busway.

B. Plug-in busway.

C. Plug-in units for plug-in busway.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete curbs for busway floor penetrations.

B. Section 07 8400 - Firestopping.

C. Section 26 0526 - Grounding and Bonding.

D. Section 26 0529 - Hangers and Supports.

E. Section 26 0553 - Identification for Electrical: Identification products and requirements.

F. Section 26 0573 - Overcurrent Coordination Study: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

G. Section 26 2701 - Electrical Service Entrance.

H. Section 26 2813 - Fuses.

I. Section 26 4300 - Surge Protective Devices: Requirements for surge protective device plug-in units for plug-in busway.

1.03 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA 408 - Standard for Installing and Maintaining Busways.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA BU 1.1 - General Instructions for Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less.

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

G. NFPA 70 - National Electrical Code.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

I. UL 857 - Busways.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the arrangement of busway with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within busway required clearances.
2. Coordinate arrangement of busway with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Where busway extends through roof, coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.

6. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week prior to performing field measurements for busway fabrication drawings; require attendance of all affected installers. Review proposed routing, sequence of installation, and protection requirements for installed busway.

C. Sequencing:
   1. Perform field measurements prior to busway fabrication. Where necessary, perform field measurement for custom lengths after installation of adjacent sections.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for busway system components and accessories. Include dimensions, weight, materials, fabrication details, finishes, and service condition requirements. Indicate voltage and current ratings, short circuit current ratings, configurations, and installed features and accessories.
   1. Include busway resistance, reactance, and impedance data and voltage drop ratings.
   2. Include characteristic trip curves for each type and rating of circuit breaker plug-in device upon request.
   3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   4. Include documentation of listed series ratings upon request.

C. Shop Drawings: Include dimensioned plan views and sections indicating proposed busway routing, required clearances, and locations and details of supports, fittings, building element penetrations, and equipment connections.

D. Where roof penetrations are provided, certify that work does not void roof warranty.

E. Field Quality Control Test Reports.

F. Project Record Documents: Record actual routing of busway.
   1. Include actual installed locations of plug-in units.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store busway in accordance with manufacturer's instructions, NECA 408, and NEMA BU1.1.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor busway, which is not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Busway System:
   1. Eaton Corporation; _____: www.eaton.com.
   2. General Electric Company: www.geindustrial.com.
   3. Schneider Electric; Square D Products: www.schneider-electric.us.
   4. Siemens Industry, Inc: www.usa.siemens.com.

B. Source Limitations: Furnish busway system and associated components and accessories produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 BUSWAY SYSTEM

A. Provide new busway system consisting of all required components, fittings, devices, supports, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Prefabricated sectionalized enclosed bus assemblies and associated fittings and devices; listed and labeled as complying with UL 857.

D. Busway General Requirements:
   1. Busway Type: Totally enclosed, non-ventilated; suitable for installation in any mounting orientation the busway is designed for (e.g horizontal flatwise, horizontal edgewise, vertical) without derating.
   2. Temperature Rise: Not exceeding 55 degrees C, when operating at continuous rated current in an ambient temperature of 104 degrees F (40 degrees C).
   3. Busbars and stabs to be suitably plated at all electrical contact points.
   4. Busbar Insulation: NEMA Class B, rated 266 degrees F (130 degrees C).
   5. Housing: Steel or aluminum, with manufacturer's standard finish unless otherwise indicated.
   6. Single-Bolt Type Joints:
      a. Use torque-indicating bolts with visual indication that proper torque has been applied.
      b. Bolts to be at ground potential to allow adjustment without requiring de-energizing of busway.
      c. Designed such that tightening of joints only requires access to one side of busway.
      d. Allows for length adjustment of plus/minus 0.125 inch (3.2 mm).

E. Service Conditions:
   1. Provide busway system and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than 6,600 feet (2,000 m).
      b. Ambient Temperature:
         1) Busway Lengths and Fittings: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
         2) Circuit Breaker Plug-In Units: Between 32 degrees F (0 degrees C) and 104 degrees F (40 degrees C).
         3) Fusible Switch Plug-In Units: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).

F. Short Circuit Current Rating:
   1. Provide busway system and associated components with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
   3. Label equipment utilizing series ratings as required by NFPA 70.

2.03 FEEDER BUSWAY

A. General Requirements:
   1. Outdoor Feeder Busway: Weatherproof, NEMA 250 Type 3R, with sealed joint covers and drain holes with removable plugs.
   2. Indoor Feeder Busway: Standard (not splash resistant), with IEC 60529 rating of IP 40.

2.04 PLUG-IN BUSWAY

A. General Requirements:
   1. Provide cover at each unused plug-in opening.
   2. Provide means for mechanical support and alignment of plug-in units.
   3. IEC 60529 Protection Rating: Standard (not splash resistant), with rating of IP 40.

B. Plug-In Busway:
   1. Voltage: As indicated on the drawings.
   2. Ampere Rating: As indicated on the drawings.
   3. Configuration: 3 phase, 4-wire (100 percent capacity neutral), with 50 percent capacity integral housing ground.
   4. Busbar Material: Copper.
   5. Plug-In Opening Spacing: 24 inches (610 mm) nominal between openings (openings on two sides).

2.05 PLUG-IN UNITS FOR PLUG-IN BUSWAY

A. Description: Plug-in units suitable for use with installed busway; types, ratings, configurations, and features as indicated on the drawings.

B. General Requirements:
   1. Designed to make positive ground connection prior to phase/neutral connections when installed.
   2. Where splash resistant busway is specified, provide splash resistant plug-in units with minimum IEC 60529 rating of IP 54 unless otherwise indicated.

C. Circuit Breaker Plug-In Units:
   1. Provide safety interlock to prevent opening the cover with the unit in the ON position with capability of overriding interlock for testing purposes.
   2. Provide mechanical interlock for plug-in units up to 250 A to prevent installation or removal with the unit in the ON position.
   3. Conductor Terminations: Suitable for use with the conductors to be installed.
   4. Provide solidly bonded equipment ground bus with suitable lug for terminating equipment grounding conductor.
   5. Molded Case Circuit Breakers:
      a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489.
      b. Interrupting Capacity:
         1) Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
         2) Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
      c. Conductor Terminations:
         1) Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D. Fusible Switch Plug-In Units:
   1. Description: Quick-make, quick-break enclosed switch complying with NEMA KS 1 where applicable.
   2. Provide hook stick operable handle with means for locking in the OFF position.
   3. Provide safety interlock to prevent opening the cover with the unit in the ON position with capability of overriding interlock for testing purposes.

4. Provide mechanical interlock for plug-in units up to 250 A to prevent installation or removal with the unit in the ON position.
5. Horsepower Rating: Suitable for connected load.
6. Minimum Short Circuit Ratings:
    a. Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
7. Provide with switch blade contact position that is visible when the cover is open.
8. Fuse Clips: As required to accept fuses indicated.
    a. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
9. Conductor Terminations: Suitable for use with the conductors to be installed.
10. Provide insulated 100 percent capacity solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
11. Provide solidly bonded equipment ground bus with suitable lug for terminating equipment grounding conductor.
12. Conductor Terminations:
    a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that the ratings of busway system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive busway and associated supports.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Perform insulation resistance testing on individual current-carrying busway system components prior to installation in accordance with NECA 408 and NEMA BU1.1.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install busway in accordance with NECA 1 (general workmanship), NECA 408, and NEMA BU1.1.

C. Unless otherwise indicated, arrange busway to be parallel or perpendicular to building lines.

D. Arrange busway to provide required clearances and maintenance access.

E. Install busway plumb and level, with sections aligned and with horizontal runs at the proper elevation.

F. Unless otherwise indicated, orient horizontal plug-in busway with plug-in openings on sides (edgewise orientation).

G. Maintain proper phase sequence throughout busway system, accounting for phase transitions where applicable.

H. Provide suitable expansion fittings where busway is subject to movement, including but not limited to:
    1. Where busway crosses structural joints intended for expansion.
    2. Long straight busway runs in accordance with manufacturer's instructions.

I. Provide end closures at unconnected ends of busway runs.

J. Busway Support:
    1. Use manufacturer's recommended hangers and supports, located at intervals complying with NFPA 70 and manufacturer's requirements. Provide required support and attachment components in accordance with Section 26 0529, where not furnished by busway manufacturer.

2. Use suitable spring hangers for vertical riser applications where busway penetrates and is supported by building floors.
3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
4. Provide sway bracing as indicated or as required to keep busway runs straight and prevent rotation and movement, accounting for unbalanced weight distribution of plug-in units where applicable.

K. Penetrations:
1. Provide suitable flanges where busway penetrates building elements. Use weatherproof flanges for exterior wall or roof penetrations. Seal roof penetrations as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
2. Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 07 8400.
3. Where busway penetrates floor, provide 4 inch (100 mm) high concrete curb constructed in accordance with Section 03 3000 around openings in accordance with NFPA 70.

L. Outdoor Feeder Busway: Arrange busway to prevent water infiltration through drain holes from rain or snow. Seal joints in accordance with manufacturer's instructions and remove drain hole plugs.

M. Plug-In Units:
1. Install plug-in units on plug-in busway in accordance with manufacturer's instructions. Provide independent supports where recommended by manufacturer.
2. Provide fuses complying with Section 26 2813 for fusible switch plug-in units as indicated or as required by equipment manufacturer's recommendations.
3. Set field-adjustable tripping function settings for circuit breaker plug-in units as indicated.
4. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 0573.
5. Unless otherwise indicated, final connections from plug-in units to loads to be provided by Contractor.

N. Provide grounding and bonding in accordance with Section 26 0526.
1. Where integral housing ground is utilized, verify joint covers and other components required for continuity are properly installed.

O. Identify busway in accordance with Section 26 0553.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Electrically isolate busway system before energizing and perform insulation resistance testing in accordance with NECA 408 and NEMA BU1.1.
1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

C. Correct deficiencies and replace damaged or defective busway system components.

D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust supports as required to minimize strain on busway and associated components.

3.06 CLEANING

A. Clean dirt and debris from busway enclosure and components in accordance with manufacturer's instructions. Do not use compressed air or a blower in order to prevent debris infiltration.

B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

3.08 PROTECTION

A. Protect busway system from subsequent construction operations.

END OF SECTION

SECTION 26 2717
EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Power Conductors and Cables.

B. Section 26 0534 - Conduit.

C. Section 26 0537 - Boxes.

D. Section 26 2726 - Wiring Devices.

E. Section 26 2818 - Enclosed Switches.

F. Section 26 2913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices.

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

C. NFPA 70 - National Electrical Code.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SJO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 26 2818 and in individual equipment sections.

C. Wiring Devices: As specified in Section 26 2726.

D. Flexible Conduit: As specified in Section 26 0534.

E. Wire and Cable: As specified in Section 26 0519.

F. Boxes: As specified in Section 26 0537.

2.02 EQUIPMENT CONNECTIONS

A. See electrical drawings for equipment connections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Receptacles.

D. Wall plates.

E. Floor box service fittings.

1.02 RELATED REQUIREMENTS

A. Section 26 0537 - Boxes.

B. Section 26 0553 - Identification for Electrical: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification.

B. FS W-S-896 - Switches, Flush-mounted (General Specification); Federal Specification.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

E. NEMA WD 1 - General Color Requirements for Wiring Devices.

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

G. NFPA 70 - National Electrical Code.

H. UL 498 - Attachment Plugs and Receptacles.

I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.

J. UL 943 - Ground-Fault Circuit-Interrupters.

K. UL 1310 - Class 2 Power Units.

L. UL 1472 - Solid-State Dimming Controls.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1. Wall Dimmers: Include derating information for ganged multiple devices.
2. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR) for each protection mode, and diagnostics information.

C. Certificates for Surge Protection Receptacles: Manufacturer's documentation of listing for compliance with UL 1449.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data:
1. Wall Dimmers: Include information on operation and setting of presets.
2. GFCI Receptacles: Include information on status indicators.
3. Surge Protection Receptacles: Include information on status indicators.

G. Project Record Documents: Record actual installed locations of wiring devices.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hubbell Incorporated: www.hubbell-wiring.com.

B. Leviton Manufacturing Company, Inc: www.leviton.com.

C. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

D. Source Limitations: Where possible, provide products for each type of wiring device produced by a single manufacturer and obtained from a single supplier.

2.02 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.

E. Provide GFCI protection for receptacles installed in kitchens.

F. Provide GFCI protection for receptacles serving electric drinking fountains.

G. Provide isolated ground receptacles for receptacles serving computers and electronic cash registers.

H. Provide isolated ground or isolated ground surge protection receptacles as indicated on the drawings.

I. Do not use combination switch/receptacle devices.

J. For flush floor service fittings, use tile rings for installations in tile floors.

K. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.03 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.

C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.

D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.

E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.

F. Isolated Ground Convenience Receptacles: Orange.

G. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

H. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.

2.04 WALL SWITCHES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell-wiring.com.
   2. Leviton Manufacturing Company, Inc: www.leviton.com.
   3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

B. All Wall Switches: Decora type, AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.

C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard paddle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

D. Lighted Wall Switches: Industrial specification grade, 20 A, 120/277 V with illuminated standard decora type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

E. Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with red illuminated standard decora type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

F. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.05 WALL DIMMERS

A. Manufacturers:
   1. Leviton Manufacturing Company, Inc: www.leviton.com.
   2. Lutron Electronics Company, Inc: www.lutron.com.
   3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

C. Electronic Low-Voltage Wall Dimmers: 120 V AC, decorator rocker control type with preset slide adjustment; single pole or three way as indicated on the drawings.
   1. Power Rating: 400 VA unless otherwise indicated or required to control the load indicated on the drawings.
   2. Provide locator light, illuminated with load off.

D. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

2.06 RECEPTACLES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell-wiring.com.
   2. Leviton Manufacturing Company, Inc: www.leviton.com.
   3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

B. Receptacles - General Requirements: Decora type, Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:
   1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
   2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
   3. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

D. GFCI Receptacles:
   1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
      a. Provide test and reset buttons of same color as device.
   2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
   3. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

E. USB Charging Devices:
   1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
      a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.
      b. Charging Capacity - Four-Port Devices: 4.2 A, minimum.
   2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.

2.07 WALL PLATES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell-wiring.com.
   2. Leviton Manufacturing Company, Inc: www.leviton.com.
   3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

B. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard.
   3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Brass Wall Plates: Brushed satin finish, factory-coated to inhibit oxidation.

F. Aluminum Wall Plates: Smooth satin finish, clear anodized, factory-coated to inhibit oxidation.

G. Chrome Wall Plates: Smooth finish, chrome plated steel.

H. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

I. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.

J. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

K. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.08 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell-wiring.com.
   2. Thomas & Betts Corporation: www.tnb.com.
   3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us

B. Description: Service fittings compatible with floor boxes provided under Section 26 0537 with components, adapters, and trims required for complete installation.

C. Flush Floor Service Fittings:
   1. Single Service Flush Convenience Receptacles:
      a. Cover: As indicated on the drawings.
      b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
   2. Single Service Flush Communications Outlets:
      a. Cover: As indicated on the drawings.
      b. Configuration: As indicated on the drawings.
      c. Voice and Data Jacks: Provided by others.
   3. Single Service Flush Furniture Feed:
      a. Cover: As indicated on the drawings.
      b. Configuration: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
   4. Dual Service Flush Combination Outlets:
      a. Cover: As indicated on the drawings.
      b. Configuration:
         1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
         2) Communications: As indicated on the drawings.
         3) Voice and Data Jacks: Provided by others.
   5. Dual Service Flush Furniture Feed:
      a. Cover: As indicated on the drawings.
      b. Configuration:
         1) Power: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
         2) Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).
   6. Accessories:
      a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
      b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that core drilled holes for poke-through assemblies are in proper locations.

H. Verify that openings in access floor are in proper locations.

I. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of wiring devices provided under this section.
   1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   3. Locate wall switches as indicated on the drawings with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
   4. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

J. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.

K. Install wiring devices plumb and level with mounting yoke held rigidly in place.

L. Install wall switches with OFF position down.

M. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

N. Do not share neutral conductor on branch circuits utilizing wall dimmers.

O. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.

P. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

Q. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

R. Identify wiring devices in accordance with Section 26 0553.

S. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.04 FIELD QUALITY CONTROL

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch and wall dimmer with circuit energized to verify proper operation.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Inspect each surge protection receptacle to verify surge protection is active.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical: Identification products and requirements.

B. Section 26 2818 - Enclosed Switches: Fusible switches.

C. Section 26 2913 - Enclosed Controllers: Fusible switches.

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses.

B. NFPA 70 - National Electrical Code.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses.

E. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses.

F. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
      a. Fusible Enclosed Switches: See Section 26 2818.
      b. Fusible Switches for Enclosed Motor Controllers: See Section 26 2913.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Fuses: Three set(s) of three for each type and size installed.
   3. Fuse Pullers: One set(s) compatible with each type and size installed.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience and with service facilities within 100 miles (160 km) of Project.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.

B. Littelfuse, Inc: www.littelfuse.com.

C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 APPLICATIONS

A. General Purpose Branch Circuits: Class RK1, time-delay.

B. Individual Motor Branch Circuits: Class RK5, time-delay.

C. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.

D. Primary Protection for Control Transformers: Class CC, time-delay.

2.03 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.
   1. Class RK1, Time-Delay Fuses:
   2. Class RK5, Time-Delay Fuses:

H. Class CC Fuses: Comply with UL 248-4.
   1. Class CC, Time-Delay Fuses:

I. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

J. Provide the following accessories where indicated or where required to complete installation:
   1. Fuseholders: Compatible with indicated fuses.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 2817
ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding.

B. Section 26 0529 - Hangers and Supports.

C. Section 26 0553 - Identification for Electrical: Identification products and requirements.

D. Section 26 0573 - Overcurrent Coordination Study: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

E. NFPA 70 - National Electrical Code.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. General Electric Company: www.geindustrial.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ENCLOSED CIRCUIT BREAKERS

A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

D. Short Circuit Current Rating:
   1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.
   2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
   3. Label equipment utilizing series ratings as required by NFPA 70.

E. Conductor Terminations: Suitable for use with the conductors to be installed.

F. Provide thermal magnetic circuit breakers unless otherwise indicated.

G. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: As indicated on the drawings.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
   3. Provide surface-mounted enclosures unless otherwise indicated.

I. Provide externally operable handle with means for locking in the OFF position.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

B. Interrupting Capacity:
   1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
   2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

3. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

C. Conductor Terminations:
   1. Provide mechanical lugs unless otherwise indicated.
   2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

E. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

F. Provide the following features and accessories where indicated or where required to complete installation:
   1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
   2. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
   3. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.

B. Install enclosed circuit breakers securely, in a neat and workmanlike manner in accordance with NECA 1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 0529.

E. Install enclosed circuit breakers plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

I. Identify enclosed circuit breakers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than 225 amperes. Tests listed as optional are not required.

D. Test shunt trips to verify proper operation.

E. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2818
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

B. Fusible switches.

C. Nonfusible switches.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding.

B. Section 26 0529 - Hangers and Supports.

C. Section 26 0553 - Identification for Electrical: Identification products and requirements.

D. Section 26 2813 - Fuses.

E. Section 26 2913 - Enclosed Controllers: Manual motor controllers.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association.

D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

F. NFPA 70 - National Electrical Code.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

I. UL 98 - Enclosed and Dead-Front Switches.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Project Record Documents: Record actual locations of enclosed switches.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. General Electric Company: www.geindustrial.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Substitutions: See Section 01 6000 - Product Requirements.

F. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Horsepower Rating: Suitable for connected load.

D. Voltage Rating: Suitable for circuit voltage.

E. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Minimum Ratings:
      a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

F. Provide with switch blade contact position that is visible when the cover is open.

G. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
   1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

M. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.
      b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

2.03 COMPONENTS

A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.
   3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install enclosed switches in accordance with manufacturer's instructions.

B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Provide identification nameplate for each enclosed switch in accordance with Section 26 0553.

J. Provide arc flash warning labels in accordance with NFPA 70.

K. Install fuses in fusible disconnect switches.

L. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2913
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed NEMA motor controllers for low-voltage (600 V and less) applications:
   1. Magnetic motor starters.
   2. Manual motor starters.
   3. Motor-starting switches without overload protection.

B. Overcurrent protective devices for motor controllers, including overload relays.

C. Motor control accessories:
   1. Auxiliary contacts.
   2. Pilot devices.
   3. Control and timing relays.
   4. Control power transformers.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding.

B. Section 26 0553 - Identification for Electrical: Identification products and requirements.

C. Section 26 2813 - Fuses: Fuses for fusible switches.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

D. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.

E. NEMA ICS 6 - Industrial Control and Systems: Enclosures.

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

H. NFPA 70 - National Electrical Code.

I. UL 98 - Enclosed and Dead-Front Switches.

J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

K. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules.

L. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contractors and Motor-starters - Electromechanical Contractors and Motor-starters.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
   3. Coordinate the work to provide motor controllers and associated wiring suitable for interface with control devices to be installed.
   4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
6. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. General Electric Company: www.geindustrial.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Square D: www.squared.com.

E. Siemens: www.siemens.com.

2.02 ENCLOSED MOTOR CONTROLLERS

A. Provide enclosed motor controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed motor controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:
1. Provide motor controllers and associated components suitable for operation under the following service conditions without derating:
    a. Altitude:
        1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet (1,000 m).
        2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet (2,000 m).
    b. Ambient Temperature: Between 32 degrees F (0 degrees C) and 104 degrees F (40 degrees C).

2. Provide motor controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:
   1. Provide motor controllers with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

F. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures:
   1. Comply with NEMA ICS 6.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.
      b. Outdoor Locations: Type 3R or Type 4.
   3. Finish: Manufacturer's standard unless otherwise indicated.

I. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

J. Magnetic Motor Starters: Combination type unless otherwise indicated.
   1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
   2. Configuration: Full-voltage non-reversing unless otherwise inidcated.
   3. Minimum Starter Size: NEMA Size 0.
   4. Use of non-standard starter sizes smaller than specified standard NEMA sizes is not permitted.
   5. Disconnects: Circuit breaker type.
      a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
      b. Disconnect Switches: Fusible type unless otherwise indicated.
      c. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
      d. Provide auxiliary interlock for disconnection of external control power sources where applicable.
   6. Overload Relays: Bimetallic thermal type unless otherwise indicated.

K. Manual Motor Starters:
   1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).
   2. Configuration: Non-reversing unless otherwise inidcated.
   3. Fractional-Horsepower Manual Motor Starters:
      a. Furnish with toggle operator.
      b. Overload Relays: Bimetallic or melting alloy thermal type.
      c. Provide means for locking operator in the OFF position.
      d. Furnish Red ON indicating light where not within sight of equipment.
   4. Integral-Horsepower Manual Motor Starters:
      a. Furnish with toggle or pushbutton operator.
      b. Overload Relays: Bimetallic or melting alloy thermal type.
      c. Provide means for locking operator in the OFF position.
      d. Furnish Red ON indicating light where not within sight of equipment.

e. Provide auxiliary contact where indicated; normally open (NO) or normally closed (NC) as indicated or as required.

L. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
3. Trip-free operation.
4. Visible trip indication.
5. Resettable.
a. Employ manual reset unless otherwise indicated.
b. Do not employ automatic reset with two-wire control.
6. Bimetallic Thermal Overload Relays:
a. Interchangeable current elements/heaters.
b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
c. Trip test function.
7. Melting Alloy Thermal Overload Relays:
a. Interchangeable current elements/heaters.

B. Fusible Disconnect Switches:
1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
2. Fuse Clips: As required to accept indicated fuses.
a. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

2.04 MOTOR CONTROL ACCESSORIES

A. Auxiliary Contacts:
1. Comply with NEMA ICS 5.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.

B. Pilot Devices:
1. Comply with NEMA ICS 5; heavy-duty type.
2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
4. Indicating Lights: Push-to-test type unless otherwise indicated.
5. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:
1. Comply with NEMA ICS 5.
2. Provide number and type of relays indicated or required to perform necessary functions.

D. Control Power Transformers:

1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus _____ VA spare capacity.
2. Include primary and secondary fuses.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that ratings of enclosed motor controllers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed motor controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install motor controllers in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment components in accordance with Section 26 0529.

E. Install enclosed motor controllers plumb and level.

F. Provide grounding and bonding in accordance with Section 26 0526.

G. Install all field-installed devices, components, and accessories.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

K. Identify enclosed motor controllers in accordance with Section 26 0553.

L. Provide engraved plastic nameplates; refer to Section 26 0553 for product requirements and location.

M. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.

D. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

E. Correct deficiencies and replace damaged or defective enclosed motor controllers or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from motor controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of motor controllers to Owner, and correct deficiencies or make adjustments as directed.

3.07 PROTECTION

A. Protect installed enclosed motor controllers from subsequent construction operations.

END OF SECTION

SECTION 26 3600
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
   1. Automatic transfer switches.
   2. Remote annunciators.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 14 2100 - Electric Traction Elevators: For interface with transfer switch.

C. Section 14 2400 - Hydraulic Elevators: For interface with transfer switch.

D. Section 26 0526 - Grounding and Bonding.

E. Section 26 0529 - Hangers and Supports.

F. Section 26 0553 - Identification for Electrical: Identification products and requirements.

G. Section 26 0573 - Overcurrent Coordination Study: Additional criteria for the selection of equipment specified in this section.

H. Section 26 3213 - Engine Generators: For interface with transfer switches.
   1. Includes related demonstration and training requirements.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

E. NFPA 70 - National Electrical Code.

F. NFPA 110 - Standard for Emergency and Standby Power Systems.

G. UL 869A - Reference Standard for Service Equipment.

H. UL 1008 - Transfer Switch Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
      a. Engine Generators: See Section 26 3213.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

D. Source quality control test reports.

E. Manufacturer’s detailed field testing procedures.

F. Maintenance contracts.

G. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

1.06 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70 (National Electrical Code).
   2. NFPA 110 (Standard for Emergency and Standby Power Systems); _____.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   1. Authorized service facilities located within 100 miles of project site.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Transfer Switches:
   1. ASCO Power Technologies, a brand of Emerson Network Power; _____: www.emersonnetworkpower.com.
   2. Eaton Corporation: www.eaton.com.
   3. General Electric Company: www.geindustrial.com.
   4. Same as manufacturer of engine generator(s) used for this project.

B. Generac Power Systems: www.generac.com

C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Applications:
   1. Utilize open transition transfer unless otherwise indicated or required.
   2. Neutral Switching (Single Phase, Three Wire and Three Phase, Four Wire Systems):
      a. Unless otherwise indicated or required, provide neutral switching:
         1) For systems with ground fault protection.
         2) Where the alternate/emergency source is a separately derived system.
   3. Provide signal before transfer contacts for transfer switches serving elevators.

D. Automatic Transfer Switch:
   1. Transfer Switch Type: As indicated on the drawings.
   2. Transition Configuration: As indicated on the drawings.
   3. Voltage: As indicated on the drawings.
   4. Ampere Rating: As indicated on the drawings.
   5. Neutral Configuration: As indicated on the drawings.
   6. Load Served: As indicated on the drawings.
   7. Primary Source: As indicated on the drawings.
   8. Alternate Source: As indicated on the drawings.

E. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

F. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

G. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

H. Switching Methods:
   1. Open Transition:
      a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
      b. Where in-phase transfer is indicated, utilize in-phase monitor to initiate transfer when phase angle difference between sources is near zero to limit in-rush currents.
   2. Neutral Switching: Either simultaneously switched neutral (break-before-make) or overlapping neutral (make-before-break) methods are acceptable.
   3. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

I. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

J. Enclosures:
   1. Environment Type per NEMA 250: As indicated on the drawings.
   2. Finish: Manufacturer's standard unless otherwise indicated.

K. Short Circuit Current Rating:
   1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.

L. Automatic Transfer Switches:

1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
2. Control Functions:
    a. Automatic mode.
    b. Test Mode: Simulates failure of primary/normal source.
    c. Voltage and Frequency Sensing:
        1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
        2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
        3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
    d. Outputs:
        1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
        2) Auxiliary contacts; one set(s) for each switch position.
    e. Adjustable Time Delays:
        1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
        2) Transfer to alternate/emergency source time delay.
        3) Retransfer to primary/normal source time delay.
        4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
    f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.
    g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
3. Status Indications:
    a. Connected to alternate/emergency source.
    b. Connected to primary/normal source.
    c. Alternate/emergency source available.
    d. Primary/normal source available.
4. Automatic Sequence of Operations:
    a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
    b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
    c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
    d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

M. Remote Annunciators:
1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
2. Transfer Switch Status Indications:
    a. Connected to alternate/emergency source.
    b. Connected to primary/normal source.
    c. Alternate/emergency source available.

N. Interface with Other Work:
1. Interface with engine generators as specified in Section 26 3213.

2. Interface with elevators as specified in Section 14 2100 and 14 2400.
    a. Utilize signal before transfer contacts to disconnect elevator(s) served prior to transfer.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive transfer switches.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install transfer switches in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install transfer switches plumb and level.

F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 3000.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Prepare and start system in accordance with manufacturer's instructions.

D. Automatic Transfer Switches:
    1. Inspect and test in accordance with NETA ATS, except Section 4.
    2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The control wiring insulation-resistance tests listed as optional are not required.
        a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

E. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Training: Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.

D. Coordinate with related generator demonstration and training as specified in Section 26 3213.

3.06 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

3.07 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Conduct site visit at least once every three months (during warranty period) to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.

C. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION

SECTION 26 4113

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Strike (air) terminals and interconnecting conductors.

B. Grounding and bonding for lightning protection.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding: Electrical system grounds.

B. Surge Protection for Wiring Systems: Specified in individual system requirements.

1.03 REFERENCE STANDARDS

A. NFPA 780 - Standard for the Installation of Lightning Protection Systems.

B. UL 96 - Lightning Protection Components.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination with Concrete Work: Coordinate the embedding of lightning protection components in concrete.

B. Coordination with Roofing Work: Ensure adequate attachment of strike terminals and conductors without damage to roofing.

C. Preinstallation Meeting: Convene a meeting at least at least two weeks prior to commencement of any work affected by lightning protection system requirements to discuss prerequisites and coordination required by other installers; require attendance by representatives of installers whose work will be affected.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.

1. Where conductors or grounds are to be embedded or concealed in other construction, submit shop drawings at least 30 days prior to start of construction.
2. If concrete-encased grounds are to be used and are not shown in the contract documents, provide sufficient data to determine concrete encasement dimensions and location.
3. Include engineering analysis of equalization of potential to metal bodies within the structure.

C. Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.

D. Installation Certification: Submit copy of certification agency's approval.

E. Operation and Maintenance Data: Provide recommended inspection and testing plan, including recommended intervals, to achieve periodic maintenance as recommended in NFPA 780; provide customized plan reflecting actual installation configuration with specific installed components identified.

F. Project Record Documents: Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.06 QUALITY ASSURANCE

A. Maintain one copy of each referenced system design standard on site.

B. Manufacturer Qualifications: Company specializing in lightning protection equipment with minimum three years documented experience.

C. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with minimum three years documented experience.

D. Installer Qualifications: Company specializing in lightning protection system design with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lightning Protection Components:
   1. Harger Lightning and Grounding: www.harger.com.
   2. National Lightning Protection Corporation: www.theprotectionsource.com.
   3. Robbins Lightning, Inc: www.robbinslightning.com.
   4. Thompson Lightning Protection, Inc.: www.tlpinc.com.
   5. A-C Lightning Security of Chicago, Inc.: www.acloc.com.
   6. Independent Protection Company, Inc.: www.ipclp.com.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LIGHTNING PROTECTION SYSTEM

A. Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.
   1. Provide system that protects:
      a. The entire structure.
      b. Open air areas within 100 feet (30 meters) of exterior walls at grade level.
      c. Open air areas within building footprint.
   2. Coordinate with other grounding and bonding systems specified.
   3. Provide copper, bronze, or stainless steel components, as applicable; no aluminum.

2.03 COMPONENTS

A. All Components: Complying with applicable requirements of UL 96.

B. Strike (Air) Terminals: Copper, solid, with adhesive bases for single-ply roof installations.

C. Grounding Rods: Solid copper.

D. Ground Plate: Copper.

E. Conductors: Copper cable.

F. Connectors and Splicers: Bronze.

END OF SECTION

SECTION 26 4300
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for service entrance locations.

B. Surge protective devices for distribution locations.

C. Surge protective devices for branch panelboard locations.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding.

B. Section 26 2413 - Switchboards.

C. Section 26 2416 - Panelboards.

D. Section 26 2419 - Motor-Control Centers.

E. Section 26 2501 - Low-Voltage Busways.

1.03 ABBREVIATIONS AND ACRONYMS

A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.

B. SPD: Surge Protective Device.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

D. NFPA 70 - National Electrical Code.

E. UL 1449 - Standard for Surge Protective Devices.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
   1. UL 1449.

E. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

G. Project Record Documents: Record actual connections and locations of surge protective devices.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Protected Modes:
   1. Wye Systems: L-N, L-G, N-G, L-L.

C. UL 1449 Voltage Protection Ratings (VPRs):
   1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
   2. 240/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
   3. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.
   4. 480V Delta System Voltage: Not more than 1,800 V for L-G mode and 3,000 V for L-L mode.

D. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

E. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   1. Indoor clean, dry locations: Type 1.
   2. Outdoor locations: Type 3R.

F. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
   1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
   2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.

G. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

2.02 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

C. Provide SPDs utilizing only field-replaceable modular protection circuits.

D. Surge Current Rating: Not less than 160 kA per mode/320 kA per phase.

E. Repetitive Surge Current Capacity: Not less than 5,000 impulses.

F. UL 1449 Nominal Discharge Current (I-n): 20 kA.

G. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

H. Diagnostics:
   1. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
   2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
   3. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

I. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.03 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 or Type 2.

C. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.

D. Provide SPDs utilizing only field-replaceable modular protection circuits.

E. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.

F. Repetitive Surge Current Capacity: Not less than 3,500 impulses.

G. UL 1449 Nominal Discharge Current (I-n): 20 kA.

H. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

I. Diagnostics:
   1. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
   2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
   3. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

2.04 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 or Type 2.

C. Provide SPDs utilizing only field-replaceable modular protection circuits.

D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.

E. UL 1449 Nominal Discharge Current (I-n): 20 kA.

F. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

G. Diagnostics:
   1. Protection Status Monitoring: Provide indicator lights to report the protection status.
   2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
   3. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of the drawings and manufacturer's instructions.

D. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install SPD in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.

F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 5100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

E. Fluorescent emergency power supply units.

F. Lamps.

G. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 0537 - Boxes.

B. Section 26 0553 - Identification for Electrical: Identification products and requirements.

C. Section 26 5600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices.

B. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements.

C. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

D. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information.

E. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society.

F. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction.

H. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems.

I. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

J. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.

K. NFPA 70 - National Electrical Code.

L. NFPA 101 - Life Safety Code.

M. UL 924 - Emergency Lighting and Power Equipment.

N. UL 935 - Fluorescent-Lamp Ballasts.

O. UL 1598 - Luminaires.

P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.

F2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
1. LED Luminaires:
a. Include estimated useful life, calculated based on IES LM-80 test data.
2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format for proposed substitutions.
3. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
4. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
5. Fluorescent Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.

D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.

E. Field Quality Control Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.

I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

C. Provide five year manufacturer warranty for all linear fluorescent ballasts.

D. Provide five year pro-rata warranty for batteries for emergency lighting units.

E. Provide ten year pro-rata warranty for batteries for self-powered exit signs.

F. Provide five year pro-rata warranty for fluorescent emergency power supply units.

PART 2 PRODUCTS

2.01 MANUFACTURERS - LUMINAIRES

A. See Light Fixture Schedule on drawings for manufacturers.

B. Substitutions: See Section 01 6000 - Product Requirements, except where individual luminaire types are designated with substitutions not permitted.

2.02 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: See Section 01 6000 - Product Requirements, except where individual luminaire types are designated with substitutions not permitted.

2.03 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Provide products complying with Federal Energy Management Program (FEMP) requirements.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

H. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
   3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

I. Fluorescent Luminaires:
   1. Provide ballast disconnecting means complying with NFPA 70 where required.
   2. Fluorescent Luminaires Controlled by Occupancy Sensors: Provide programmed start ballasts.
   3. Fluorescent Luminaires Controlled by Dual-Level Switching: Provide with stepped-dimming ballast.

J. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

K. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.

L. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.04 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:
1. Sealed maintenance-free nickel cadmium unless otherwise indicated.
2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status.

G. Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.

H. Accessories:
1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
3. Provide compatible accessory wire guards where indicated.
4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.05 EXIT SIGNS

A. Description: Exit signs and similar signs for special purpose applications such as area of refuge/rescue assistance.

B. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
1. Number of Faces: Single or double as indicated or as required for the installed location.
2. Directional Arrows: As indicated or as required for the installed location.

C. Self-Powered Exit Signs:
1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

4. Provide low-voltage disconnect to prevent battery damage from deep discharge.
5. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status.

D. Accessories:
1. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
2. Provide compatible accessory wire guards where indicated.

2.06 BALLASTS AND DRIVERS

A. Manufacturers:
1. General Electric Company/GE Lighting: www.gelighting.com.
2. Osram Sylvania: www.sylvania.com.
3. Philips Lighting Electronics/Advance: www.advance.philips.com.
4. Substitutions: See Section 01 6000 - Product Requirements.
5. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B. Ballasts - General Requirements:
1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

C. Fluorescent Ballasts:
1. All Fluorescent Ballasts: Unless otherwise indicated, provide high frequency electronic ballasts complying with ANSI C82.11 and listed and labeled as complying with UL 935.
   a. Inrush Current: Not exceeding peak currents specified in NEMA 410.
   b. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
   c. Total Harmonic Distortion: Not greater than 10 percent.
   d. Power Factor: Not less than 0.95.
   e. Ballast Factor: Normal ballast factor between 0.85 and 1.15, unless otherwise indicated.
   f. Thermal Protection: Listed and labeled as UL Class P, with automatic reset for integral thermal protectors.
   g. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
   h. Lamp Compatibility: Specifically designed for use with the specified lamp, with no visible flicker.
   i. Lamp Operating Frequency: Greater than 20 kHz.
      1) Do not operate lamp(s) within the frequencies from 30 kHz through 40 kHz in order to avoid interference with infrared devices.
   j. Lamp Current Crest Factor: Not greater than 1.7.
   k. Lamp Wiring Method:
      1) Instant Start Ballasts: Parallel wired.
      2) Rapid Start Ballasts: Series wired.
      3) Programmed Start Ballasts: Provide parallel or series/parallel wired where available; otherwise series wired is acceptable.
   l. Provide automatic restart capability to restart replaced lamp(s) without requiring resetting of power.
   m. Provide end of lamp life automatic shut down circuitry for T5 and smaller diameter lamp ballasts.
   n. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
   o. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class A, non-consumer application.

p. Provide high efficiency T8 lamp ballasts certified as NEMA premium where indicated.
q. Provide lamp striation reduction circuitry.
r. Ballast Marking: Include wiring diagrams with lamp connections.

2. Non-Dimming Fluorescent Ballasts:
   a. Lamp Starting Method:
      1) T8 Lamp Ballasts: Rapid start unless otherwise indicated.
      2) T5 Lamp Ballasts: Programmed start unless otherwise indicated.
      3) Compact Fluorescent Lamp Ballasts: Programmed start unless otherwise indicated.
   b. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of 0 degrees F (-18 degrees C), and energy saving lamp(s) at a minimum of 60 degrees F (16 degrees C) unless otherwise indicated.
3. Dimming Fluorescent Ballasts:
   a. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker and with even tracking across multiple lamps.
   b. Control Compatibility: Fully compatible with the dimming controls to be installed.
   c. Lamp Starting Method: Programmed start unless otherwise indicated.
   d. Lamp Starting Temperature: Capable of starting lamp(s) at a minimum of 50 degrees F (10 degrees C).
   e. Dimmed Lamp Starting: Capable of starting lamp(s) at any dimmed preset without transitioning first to full light output.
4. Bi-Level Stepped Dimming Linear Fluorescent Ballasts:
   a. Bi-Level Operation: Capable of being switched between full light output on all lamps, 50 percent of full light output on all lamps, and all lamps off.
   b. Control Compatibility: Capable of being controlled by standard manual light switches or occupancy sensors unless otherwise indicated.
   c. Lamp Starting Method: Programmed start unless otherwise indicated.
   d. Lamp Starting Temperature: Capable of starting lamp(s) at a minimum of 50 degrees F (10 degrees C).

D. Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.07 FLUORESCENT EMERGENCY POWER SUPPLY UNITS

A. Manufacturers:
1. Iota Engineering, LLC: www.iotaengineering.com.
2. Lithonia Lighting: www.lithonia.com.
3. Philips Emergency Lighting/Bodine: www.bodine.com.
4. Substitutions: See Section 01 6000 - Product Requirements.
5. Manufacturer Limitations: Where possible, for each type of luminaire provide fluorescent emergency power supply units produced by a single manufacturer.
6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B. Description: Self-contained fluorescent emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

C. Compatibility:
1. Ballasts: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.
2. Lamps: Compatible with low-mercury lamps.

D. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the fluorescent emergency power supply for minimum of 90 minutes of

rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

E. Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated.

F. Emergency Illumination Output:
   1. Luminaires with F32T8 Lamps: Operate one lamp(s) at a minimum of 1350 lumens unless otherwise indicated.
   2. Luminaires with F28T5 Lamps: Operate one lamp(s) at a minimum of 1325 lumens unless otherwise indicated.
   3. Luminaires with F54T5HO Lamps: Operate one lamp(s) at a minimum of 2650 lumens unless otherwise indicated.

G. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.

H. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status and field selectable audible alert.

I. Operating Temperature: From 32 degrees F (0 degrees C) to 122 degrees F (50 degrees C) unless otherwise indicated or required for the installed location.

J. Accessories:
   1. Provide compatible accessory remote combination test switch/indicator light where indicated.

2.08 LAMPS

A. Manufacturers:
   1. General Electric Company/GE Lighting: www.gelighting.com.
   2. Osram Sylvania: www.sylvania.com.
   3. Philips Lighting Company: www.lighting.philips.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.
   5. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
   6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B. Lamps - General Requirements:
   1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
   2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
   3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
   4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

C. Incandescent Lamps: Wattage and bulb type as indicated, with base type as required for lighting fixture; 130 V rated.
   1. Reflector Type Incandescent Lamps: Beam pattern as indicated.
   2. Non-Reflector Type Incandescent Lamps: Inside frosted lamp finish unless otherwise indicated.

D. Compact Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
   1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
   2. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.

3. Color Rendering Index (CRI): Not less than 80.
4. Average Rated Life: Not less than 10,000 hours for an operating cycle of three hours per start.

E. Linear Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
2. T8 Linear Fluorescent Lamps:
a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
b. Color Rendering Index (CRI): Not less than 80.
c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
3. T5 Linear Fluorescent Lamps:
a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
b. Color Rendering Index (CRI): Not less than 80.
c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.

2.09 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, size as indicated, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

D. Tube Guards for Linear Fluorescent Lamps: Provide clear virgin polycarbonate sleeves with endcaps where indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA 500 (commercial lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Suspended Ceiling Mounted Luminaires:
1. Do not use ceiling tiles to bear weight of luminaires.

2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
4. Secure pendant-mounted luminaires to building structure.
5. Secure lay-in luminaires to ceiling support channels using listed safety clips at two corners.
6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

F. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

G. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet (1.2 m) between supports.
4. Install canopies tight to mounting surface.
5. Unless otherwise indicated, support pendants from swivel hangers.

H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to bottom of luminaire.

I. Install accessories furnished with each luminaire.

J. Bond products and metal accessories to branch circuit equipment grounding conductor.

K. Fluorescent Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding lamps in each luminaire.

L. Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units.

M. Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units.

N. Fluorescent Emergency Power Supply Units:
1. For field-installed units, install inside luminaire unless otherwise indicated. Where installation inside luminaire is not possible, install in remote location not exceeding manufacturer's recommended maximum conductor length to luminaire.
2. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.
3. Install lock-on device on branch circuit breaker serving units.

O. Remote Ballasts: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

P. Install lamps in each luminaire.

Q. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test emergency lighting units and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting) and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, replace all lamps that have failed .

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 26 5600
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Ballasts.

C. Lamps.

D. Poles and accessories.

E. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.

B. Section 26 0526 - Grounding and Bonding.

C. Section 26 0537 - Boxes.

D. Section 26 2726 - Wiring Devices: Receptacles for installation in poles.

E. Section 26 2813 - Fuses.

F. Section 26 5100 - Interior Lighting.

1.03 UNIT PRICES

A. See Section 01 2200 - Unit Prices, for additional unit price requirements.

B. Exterior Lighting Unit:
   1. Basis of Measurement: Each.
   2. Basis of Payment: Includes concrete foundation, pole, and luminaire(s) with lamps and accessories.

1.04 REFERENCE STANDARDS

A. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements.

B. IEEE C2 - National Electrical Safety Code.

C. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

D. IESNA LM-5 - Photometric Measurements of Area and Sports Lighting Installations.

E. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information.

F. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society.

G. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction.

I. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems.

J. NFPA 70 - National Electrical Code.

K. UL 935 - Fluorescent-Lamp Ballasts.

L. UL 1598 - Luminaires.

M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution.
3. Provide structural calculations for each pole proposed for substitution.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
1. LED Luminaires:
a. Include estimated useful life, calculated based on IES LM-80 test data.
2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format for proposed substitutions.
3. Lamps: Include rated life and initial and mean lumen output.
4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.

E. Field Quality Control Reports.
1. Include test report indicating measured illumination levels.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Lamps: Five percent of total quantity installed for each type, but not less than one of each type.
3. Touch-Up Paint: 2 gallons (8 liters), to match color of pole finish.

I. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers shall be as indicated on drawings.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.03 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Provide products complying with Federal Energy Management Program (FEMP) requirements.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

H. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

I. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.04 BALLASTS

A. All Ballasts:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Fluorescent Ballasts: Unless otherwise indicated, provide high frequency electronic ballasts complying with ANSI C82.11 and listed and labeled as complying with UL 935.
   1. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
   2. Total Harmonic Distortion: Not greater than 20 percent.
   3. Power Factor: Not less than 0.95.
   4. Ballast Factor: Normal ballast factor between 0.85 and 1.15, unless otherwise indicated.
   5. Thermal Protection: Listed and labeled as UL Class P, with automatic reset for integral thermal protectors.
   6. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
   7. Lamp Compatibility: Specifically designed for use with the specified lamp, with no visible flicker.
   8. Lamp Operating Frequency: Greater than 20 kHz.
      a. Do not operate lamp(s) within the frequencies from 30 kHz through 40 kHz in order to avoid interference with infrared devices.

9. Lamp Current Crest Factor: Not greater than 1.7.
10. Lamp Wiring Method:
    a. Instant Start Ballasts: Parallel wired.
    b. Rapid Start Ballasts: Series wired.
    c. Programmed Start Ballasts: Provide parallel or series/parallel wired where available; otherwise series wired is acceptable.
11. Lamp Starting Method:
    a. T8 Lamp Ballasts: Rapid start unless otherwise indicated.
    b. T5 Lamp Ballasts: Programmed start unless otherwise indicated.
    c. Compact Fluorescent Lamp Ballasts: Programmed start unless otherwise indicated.
12. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of 0 degrees F (-18 degrees C) unless otherwise indicated.
13. Provide automatic restart capability to restart replaced lamp(s) without requiring resetting of power.
14. Provide end of lamp life automatic shut down circuitry for T5 and smaller diameter lamp ballasts.
15. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
16. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class A, non-consumer application.
17. Provide high efficiency T8 lamp ballasts certified as NEMA premium.
18. Provide lamp striation reduction circuitry.
19. Ballast Marking: Include wiring diagrams with lamp connections.

C. High Intensity Discharge (HID) Ballasts: Unless otherwise indicated, provide electromagnetic ballasts complying with ANSI C82.4 and listed and labeled as complying with UL 1029.
    1. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 5 percent.
    2. Power Factor: Not less than 0.90 unless otherwise indicated.
    3. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of -22 degrees F (-30 degrees C).

2.05 LAMPS

A. Lamps - General Requirements:
    1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
    2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
    3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
    4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

B. Incandescent Lamps: Wattage and bulb type as indicated, with base type as required for lighting fixture; 130 V rated.
    1. Reflector Type Incandescent Lamps: Beam pattern as indicated.
    2. Non-Reflector Type Incandescent Lamps: Inside frosted lamp finish unless otherwise indicated.

C. Compact Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
    1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
    2. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
    3. Color Rendering Index (CRI): Not less than 80.
    4. Average Rated Life: Not less than 10,000 hours for an operating cycle of three hours per start.

D. Linear Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
    1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
    2. T8 Linear Fluorescent Lamps:
        a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
        b. Color Rendering Index (CRI): Not less than 80.
        c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
    3. T5 Linear Fluorescent Lamps:
        a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
        b. Color Rendering Index (CRI): Not less than 80.
        c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.

2.06 POLES

A. All Poles:
    1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
    2. Structural Design Criteria:
        a. Comply with AASHTO LTS.
        b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
        c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.

2.07 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, size as indicated, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.

F. Suspended Luminaires:
   1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.

G. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

H. Pole-Mounted Luminaires:
   1. Maintain the following minimum clearances:
      a. Comply with IEEE C2.
      b. Comply with utility company requirements.
   2. Foundation-Mounted Poles:
      a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 3000.
         1) Install anchor bolts plumb per template furnished by pole manufacturer.
         2) Position conduits to enter pole shaft.
      b. Install foundations plumb.
      c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
      d. Tighten anchor bolt nuts to manufacturer's recommended torque.
   3. Grounding:
      a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
      b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.
   4. Install separate service conductors, size as indicated on drawings, from each luminaire down to handhole for connection to branch circuit conductors.
   5. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 26 2726 in designated poles.

I. Install accessories furnished with each luminaire.

J. Bond products and metal accessories to branch circuit equipment grounding conductor.

K. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

E. Measure illumination levels at night with calibrated meters to verify conformance with performance requirements. Record test results in written report to be included with submittals.
   1. Test according to IESNA LM-5 (area and sports lighting installations).

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 28 15 00
ACCESS CONTROL HARDWARE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Standalone Access door locks that shall contain keypad and/or prox reader. Lock model styles include cylindrical, mortise, dual-sided and exit trims.
2. Standalone Access door locks that shall communicate serially with a database for a comprehensive door access control system.
3. Standalone Access door locks that provide battery power, not requiring power transfer through the frame/door.
4. DL-Windows Access Control software and accessories associated with the electronic digital door lock. This DL-Windows Access Control software and all future updates are provided to the owner at no charge. All hardware and firmware is flash upgradeable.

1.2 REFERENCES

A. National Fire Protection Association (NFPA):
1. NFPA 70; National Electrical Code - The standard for the safe installation of electrical wiring and equipment in the United States.
2. NFPA-80: The standard for Fire Doors and Windows.
3. NFPA-101:Life Safety Code

B. American National Standards Institute (ANSI):
1. ANSI A156.1 - American National Standard for Butts and Hinges.

1.3 SUBMITTALS

A. Product Data
1. Submit manufacturer current technical literature for each type of product.

B. Shop Drawings:
1. Include details, dimensions, and attachments to other work.

C. Finish Hardware Schedule:
1. Coordinate finish hardware schedule with project Door Hardware Consultant
2. Coordinate hardware with doors, frames and related work to ensure proper size, thickness, hand, function and finish of hardware. Organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening; and include the following information:
   a. Type, style, function, size and finish of each hardware item.
   b. Name and manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of hardware set cross-referenced to indications on drawings both on floor plans and in door and frame schedule.
   e. Explanation of all abbreviations, symbols, codes, etc.
   f. Mounting locations for hardware.
   g. Door and frame sizes and materials.

D. Keying requirements for digital locks shall be coordinated with the owner and /or architect by an authorized Alarm Lock representative.

E. Templates: Successful bidder shall furnish hardware templates to the door and frame manufacturer to insure proper preparation for the installation of hardware. Check approved shop drawings to confirm adequate provisions have been made for the proper installation of items.

F. Wiring Diagrams: Complete system wiring diagrams for all digital locks and controls shall be prepared and provided by the hardware manufacturer, and include lock functions, monitoring requirements, color coded conductor locations, and conductor connections.

1.4 QUALITY ASSURANCE

A. Qualifications
1. Manufacturer:
   The manufacturer shall have a minimum of ten years of experience in the production of Door Hardware.
2. Installer:
   The installer shall be authorized by the manufacturer.
3. All components must be installed by a certified Alarm Lock installer trained in the application of all specified components and applications specified.

1.5 DELIVERY, STORAGE & HANDLING

A. Delivery and Acceptance Requirements:
1. Mark or tag each item of hardware, with identification related to final hardware schedule, and include basic installation instructions with each item or package.
2. Wrap and crate finished components and assemblies to prevent damage to finished items.
3. Deliver individually packaged hardware items at the proper time and location (shop or project site) for installation.
4. Deliver pertinent items requiring being built-in to the General Contractor or trades in accordance with construction progress to prevent any delay.
5. Determine and coordinate the openings for delivery and installation of equipment.

B. Storage and Protection: Storage and Protection:
1. Hardware received, but not installed shall be placed in secured storage. Control handling to prevent losses and delays before and after installation.

C. Key Delivery:
1. Keys for mechanical key override shall be issued by the owner upon completion of training by a certified Alarm Lock representative.

1.6 WARRANTY

A. Manufacturer's Warranty:
1. All components of the digital lock system shall be warranted against defects for two years after installation. Any component found defective will be replaced by the manufacturer.
2. Compliance with warranty will require that the Contractor maintain the following services:
   a. A full-time, dedicated technician who is factory trained and certified.
   b. A field representative who will call on the end user on a regular basis to provide service.
   c. Company warehousing capability within a 250 mile radius of end user with dedicated inventory.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. List of approved manufacturers:
   1. Alarm Lock
      333 Bayview Ave.
      Amityville, N.Y. 11701
      Phone (631) 842-9400
      Fax (631) 789-3383

2.2 ASSEMBLY

A. Access Control Locks to be Trilogy series as manufactured by Alarm Lock of Amityville, NY.

B. Locks shall conform to ANSI A156 Grade 1

C. Provide configuration of lock as required by hardware group:
   1. Mortise lock type
      a. Proximity/keypad – Model Series PDL4500 (Privacy/Lockout)
   2. Exit Device Trim type
      a. Proximity/keypad – Model Series ETPDL (Prox and Keypad)

D. Programming:
   1. All programming, including user credentials, scheduling and audit trail retrieval, shall be performed using Alarm Lock DL-Windows software version 5.5.3x or higher.
   2. Communication of all programming from computer containing Alarm Lock DL-Windows software to locks shall be through serial communications.
   3. Digital keypad locks to be fully keypad programmable.

E. Lock features:
   1. Locks to be battery powered by standard off the shelf batteries (AA or C size), providing 3-4 years battery life, under normal operating conditions.
   2. Locks shall be stand-alone battery operated units, not requiring power transfer through the frame/door.
   3. Locks to support up to 2000 users with 3-6 digit numeric PIN code, or HID format proximity credential, or both for dual credential requirement.
   4. Locks to support up to 500 event schedules.
   5. Locks to support in non-volatile memory 40,000 event audit trail.
   6. Locks to be weatherproof (storage temperature range of -31 to +151 degrees Fahrenheit).
   7. Locks shall have an operating temperature range of -4 to +140 degrees Fahrenheit.
   8. Locks shall continue to operate as last instructed including maintaining schedules and audit trail, independent of building network system failure.
   9. Locks shall adjust schedules automatically to correspond with daylight savings time.
   10. Locks shall have remote release capability through hard-wired connection.
   11. Locks shall have a single pole, double throw relay output to provide external functions through hard-wired connection.
   12. Locks shall be Dual-Sided.
   13. Digital Keypads shall be all metal and 12 buttons.
   14. Locks shall perform a Classroom Lockdown using one keyfob and include a lockdown indicator.

15. Locks shall include a Privacy function for use in restrooms, classrooms and other private areas.
16. Locks shall include a narrow stile trim for all glass/aluminum doors.
17. Locks shall be field upgradeable into Wireless Networked Networx locks.

F. Software:
1. Software to be Alarm Lock DL-Windows supporting 2000 locks per system account.

G. Security Mode:
1. Security is the essence of this section. Normal operation will require battery power to operate the Trilogy locks. Emergency mechanical key override shall be provided in the event of battery failure (except for keypad only unit).

H. Registration of Codes and Credentials/Security Management:
1. All codes and /or credentials shall be recorded by the DL-Windows software-based program specific to the building site.
2. Every code and/or credential issued by the owner shall be entirely unique to that user to whom it is issued. Cards and fobs identified and protected by type and facility code.
3. System to provide for audit trail of 40,000 events/lock and up to 500 lock/unlock schedules with time zone support.
4. System to be managed from a single computer utilizing the DL-Windows software 5.5.3X version or higher.
5. Provide construction codes to the contractor during the building's construction period.
6. Construction codes shall self-disable at a specified time and date and shall not require any physical modification of the lock or cylinder.
7. In the event the construction period is longer or shorter than originally planned, locks shall be re-programmable to conform to the schedule change.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All components shall be programmed in the full operational mode as instructed by the owner.

3.2 CLOSEOUT ACTIVITIES

A. Refer to Division 01 "Closeout Procedure's" section or sections for activities related to the close out procedures including operations manuals, maintenance, demonstration, and training requirements.

B. Training:
1. A certified Alarm Lock representative (distributor or manufacturer based) shall provide training to the owner for the purpose of software set up and maintenance of the digital lock system.

END OF SECTION

SECTION 31 10 00 – SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Protecting existing trees, shrubs, groundcovers, plants, and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants, and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities or abandoning site utilities in place.
7. Temporary erosion and sedimentation control measures.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site-clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

3.5 CLEARING AND GRUBBING

A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of eight inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Base course for concrete walks and pavements.
5. Base course for asphalt paving.
6. Excavating and backfilling for utility trenches.

1.2 QUALITY ASSURANCE

A. Standard Specifications: Comply with the Standard Specifications for Public Works Construction (SSPWC), latest edition and supplements for rock materials. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.3 REFERENCES

A. This specification section has been prepared using the project soils report “Proposed Community Hub Building at Santa Ana Zoo”, by Associated Soils Engineering, dated January 23, 2024 as a reference.

1.4 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Type “B” Material: Backfill placed beside pipe in a trench, including haunches to support sides of pipe.
2. Initial Backfill: Backfill placed over pipe in a trench.
3. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subgrade and hot-mix asphalt or concrete paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Classified Excavation: Removal and disposal of materials not defined as rock

F. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

H. Fill: Soil materials used to raise existing grades.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base, drainage fill, or topsoil materials.

K. Unclassified Excavation: Removal and disposal of materials encountered regardless of nature of materials, including rock.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 PROJECT CONDITIONS

A. Examine site, Drawings, records of existing utilities and construction, record of test borings, and subsurface exploration report available from Owner. Records of test borings are for information only and are not guaranteed to represent all conditions that will be encountered.

1.6 PROTECTION

A. Soils Consultant: A geotechnical consultant shall advise on Construction techniques involved in work, including design, checking and approving of temporary bracing, sheeting, shoring, underpinning and other items pertinent to work, and encountered during prosecution of work. Consultant shall be primarily concerned with construction methods, which will prevent settlement or damage to surrounding structures, sidewalks, embankments, utilities and roads on Owner’s property and adjoining properties.

B. Existing Utilities:

1. Maintain existing utilities that are to remain in service. Before excavating over or adjacent to existing utilities, notify utility Owner to ensure protective work will be coordinated and performed in accordance with utility Owner's requirements. If existing service lines, utilities and utility structures, which are to remain in service, are uncovered or encountered during these operations, safeguard and protect from damage.
2. Within limits of excavation, remove existing piping, subsoil drainage systems, conduit, manholes and relocated items, which are to be abandoned. Plug open ends of utilities to remain with concrete.
3. Re-route existing subsoil drains which obstruct work around new constructions or incorporate them into new drainage systems.
4. Consult Architect immediately for directions, should uncharted or incorrectly charted piping or other utilities be encountered during excavation. Cooperate with Owner and public and private utility companies in keeping their respective services, utilities and facilities in operation. If damaged, repair utilities to satisfaction of Architect and utility Owner.

C. Existing Facilities: Protect and maintain in satisfactory manner, existing pavements, curbs, gutters, structures, conduits, fences, walls and other facilities to remain above and below grade. Restore facilities damaged by construction operations.

D. Pumping and Draining: Excavate areas in such manner as to afford adequate drainage. Control grading in vicinity of excavated areas so ground surface will slope to prevent water running into excavated areas. Until work is completed, remove water from areas of construction that may interfere with proper performance of work or that may result in damage to the soil sub-grade and provide sumps, pumps, well points, electric power and attendance required for this purpose on a 24-hour basis if necessary. Protect construction from water during construction, including prevention of erosion of completed work during construction and until permanent drainage and erosion controls are operational. Repair adjoining properties, facilities and streets damaged due to improper protection.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Sand, gravel, friable earth, or non-expansive clays, subject to Testing Laboratory's approval. Fill and backfill material shall be free of organic material, slag, cinders, expansive soils, trash or rubble and stones having maximum dimension greater than four inches.

C. Unsatisfactory Soils: Expansive and other soils as defined in the project's geotechnical investigation report.

1. Unsatisfactory soils also include satisfactory soils not maintained within two percent of optimum moisture content at time of compaction.

D. Base Course: Material conforming to SSPWC section 200-2.2, Crushed Aggregate Base or SSPWC section 200-2.4 Crushed Miscellaneous Base.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a one and one-half-inch sieve and not more than 12 percent passing a No. 200 sieve.

F. Bedding Course:

1. Flexible pipes: clean coarse sand.
2. All other pipes: crushed rock conforming to subsection 200-1.2 and Table 200-1.2.1 (A) of the "Standard Specifications for Public Works Construction." For pipes up to and including 15 inches, maximum rock gradation shall be one-half inch. For pipes over 15 inches, maximum rock gradation shall be three-fourths inch.

G. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a one and one-half-inch sieve and zero to five percent passing a No. 8 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, six inches wide and four mils thick, continuously inscribed with a description of the utility. Color coding shall be according to the American Public Works Association (APWA) standards:

1. Blue – Potable water and fire suppression lines.
2. Green – Sanitary sewer and storm drain lines
3. Orange – Communication, alarm or signal lines
4. Purple – Reclaimed water, irrigation, and slurry lines
5. Red – Electrical power lines, cables, conduit and lighting lines
6. Yellow – Gas, oil, steam, petroleum, or gaseous material lines.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing" or "Demolition."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing" or "Demolition," during earthwork operations.

3.2 EXCAVATION

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus one inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide six-inch clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches six inches deeper than elevation required in rock or other unyielding bearing material, four inches deeper elsewhere, to allow for bedding course.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2,500 pounds per square inch (psi), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 3 Section Cast-in-Place Concrete.

D. Place and compact initial backfill of satisfactory soil, free of particles larger than one and a half inches in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

F. Install warning tape directly above utilities, minimum six inches above top of pipe, minimum 12 inches below finished grade, except six inches below subgrade under pavements and slabs.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than one vertical to four horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use engineered fill.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within two percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by two percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than eight inches in loose depth for material compacted by heavy compaction equipment, and not more than four inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 2 inches of existing subgrade and each layer of backfill or fill soil material to 90 percent.
2. Under walkways, scarify and recompact top six inches below subgrade and compact each layer of backfill or fill soil material to 90 percent.
3. Under lawn or unpaved areas, scarify and recompact top six inches below subgrade and compact each layer of backfill or fill soil material to 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material to 90 percent.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus one inch.
2. Walks: Plus or minus one inch.

3. Pavements: Plus or minus one-half inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of one-half inch when tested with a 10-foot straightedge.

3.14 BASE COURSES

A. Place base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place base course under pavements and walks as follows:

1. Shape base course to required crown elevations and cross-slope grades.
2. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.15 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds six inches in compacted thickness in layers of equal thickness, with no compacted layer more than six inches thick or less than three inches thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 90 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 312000

SECTION 320190.33 – TREE PROTECTION

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The requirements of the "General Provisions of the Contract" and of Division 1, "General Requirements", shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.2 SUMMARY

A. Work included: All labor, materials, equipment, and services necessary to protect trees which are within the Limits of Construction, Permanent Drainage Easements, Permanent Needs Line, and Temporary Construction Easement Lines and which are indicated to remain. Remove trees which have been damaged beyond repair, as determined by the Owner or its designee, and furnish and install replacement trees of a size to match existing.

B. Related Work:
   1. Irrigation System - Section 32 8400
   2. Landscape Planting - Section 32 9000

C. All reference to the Owner shall be interpreted as the Owner's Authorized Representative.

1.3 TREE SPECIALIST

A. All tree protection and maintenance, including watering, pruning, fertilizing, and pest control, shall be done by, or under the supervision of, licensed Arborist or equally qualified Tree Specialist to be approved by the Owner or its designee. Cost of Arborist shall be borne by the Contractor.

1.4 SUBMITTALS

A. Before the beginning of any construction activities, submit to the Owner for approval a drawing showing locations of plants to be protected in place, and the proposed method of protection. Provide estimated height, caliper, and two photographs of each plant to be protected, clearly showing the structure and appearance of each plant.

1.5 GUARANTEE

A. Trees protected in place shall be guaranteed as to acceptable growth, appearance, and health through the construction period, and for a period of one year after the beginning of the project maintenance period.

PART 2 - PRODUCTS

2.1 WATER - Potable.

2.2 FENCING MATERIALS - Contractor's selection with Owner or its designee's acceptance.

2.3 STRAW, HAY AND SOD

A. Provide clean material, free from debris, noxious weeds, and ingredients, insects and pests detrimental to plant growth.

2.4 TOPSOIL

A. Provide fertile, friable, natural loam having an acceptable pH level and free from alkali, weed seed, mold, fungus, excessive clay content, large rocks, nematodes, insects and other pests detrimental to plant growth.

2.5 FERTILIZER - Commercial grade 10-10-5.

2.6 TREE ROOT PROTECTION

A. Provide burlap root wrap.

B. Provide root wound dressing that is a waterproof, antiseptic, elastic compound, free from substances harmful to trees and shrubs, such as Walter E. Clark and Son Company's "Tree-Kote" or approved equivalent.

C. Use of gravel and/or broken stone for protecting roots of existing trees and shrubs is not allowed.

PART 3 - EXECUTION

3.1 PROHIBIT - traffic and storage of materials within the drip lines of trees and shrubs which are indicated to be salvaged or to remain.

3.2 ERECT FENCES - around the trees and shrubs, which are indicated to remain, a minimum of six feet outside the drip line of such trees and shrubs unless otherwise noted on the drawings. Erect fence areas within the drip line of trees on adjacent property, which overhang the Contract site.

3.3 PROVIDE TREE ROOT PROTECTION as indicated and as follows:

A. Protect roots from flooding, erosion and excessive wetting resulting from dewatering operations, run-off and spillage, or drainage of solutions containing materials which would be deleterious to tree roots. Area of tree-root protection is that which is within the drip line.

B. Cut tree roots whose greatest cross-section is larger than one inch and which will remain exposed during excavation operations. Coat wounds with root wound dressing and wrap the root stub with wet burlap.

C. Jack or tunnel spaces for utilities by hand if utilities are indicated to be within drip line of trees. Do not cut tap roots and main lateral roots. Cut smaller roots, which interfere with the Work, with sharp pruning instruments and wrap the root stub with wet burlap until backfilled.

D. If excavations are indicated to be within drip lines of trees, excavate by hand and provide sheeting. Expose roots with narrow-tine spading forks and by combing of soil. If large, main lateral roots are encountered, expose those roots beyond excavation limits and bend and relocate without breaking. Do not allow exposed roots to dry out before permanent backfill is placed; either cover roots with earth or pack with peat moss and wrap with burlap. Water, keep moist, and temporarily support and protect roots from damage until they have been permanently relocated and covered with backfill.

E. If existing grade around trees is above the finish grade, accomplish excavation within drip line by hand. Cut exposed roots approximately three inches below elevation of finish grade. Engage a qualified Arborist to recommend procedures to compensate for loss of roots, such as pruning of branches and stimulation of root growth.

F. All construction around existing trees to remain shall be observed by the Arborist. Daily reports of observations and recommendations shall be forwarded to the Owner.

END OF SECTION 320190.33

SECTION 321313 – CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Parking lots.
3. Curbs and gutters.
4. Walkways.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, including admixtures.

B. Design Mixtures: For each concrete pavement mixture.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

C. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.

D. The Contractor shall have one copy of the Standard Specifications at the job site.

E. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and pavement sections do not apply to this document.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, Type II, low alkali. Supplement with the following:

a. Pozzolan: ASTM C618, Class F or N Fly Ash, 100 pounds maximum per cubic yard, containing one percent or less carbon. Fly ash shall not be used in excess of 15 percent by weight of total cement quantity.

B. Combined Aggregates: Gradation "C" conforming to SSPWC Section 201-1.3.2.

C. Water: ASTM C 94/C 94M.

2.2 CURING MATERIALS

A. Liquid Curing Compound: ASTM C309, fugitive dye dissipating type, complying with Rule II 13 of the South Coast Air Quality Management District and Federal Air Quality Regulation 40 CFR 52.254.

B. Moisture-Retaining Cover (Curing Sheet): ASTM C 171, non-staining polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

2.3 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with Caltrans Standard Specifications - Section 84 (Federal Specification No. TT-P-1952 for Blue, Red and Green paint; and State of California Standard Specification No. PTWB-01 for White, Yellow and Black paint) with drying time of less than 45 minutes.

1. Color: As indicated.

2.4 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Compressive Strength (28 Days): Minimum 4,000 pounds per square inch (psi) Maximum 4,500 pounds per square inch (psi).
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.60.
3. Slump Limit: Four inches, plus or minus one inch.

B. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

2.5 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates to Architect for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 JOINTS

A. General: Form construction, isolation, and control joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

D. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated. Within 24 hours of pour, construct control joints for a depth equal to at least one-fourth of the concrete thickness to match jointing of existing adjacent concrete pavement.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a one-fourth-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.4 CONCRETE PLACEMENT

A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed pavement surfaces with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.5 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface one-sixteenth to one-eighth inch deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer's written instructions.

1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.6 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 pounds/square feet x h before and during finishing operations. Apply according to manufacturers written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these methods.

3.7 PAVEMENT TOLERANCES

A. Comply with tolerances as follows

1. Elevation: One-fourth inch.
2. Thickness: Plus three-eighths inch minus one-fourth inch.
3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed one-fourth inch.
4. Joint Spacing: Three inches.
5. Contraction Joint Depth: Plus one-fourth inch no minus.
6. Joint Width: Plus one-eighth inch, no minus.

3.8 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.9 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior Concrete Walks

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each exposed product and for each color and texture specified.

C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT – EPOXY COATED

A. All reinforcing steel shall be epoxy coated with 3M Scotchkote 413 or approved equal.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

F. Deformed-Steel Wire: ASTM A 496/A 496M.

G. Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.2 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, gray Portland cement Type I or II

a. Fly Ash: ASTM C 618, Class C or F.
b. Ground Granulated Blast-Furnace Slag is not permitted.

B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.3 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Compressive Strength (28 Days): 3500 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
3. Slump Limit: 4 inches, plus or minus 1/2 inch.
4. Air Content: 6 percent plus or minus 1.5 percent.

B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

C. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 TOLERANCES

A. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials." In addition, the Contractor shall make all concrete slabs even and uniform in appearance. Where no slope is required and **not in an area designated as ADA accessible**, the Contractor shall level within a plus or minus 1/8 inch in 10 feet when tested with a 10-foot straightedge. In **areas designated as ADA accessible** (including but not limited to: paths of travel, clearances, drainage slopes, cross slopes, parking spaces and parking loading/unloading areas) the Contractor shall level the finished surface to a slope not to exceed the minimum or maximum slope indicated on the Drawings when **tested with a 2-foot electronic level.**

3.2 EXAMINATION AND PREPARATION

A. Proof-roll prepared sub base surface below concrete paving to identify soft pockets and areas of excess yielding.

B. Remove loose material from compacted sub base surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. All nicks, exposed ends, etc. shall be re-coated with approved epoxy coating by either spray can or brush and touch-up can.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminate at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, to match jointing of existing adjacent concrete paving.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Moisten sub base to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed paving surface with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions.

1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301. Test reports shall be submitted to the State’s Representative within forty-eight (48) hours of testing.

1. Testing Frequency: One composite sample for each day’s pour exceeding 5 cu. yd. but less than 25 cu. yd., plus one sample for each additional 25 cu. yd. or fraction thereof.

B. All costs for field tests, retests, inspections, re-inspections and test reports are included in the Contractor's base bid.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by State Representative.

B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 321316 - DECORATIVE CONCRETE PAVING

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The requirements of the "General Provisions of the Contract" and of Division 1, "General Requirements", shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

A. Integrally colored concrete with smooth trowel finish and light sandblast. OR

B. Integrally colored concrete with acid wash finish.

C. Concrete with surface-applied colored hardener with smooth trowel finish and light sandblast. OR

D. Concrete with surface-applied colored hardener with smooth trowel finish and acid wash finish.

1.3 RELATED WORK

A. Division 3 – Cast-In-Place Concrete

B. Section 321313 - Concrete.

1.4 REFERENCES

A. A.ASTM C33 - Concrete Aggregates.

B. ASTM C94 - Ready-Mixed Concrete.

C. ASTM C150 - Portland Cement.

D. ASTM C260 - Air Entraining Admixtures for Concrete.

E. ASTM C494 - Chemical Admixtures for Concrete.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

B. Obtain each material from same source and maintain high degree of consistency in workmanship throughout project.

C. Installer Qualifications: Concrete work shall be by firm with five years experience with work of similar scope and quality, and regularly engaged in installation of architectural concrete having a record of successful installations acceptable to the Client/Landscape Architect.

1.6 SUBMITTALS

A. Samples for Verification: Submit 6” x 6” sample chip of specified concrete color indicating Davis color name and finish.

B. At location approved by the Architect, construct a 6’ wide x 4’ long x 4” thick paving panel sample prior to start of work of this Section. Demonstrate patterns and finishes proposed. Each test application shall be sufficiently complete for inspection by Client/Landscape Architect for approval prior to commencement of construction. Adjust as necessary to secure the Client/Landscape Architect's acceptance. Provide all work in accordance with this accepted job site sample.

1.7 ENVIRONMENTAL CONDITIONS

A. Comply with requirements of Section 03300 for techniques of placing concrete.

B. Do not place or finish colored concrete in the rain.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150; Portland Type II; from a single source and of same color throughout.

B. Aggregates: ASTM C33, specify size.

C. Water: Fresh, clean and potable.

2.2 CONCRETE MIX

A. Concrete mix design as specified in Section 321313. Concrete mix design shall also conform to Davis Colors written requirements for consistency of mix for all colored concrete. Mixes shall result in concrete to match approved samples. Minimum compressive strength at 28 days of 3,000 psi. The concrete mix design shall have a minimum cement content of 470 pounds (5 sacks). Calcium chloride shall not be used in the concrete mix. Either give details here or in other appropriate section.

B. Maintain water content as constant as possible.

C. Mix in admixtures of quantities specified and in accordance with manufacturer's instructions. Maintain consistent quantities throughout job.

D. Control slump to maintain constant color.

2.3 COLOR ADDITIVES

A. Manufacturer: Davis Colors (800-356-4848 or 323-269-7311)

B. Type:
   1. Concentrated pigments specifically processed for mixing into concrete and complying with ASTM C979.
   2. Color additives containing carbon black are not acceptable.

C. Color Additive Delivery:
   1. Automated Dispensing: Meter and dispense colors using computer-controlled automated color weighing and dispensing system. Use Davis Colors Chameleon liquid metering system and Hydrotint liquid color additives.
   2. Manual Dispensing: Use Davis Colors Mix-Ready powdered color additives in pre-measured disintegrating bags.

2.4 COLOR SURFACE RETARDER

A. Spray applied, film forming, water based top surface retarder, calibrated for specific sized aggregate and finish requirements. Subject to compliance with requirements provided the product listed below or comparable product acceptable to the Landscape Architect.
   1. Acceptable Materials: “Top Cast” by Grace Construction Products (888-336-9303)
   2. For Medium Sandblast Finish, use Top-Cast 25

PART 3 - EXECUTION

3.1 PREPARATION

A. Form areas of different colors and different materials separately.

3.2 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

C. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.

D. Honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

3.3 CONCRETE SURFACE RETARDER APPLICATION

A. Preparation and Application:
   1. Protect all curbs, borders, adjacent stones, pavers, etc. that are not to receive retarded finish prior to application of retarders. Use Protector Face Off by Grace Construction Projects.

2. Pour concrete, float and lightly trowel finish where required. Do not delay the application of the surface retarder beyond the loss of the initial bleed water.
3. Apply Top Cast Retarders with a low-pressure commercial grade sprayer at a rate of 200-300 sq. ft./gal. per manufacturer's requirements. Material is colored to allow for verification of even and complete coverage.
4. Once dry (1-2 hours), Top Cast provides protection against intermittent rain or hot, windy conditions and requires no additional covering.

B. Finishing:
1. Wash with water rinse/light broom or pressure wash with power equipment within 6-24 hours after the retarder is applied. Retarder removal intervals depend on strength of mix, exposed aggregate size and desired washing techniques. Verify with test panels.
a. Do not over-finish and/or delay application beyond the initial bleeding on the light finishes.

3.4 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required color, texture, levels and lines, details and elevations.

B. Repair or replace concrete not properly finished or of the specified type.

3.5 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01400.

3.6 PROTECTION

A. Protect finished work under provisions of Section 01500.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.7 CLEANING

A. When desired finish is achieved, wash and rinse exposed aggregate surface with water or with trisodium phosphate and water, if necessary.

B. Upon completion of the curing period, but not before 7 days has elapsed since pouring the concrete, remove all concrete spills, overflows and debris.

END OF SECTION 321316

SECTION 321373 – CONCRETE PAVEMENT JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Expansion and isolation joints within cement concrete pavement.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Compatibility and Adhesion Test Reports: From sealant manufacturer.

1.3 QUALITY ASSURANCE

A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

1. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

1. Products:

a. Crafco Inc.; RoadSaver Silicone.
b. Dow Corning Corporation; 888.
c. Or any equivalent product.

B. Type SL Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Products:

a. Crafco Inc.; RoadSaver Silicone SL.
b. Dow Corning Corporation; 890-SL.
c. Or any equivalent product.

2.4 HOT-APPLIED JOINT SEALANTS

A. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

1. Products:

a. Crafco Inc.; Superseal 444/777.
b. Meadows, W. R., Inc.; Poly-Jet 3406.
c. Or any equivalent product.

2.5 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Concrete curing requirement: The concrete must be allowed to cure and dry a minimum of seven days in good drying weather before installing sealant. An additional day of good drying weather must be allowed for each day of poor, inclement weather.

B. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

C. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience.

D. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

E. Install backer materials to support sealants during application and at position required to produce optimum sealant movement capability. Do not leave gaps between ends of backer materials. Do not stretch, twist, puncture, or tear backer materials. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

F. Install sealants at the same time backings are installed to completely fill recesses provided for each joint configuration and to produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

H. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 321373

SECTION 32 14 00 - UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Concrete pavers set in aggregate and mortar setting beds.
   2. Steel edge restraints.
   3. Cast-in-place concrete edge restraints.
   4. .

B. Related Sections include the following:
   1. Section 32 13 13 Landscape Concrete, Paving and Walls

1.3 SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Product Data: For the following:
   1. Pavers.
   2. Mortar and grout materials.
   3. Edge restraints.
   4.

C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.

D. Samples for Initial Selection: For the following:
   1. Each type of unit paver indicated.
   2. Joint materials involving color selection.
   3. Exposed edge restraints involving color selection.

E. Samples for Verification:
   1. Full-size units of each type of unit paver indicated. Assemble not less than five Samples of each type of unit on suitable backing and grout joints.
   2. Joint materials.
   3. Exposed edge restraints.

F. Compatibility and Adhesion Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Preconstruction Compatibility and Adhesion Testing: Submit to latex-additive manufacturer, for testing indicated below, samples of paving materials that will contact or affect mortar and grout that contain latex additives.
   1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be nonstaining to, installed pavers and other materials constituting paver installation.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquids in tightly closed containers protected from freezing.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:
   1. Cold-Weather Requirements: Protect unit paver work against freezing when ambient temperature is 40 deg F and falling. Heat materials to provide mortar and grout temperatures between 40 and 120 deg F. Provide the following protection for completed portions of work for 24 hours after installation when the mean daily air temperature is as indicated: below 40 deg F, cover with weather-resistant membrane; below 25 deg F, cover with insulating blankets; below 20 deg F, provide enclosure and temporary heat to maintain temperature above 32 deg F.

2. Hot-Weather Requirements: Protect unit paver work when temperature and humidity conditions produce excessive evaporation of setting beds and grout. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
    a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS

A. Concrete Pavers: Solid paving units, made from normal-weight concrete with a compressive strength not less than 5000 psi, water absorption not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Architectural Narrow Modular Paver as manufactured by Stepstone, Inc. (800-572-9029).
    2. Thickness: 2 ½”
    3. Face Size and Shape: Varies- see finish and materials schedule indicated on Landscape drawings.
    4. Color: As selected by Landscape Architect from manufacturer's full range.

2.2 POOL COPING CONCRETE PAVERS

A. Concrete Pavers: Solid paving units, made from normal-weight concrete with a compressive strength not less than 5000 psi, water absorption not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Custom Modular Paver as manufactured by Stepstone, Inc. (800-572-9029).
    2. Thickness: 2 ½”.
    3. Face Size and Shape: Varies- see finish and materials schedule indicated on Landscape drawings
    4. Color: As selected by Landscape Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Steel Edge Restraints: Steel edging 3/16 inch thick by 4 inches high with loops pressed from or welded to face to receive stakes at 36 inches o.c., and steel stakes 15 inches long for each loop.
    1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
        a. Border Concepts, Inc.
        b. Collier Metal Specialties, Inc.

c. J. D. Russell Company (The).
d. Ryerson, J. T. & Son, Inc.
e. Sure-Loc Edging Corporation.

2. Color: As selected by Landscape Architect from manufacturer's full range.
a.

B. Job-Built Concrete Edge Restraints: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi.

C. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

2.4 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with [ASTM D 448 for Size No. 57.

B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with [ASTM D 448 for Size No. 8.

C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

D. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.
1. Provide sand of color needed to produce required joint color.

E. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
4. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

F. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.5 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C 150, Type I or II.

B. Hydrated Lime: ASTM C 207, Type S.

C. Sand: ASTM C 144.

D. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

1. Manufacturer: Subject to compliance with requirements, provide latex additive by one of the following:
   a. Boiardi Products Corporation.
   b. Bonsal, W. R. Company.
   c. Bostik Findley Inc.
   d. C-Cure.
   e. Custom Building Products.
   f. DAP Inc.
   g. Jamo Inc.
   h. Laticrete International, Inc.
   i. MAPEI Corp.
   j. SGM.
   k. Summitville Tiles, Inc.
   l. TEC Incorporated; H. B. Fuller Company.

E. Water: Potable.

F. Reinforcing Wire: Galvanized, welded, 0.062-inch- diameter wire; 2-by-2-inch mesh; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.

2.6 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement, unfading mineral pigments and white or colored sand as required to produce required color.

1. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed sand-portland cement grout.
   a. Manufacturer: Subject to compliance with requirements, provide latex additive by one of the following:
      1) Boiardi Products Corporation.
      2) Bonsal, W. R. Company.
      3) Bostik Findley Inc.
      4) C-Cure.
      5) Custom Building Products.
      6) DAP Inc.
      7) Jamo Inc.
      8) Laticrete International, Inc.
      9) MAPEI Corp.
      10) SGM.
      11) Summitville Tiles, Inc.
      12) TEC Incorporated; H. B. Fuller Company.

B. Polymer-Modified Grout: ANSI A118.7, sanded grout; in color indicated.
   1. Manufacturer: Subject to compliance with requirements, provide polymer-modified grout by one of the following:

      a. Boiardi Products Corporation.
      b. Bonsal, W. R. Company.
      c. Bostik Findley Inc.

d. C-Cure.
e. Custom Building Products.
f. DAP Inc.
g. Jamo Inc.
h. Laticrete International, Inc.
i. MAPEI Corp.
j. SGM.
k. Summitville Tiles, Inc.
l. TEC Incorporated; H. B. Fuller Company.

2. Product Type: Two-component mix, containing acrylic resin in liquid-latex form and prepackaged dry-grout mix complying with ANSI A118.6 and recommended by latex-additive manufacturer.

C. Grout Colors: As selected by Landscape Architect from manufacturer's full range.

D. Water: Potable.

2.7 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement or cement and sand with latex additive to a creamy consistency.

C. Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C 270, Proportion Specification.

D. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

E. Job-Mixed, Polymer-Modified Portland Cement Grout: Add liquid-latex additive to portland cement and sand in proportion and concentration recommended by liquid-latex manufacturer. Proportion cement and sand to comply with written instructions of latex-additive manufacturer.
1. Pigmented Grout: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.

F. Packaged, Polymer-Modified Grout Mix: Proportion and mix grout ingredients according to grout manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
   2. Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations. Examine areas where waterproofing system is turned up or flashed against vertical surfaces and horizontal waterproofing. Proceed with installation only after protection is in place.

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Clean concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in Division 31 Section "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
   1. For concrete pavers, a block splitter may be used.

D. Joint Pattern: As indicated.

E. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.
   1. Provide joint filler at waterproofing that is turned up on vertical surfaces[, unless otherwise indicated; where unfilled joints are indicated, provide temporary filler or protection until paver installation is complete].

F. Tolerances: Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.

G. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide foam filler as backing for sealant-filled joints, unless otherwise indicated. Install joint filler before setting pavers. Sealant materials and installation are specified in Division 07 Section "Joint Sealants."

H. Expansion and Control Joints: Provide joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.

I. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
   1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
   2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch below top edge.
   3. Install job-built concrete edge restraints to comply with requirements in Division 03 Section "Cast-in-Place Concrete."
   4. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
   5. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.

3.4 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches.

D. Place aggregate subbase and base, compact by tamping with plate vibrator, and screed to depth indicated.

E. Place aggregate subbase and base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.

F. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches.

G. Place leveling course and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.

H. Treat leveling course with herbicide to inhibit growth of grass and weeds.

I. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer

bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.

1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

J. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:

1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
2. Before ending each day's work, fully compact installed concrete pavers to within 36 inches of the laying face. Cover pavers that have not been compacted, and leveling course on which pavers have not been placed, with nonstaining plastic sheets to protect them from rain.

K. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

L. Do not allow traffic on installed pavers until sand has been vibrated into joints.

M. Repeat joint-filling process 30 days later.

3.5 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing setting bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch thickness for bond coat.

C. Apply mortar bed over bond coat immediately after applying bond coat. Spread and screed setting bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

D. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Cut back, bevel edge, remove, and discard setting-bed material that has reached initial set before placing pavers.

E. Place pavers before initial set of cement occurs. Immediately before placing pavers on setting bed, apply uniform 1/16-inch- thick, slurry bond coat to bed or to back of each paver with a flat trowel.

F. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

G. Spaced Joint Widths: Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/16 inch.

H. Grout joints as soon as possible after initial set of setting bed.
   1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
   2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
   3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
   4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

I. Cure grout by maintaining in a damp condition for seven days, unless otherwise recommended by grout or liquid-latex manufacturer.

3.6 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point up joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

END OF SECTION 32 14 00

SECTION 321501 - DECOMPOSED GRANITE PAVING

1.00 GENERAL

1.01 GENERAL CONDITIONS

A. The requirements of the "General Provisions of the Contract" and of Division 1, "General Requirements", shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.02 SUMMARY

A. Work included: All labor, materials, equipment, and services necessary to provide decomposed granite paving, complete as shown, and as specified.

B. Related work:

1. Excavating, Backfilling and Compacting - Section 02220.
2. Irrigation System - Section 02810.
3. Planting - Section 02900.
4. Palm Planting - Section 02951.
5. Landscape Maintenance and Plant Establishment - Section 02970.

1.03 REFERENCES

A. Standard Specifications - Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, Caltrans.

B. ASTM - American Society for Testing and Materials.

1.04 DEFINITIONS

A. Percent Compaction: ASTM D1557, percentage of the maximum in-place dry density of the same material as determined by Soils Engineer.

1.05 SUBMITTALS

A. Product Data: Manufacturer's current catalog cuts and specifications for decomposed granite and stabilizer.

B. Samples: Half a pound for each size and color range of decomposed granite.

C. Mock-up: Six foot by six foot sample, full depth to match finish condition.

D. Test Reports: Certified copies of field tests of compressive strengths of decomposed granite paving.

1.06 QUALITY ASSURANCE

A. Qualifications: Submit certified documentation of successful experience of no less than three years in the installation of similar crushed stone paving.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect from contamination with foreign materials. Isolate stockpiles to prevent mixing of different aggregate grades. Prevent contamination of organic materials.

1.08 SITE CONDITIONS

A. Environmental Requirements: Do not install decomposed granite during rain or while sub-base is wet from rain.

B. Existing Conditions: For protection of existing plants to remain, see Section 02120 - Tree Protection.

1.09 SEQUENCING

A. Acceptance: Do not install work under this section prior to acceptance of sub-grade preparation under another section.

B. Coordination: Coordinate with other trades to insure the following:

1. Irrigation Sleeving: To be placed prior to placement of aggregate base.

2. Trees in Paving: To be installed prior to headers and paving. Do not mix soil with decomposed granite.

1.10 MAINTENANCE

A. Service: Immediately repair all damage to the work as the result of weather or traffic conditions. Report all damage resulting from work of other trades after acceptance of decomposed granite work. Repair to match adjacent undisturbed work.

2.00 PRODUCTS

2.01 MATERIALS

A. Decomposed Granite:

1. 1/4" Minus Aggregate Surface:

Screen Size	Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	90

No. 8 (2.36 mm)	71
No. 16 (1.18 mm)	55
No. 30 (0.6 mm)	42
No. 50 (0.3 mm)	31
No. 100 (0.15 mm)	21
No. 200 (0.075 mm)	13

2. Color: California Gold unless otherwise noted on drawings.

B. Non-toxic organic binder is a colorless, odorless concentrated powder that naturally binds Crushed Aggregate Screenings (CAS).

2.02 EQUIPMENT

A. Mixing Equipment: Pug mill with a weight belt feeder.

B. Compaction Equipment: Power roller with weight between one to five tons.

2.03 ACCESSORIES

A. Water: Fresh, clean, potable water as available from the Owner. Transport as required.

3.00 EXECUTION

3.01 EXAMINATION

A. Sub-grades shall have been rough graded to within one-tenth foot of finish grades less depth of decomposed granite paving.

B. Verify that concrete bands or adjacent paving and irrigation sleeving have been installed and accepted under another Section prior to commencement of work.

3.02 PREPARATION

A. Compaction: After completion of soil sterilization, compact sub-grade to minimum 90% compaction.

3.03 INSTALLATION

A. Stabilized Decomposed Granite Paving:

1. Lines and Levels:

a. Install stabilized decomposed granite work true to grade, properly coinciding with adjacent work and elevation. Install in maximum two-inch lifts.

b. Provide a finished surface uniform in texture and appearance. Do not permit finished work to vary more than eighth-inch in ten feet from true profile and cross section.

2. Mixing:

   a. General: Paving shall consist of a mixture of decomposed granite, stabilizer, thoroughly and continuously mixed with a pug mill. A bucket mix or rototiller is not acceptable. Mix at a rate of twelve pounds (pedestrian loading) or fourteen pounds (vehicular loading) of stabilizer per ton of crushed aggregate screenings.

   b. Water: Adjust quantity of water added to the mixture to permit maximum compaction of the materials after it is placed on the sub-grade. Moisture shall permeate full depth. After water application test with a minimum of one core sample per one thousand square feet; repair sample area to match adjacent section.

3. Depth:

   a. Decomposed granite shall be placed to a minimum three inches compacted depth (foot traffic) and four inches compacted depth (vehicular traffic) unless otherwise noted on drawing.

4. Compacting: Thoroughly compact each two-inch lift to a minimum ninety percent. Compact each area with at least four passes of the compacting equipment. After compacting, screed smooth. Do not use a wacker or vibratory roller to compact the decomposed granite.

5. Contaminated Areas: Do not permit mixture to contaminate planting areas. Clean up immediately all mixtures spilled on adjacent paving.

6. Grading: When surface areas have been rolled and it becomes necessary to add a thin layer of material to bring the surface to grade, the previously rolled or compacted area shall be raked to provide a bond with the added material.

7. Finish Paving Surface: Provide a uniform texture and color and without a cement mortar film on the exposed surface. Finished surface shall not vary more than two one-hundredths of a foot from the lower edges when measured with a ten-foot straightedge.

8. Curing: After installation, keep moist for a period of seven days. Apply water in a fine mist or spray and in such a manner that it will not damage the finished surface.

9. Damaged or Defective Installation: Repair and replace in accordance with these Specifications at no additional cost.

10. Replacement:

    a. If compression tests of samples fail to meet specified compressive strength, immediately remove and replace decomposed granite paving with material conforming to Specifications.

b. Pay cost of all work required for removing and replacing the decomposed granite.

11. Keep decomposed granite off of adjacent paved areas.

3.04 FIELD QUALITY CONTROL

A. Tests: For each lift, have the testing laboratory verify the degree of compaction. Recompact filed areas until specified compaction is achieved. Testing to be paid by contractor.

3.05 PROTECTION

A. Protect the paving against traffic, injury or defacement, or damage (by rain) and subsequent construction operations until Final Acceptance.

END OF SECTION 321501

SECTION 323118 - METAL FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Decorative metallic-coated steel tubular picket fences.
   2. Swing gates.
   3. Wire mesh infill.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each fence material and for each color specified.
   1. Provide Samples 12 inches in length for linear materials.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for decorative metallic-coated steel tubular picket fences, including finish, indicating compliance with referenced standard and other specified requirements.

E. Maintenance Data: For gate operators to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal fences and gates that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Decorative Metallic-Coated Steel Tubular Picket Fences:
   1. Ametco Manufacturing Corporation. (Basis of Design)
   2. Ameristar Fence Products.
   3. Master Halco.
   4. Merchants Metals; a division of MMI Products, Inc.
   5. Xcel Fence.
   6. Or equal.

2.2 STEEL AND IRON

A. Plates, Shapes, and Bars: ASTM A 36.

B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29, Grade 1010.

C. Tubing: ASTM A 500, cold formed steel tubing.

D. Bar Grating: NAAMM MBG 531.
   1. Bars: Hot-rolled steel strip, ASTM A 1011/A 1011M, Commercial Steel, Type B.
   2. Wire Rods: ASTM A 510.

E. Uncoated Steel Sheet: Hot-rolled steel sheet, ASTM A 1011, Structural Steel, Grade 45 or cold-rolled steel sheet, ASTM A 1008, Structural Steel, Grade 50.

F. Galvanized-Steel Sheet: ASTM A 653, structural quality, Grade 50, with G90 coating.

G. Perforated Metal: Comply with Division 5 Section “Metal Fabrications”.

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Division 3 Section "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 4000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C 387 mixed with potable water according to manufacturer's written instructions.

C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 and specifically recommended by manufacturer for exterior applications.

2.4 DECORATIVE STEEL FENCES AND GATES

A. Product: Eagle Design by Ametco or equal.

1. Galvanized Steel Picket Fence has a 1” diameter 14 gauge tubes on 4” centers with swaged picket top.
2. Post: 2-1/2” diameter 14 gauge tube with a swaged top.
3. Framing: 11 gauge top and bottom framing channel is bolted directly to the post for easy installation.
4. Tops: Swaged tops can be either straight in line, staggered or waved.
5. Option: Can be provided with anti-intruder top design by extending the top picket and forming to a 45 degree angle.
6. Finish: Factory Hot dip galvanized and powder coated.
    a. Color: Available in 15 standard colors or custom color of your choice

2.5 SWING GATES

A. Gate Configuration: As indicated.

B. Gate Frame Height: As indicated.

C. Gate Opening Width: As indicated.

D. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes 1-1/2 by 1-1/2 inches formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication.

E. Frame Corner Construction: Welded or assembled with corner fittings and 5/16-inch- diameter, adjustable truss rods for panels 5 feet wide or wider.

F. Additional Rails: Provide as indicated, complying with requirements for fence rails.

G. Infill: Comply with requirements for adjacent fence.

H. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.

I. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet wide. Provide center gate stops and cane bolts for pairs of gates. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

J. Exit Hardware: 98/99 Rim exit device by Von Duprin or equal.
1. Type: Ax - Accessible device.
2. Description: UL certified to meet 5 lb. maximum operating force requirement.
3. Exceeds ANSI/BHMA requirements.
    a. ANSI/BHMA A156.3 2014 Grade 1 certified.
    b. ANSI/UL 305.
    c. CAN/ULC-S132.

K. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1/2-inch- diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.

L. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

M. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123 unless otherwise indicated. For hardware items, hot-dip galvanize to comply with ASTM A 153.

N. Metallic-Coated Steel Finish: Same as fencing.

2.6 WIRE MESH INFILL

A. Profile and finish: As indicate on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
   1. Construction layout and field engineering are specified in Division 1 Section "Execution Requirements."

3.3 FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 323118

SECTION 32 8400 – LANDSCAPE IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes all material, pipe, pipe fittings, automatic valves, wiring, and labor to install a fully automatic sprinkler system.
   1. Landscape Maintenance and Plant Establishment - Section 32 0190.
   2. Landscape Planting - Section 32 9000.

B. Restore any existing landscaping disturbed during the installation.

1.3 SUBMITTALS

A. Material List:
   1. Furnish the articles, equipment, materials, or processes specified by name in the drawings and specifications. Substitution is allowed only with prior written approval of the Architect.
   2. Submit complete material list prior to performing any work. Material list shall include the manufacturer name, model number and description of all proposed materials and equipment.
   3. Equipment or materials installed or furnished without prior approval of the Architect may be rejected and the Contractor required to remove such materials from the site at the Contractor’s own expense.
   4. If equipment proposed for use is as specified, a material list ONLY is required, and it is UNNECESSARY to submit manufacturer descriptive catalogs with submittal.

B. Record Drawings:
   1. Provide and maintain up to date and complete project record documents (set of blueline prints). Update daily and show all changes from the original drawings and specifications, as well as exact "as-built" locations, and sizes and types of equipment. Prints for this purpose may be acquired from the Architect. Keep this set of drawings on site and use only for such recording.
   2. These drawings shall also serve as work progress prints and shall be the basis for measurement and payment for work completed. Drawings must be available at all times for site reviews, in a location designated by the Architect. Should the record blueline progress prints be unavailable for review or fail to be up to date at the time of any site reviews (refer to Section 3.02-B-3 - Observation Schedule), it will be assumed no work has been completed and the Contractor will be assessed the cost of that site visit at the current

billing rate of the Architect. No other inspections will take place until payment of that assessment.

3. Make neat and legible notations daily on the record progress prints as the work proceeds, showing the work as actually installed. Should equipment location differ from plan, indicate the new location in a graphic manner, matching the original symbols in the irrigation legend.
4. Before the final site review, transfer all information from the record prints to computer-generated reproducible drawings (or other approved method), and submit these reproducible drawings along with related CAD disk to the Architect for approval prior to preparing controller chart.
5. Dimension the following locations from two permanent points of reference (building corners, sidewalks, road intersections, etc.):
    a. connection to existing water lines
    b. connection to existing electrical power supply
    c. ball valves
    d. lightning protection (rod, plate, etc.)
    e. existing backflow prevention unit
    f. remote control valves
    g. quick coupling valves
    h. automatic controller
    i. flush-out valves

C. Controller Charts:
1. Record drawings must be approved by the Architect before controller charts are prepared.
2. Provide two controller charts for each controller installed.
3. The chart shall show the area controlled by the automatic controller and shall be the maximum size controller door will allow.
4. The chart shall be based on a record drawing, reduced to the maximum size that will fit inside controller housing (printed on two sides if required for graphic clarity).
5. The chart shall be a photocopy or black line print with colors to differentiate areas of coverage for each hydro-zone, using pastel or transparent colors.
6. When completed and approved, hermetically seal the chart between two pieces of plastic (thickness of each piece being minimum 10 mils).
7. These charts must be completed and **approved** prior to final acceptance of the irrigation system. Installation will not be accepted without charts.

D. Operation and Maintenance Manuals:
1. Prepare and deliver to the Architect within 10 calendar days prior to completion of construction two hardcover three ring binders containing the following information:
    a. Index sheet stating Contractor's address and telephone number
    b. List of equipment with names, addresses, and telephone numbers of local manufacturer representative
    c. Catalog and parts sheets regarding material and equipment installed under this contract
    d. Warranty statement

e. Complete operating and maintenance instruction on all major equipment

2. In addition to these maintenance manuals, instruct Owner's maintenance personnel regarding operation of major equipment and show written evidence to the Architect at the conclusion of the project that this service has been rendered.

E. Equipment to be Furnished:

1. Supply as part of this contract the following tools:
   a. **Two keys** for each automatic controller
   b. **Two keys** for opening valve boxes (if applicable)
   c. **One quick coupler key** and matching hose swivel **(per five** quick coupling valves)
   d. **One remote hand-held radio control unit per controller specified** (transmitter and receiver) compatible with controller specified. (if applicable)
   e. **Two Rain Bird pressure gauges**, RBG-L160-D (if applicable)
2. Turn over this equipment to the Owner at the conclusion of the project. Before final acceptance can occur, written evidence that the Owner has received materials must be shown to the Architect.

F. Backflow Prevention Device Certification:

1. Ensure that backflow prevention unit is certified as required by prevailing authority and submit two copies of certification at final review.

1.4 QUALITY ASSURANCE

A. Obtain and pay for any and all permits and inspections as required.

B. Follow manufacturer's directions and detailed drawings in all cases when the manufacturers of products used in this contract furnish directions covering points not included in the drawings and specifications.

C. All local, municipal and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed as conflicting with any such rules and regulations, or the requirements of the same. However, when these specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by such rules and regulations, the provisions of these specifications and drawings shall take precedence.

D. Superintendent:

1. A superintendent satisfactory to the Owner's Representative shall be present on the site at all times during progress of the work.
2. Do not change the Superintendent except with the consent of the Architect.
3. The Superintendent shall be authorized to represent the Contractor.

E. Explanation of Drawings:

1. Due to the scale of drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. Carefully investigate the structural and finish conditions affecting this work and plan work accordingly, furnishing such offsets, fittings, sleeves, etc., as may be required to meet site conditions. Drawings are generally diagrammatic and indicative of the work to be installed. Install the work in such a manner as to avoid conflicts between irrigation systems, planting and architectural features.
2. The word Architect as used herein refers to the Owner's authorized representative.
3. Furnish and install all work called for on the drawings by notes or details whether or not specifically mentioned in the specifications.
4. Do not install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Bring such obstructions or differences to the attention of the Architect. Failure to do so will mean the Contractor is responsible for any revisions necessary.
5. Do not purchase or install materials as noted in legend on drawing when it is obvious there is an oversight or discrepancy. Failure to obtain prior material approval may result in rejection by the Architect. The Contractor will be responsible for any revisions necessary due to his failure to bring material discrepancies to the attention of Architect, or failure to comply with material submittals.
6. Coordinate as necessary the work of this Section which is allied with the work of other trades.
7. It is the intent of the drawings and specifications to describe a complete irrigation system providing uniform water coverage. If the plans or specifications appear in any way to be incomplete, misleading, conflicting, or subject to misinterpretation, it is the Contractor's responsibility to bring these concerns to the Architect's attention before bidding. If the Contractor fails to do so, the Contractor must accept the Architect's interpretation and any potential related financial impact that may occur.

F. Electrical wiring, controls, motors, and devices shall be Underwriters Laboratories listed, and labeled U.L.

1.5 DELIVERY, STORAGE AND HANDLING

A. Exercise care in handling, loading, unloading, and storing p.v.c. pipe and fittings. Transport p.v.c. pipe in a vehicle which allows the length of pipe to lie flat, to avoid undue bending or concentrated external load at any point. Any section of pipe dented or damaged must be discarded or, if installed, must be replaced with new piping.

B. Cover any pipe stored outdoors to protect it from sunlight.

1.6 substitutions

A. To request substitution of any equipment or material in lieu of equipment or material listed on the irrigation drawings and in the specifications, provide the following information to the Architect for approval:
   1. Statement indicating the reason for making the substitution, using a separate sheet of paper for each requested substitution

2. Descriptive catalog literature and performance charts (if available) for each requested substitution
3. Hydraulic calculations for proposed substitution, as applicable
4. Itemized list of proposed substitution(s), noting difference in material and labor costs between substitution and item originally specified
5. Written confirmation that Owner has received any credit resulting from approved substitution (with a copy sent to Architect).

B. Approval of any substitution or alternate will be based on information and/or samples provided by the Contractor.

C. Responsibility for the total performance of any substitution to equal or surpass the item originally specified in every respect rests with the Contractor.

D. If the Architect determines the substitution has proven to be unsatisfactory, it shall be removed and replaced with the originally specified item as part of the work of this contract (both materials and labor).

E. The Architect shall be solely responsible for accepting or rejecting any substitution as equal to equipment and materials listed on the irrigation drawings and in the specifications.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Perform actual planting only when weather and soil conditions are suitable and will not be detrimental to the plant material. Do not apply during inclement weather or when forecasted conditions will not permit work in accordance with manufacturer's printed instructions.

1.8 WARRANTY

A. Sprinkler irrigation system warranty shall be according to the following form. The general and supplementary conditions of these specifications shall be filed with the Owner or his representative prior to acceptance of the irrigation system.Within 15 days after notification by Owner, remove and replace failed plantings. Replacement plantings shall be guaranteed as specified for original plantings.

B. Manufacturer warranties do not relieve the Contractor of his liability under the warranty. Such warranties only supplement the warranty.

C. Include a copy of the warranty form in the Operations and Maintenance Manual.

D. The following warranty form shall be typed on Contractor's letterhead:

PROJECT:

CONTRACTOR:

ADDRESS:

PHONE NO.:

BY:

DATE OF ACCEPTANCE:

BY:

1.9 TEMPORARY REPAIRS

A. The Owner reserves the right to make temporary repairs as necessary to keep the sprinkler system equipment in operating condition. The exercise of this right by the Owner will not relieve the Contractor of responsibilities under the terms of the guarantee as herein specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe & Fittings
   1. Non-pressure lines (buried) shall be p.v.c Schedule 40. (1/2 inch pipe is not permitted.
   2. Landscape dripline tubing (In-line drip emitter tubing) shall be a flexible polyethylene tubing.
   3. All p.v.c. pipe and fittings shall conform to following specific requirements:
      a. P.v.c. (Solvent Weld)
         1) Pipe shall be manufactured from virgin polyvinyl chloride compound in accordance with ASTM D 1784 or ASTM D 2241, cell classification 12454 B, hydrostatic design stress rating not less than 2,000 p.s.i.
         2) Fittings (solvent weld or thread) shall be standard weight, Schedule 40, side gated, injection molded p.v.c., complying with ASTM D 1784, cell classification 13454 B, including threads when required.
      b. P.v.c. nipples shall be Schedule 80, with molded threads
      c. All p.v.c. pipe must bear the following markings:
         1) Manufacturer name
         2) Nominal pipe size
         3) Schedule or class
         4) Date of extrusion
      d. Solvent cement and primer for p.v.c. solvent-weld pipe and fittings shall be of type and installation method prescribed by the manufacturer.
   4. Copper Pipe and Fittings (Provided Under Mechanical Section by the Plumbing Contractor):
      a. Pipe shall be Type L, hard tempered.
      b. Fittings shall be wrought copper, solder joint type.
      c. Joints shall be soldered with silver solder, 45 percent silver, 15 percent copper, 16 percent zinc, 24 percent cadmium, solidus at 1125 F. and liquidus at 1145 F.
   5. Distribution Tubing (if applicable):
      a. Distribution tubing shall be 1/4 inch i.d., flexible p.v.c.

B. Electrical (High Voltage)

1. All high voltage electrical services required for automatic controller and other irrigation system equipment noted on drawing shall reconnect to existing service.
2. Electrical equipment installed outside building shall be NEMA 4 type.
3. All connections between electrical services and equipment shall be in rigid galvanized electrical conduit, with conduit and wiring sizes as required.

C. Electrical (Low Voltage):

1. Make connections between controller and remote control valves using direct burial AWG-UF 600 volt wire, insulation thickness 3/64 inch, utilizing low density, high molecular weight polyethylene insulation.
2. Waterproof splices (where permitted) using King Connectors or equal, and house in a box. Boxes for other irrigation uses may be utilized for this purpose when approved by Architect.
3. Wire shall be minimum #14 UF 600 volt underground wiring. Common wire shall be white, and all other wires any color except white.

D. Ball Valves:

1. Ball valves shall be of the manufacturer, size and type indicated on the drawings.
2. Ball valves shall be constructed of a bronze body, stainless steel ball and stem or PVC. Ball valves shall have threaded connections.
3. All ball valves shall have a minimum working pressure of not less than 150 PSI and shall conform to AWWA standards.

E. Quick Coupling Valves:

1. Valves shall have brass body, 150 pound class, with 1 inch female threads opening at base permitting operation with a special connecting device (coupler) designed for this purpose.
    a. Coupler threads shall be lug type.
    b. Provide with rubber-like vinyl hinge cover.

F. Backflow Prevention Unit

1. Backflow preventer is a reduced-pressure type. Contractor shall check and repair unit, as necessary for proper certification.

G. Automatic Controller

1. Controller shall be fully automatic and capable of operating the required number of stations, flow sensors (if called out), master valves, and moisture sensors (if called out). Controller shall be *wall* mount type, in a housing with locking hinged cover. Fuse and chassis ground all controller components. Automatic controller shall include the following:
    a. Surge protection.
    b. Copper clad lightning protection device (specific type to be coordinated with General Contractor).
    c. Permanent connection outside controller housing for quick connection of remote hand-held radio controls.

H. Remote Control Valves

1. Valve shall be spring-loaded, packless diaphragm activated, normally closed type with glass-filled nylon body, equipped with flow control and pressure regulation capabilities when noted on drawing.
2. Valve solenoid shall be 24 volt a.c. 4.5 watt maximum, 500 mili-amp maximum surge, corrosion-proof, stainless steel construction, epoxy encapsulated to form a single integral unit.
3. When valves called for are not equipped with a flow control, provide a ball valve on discharge side of valve.
4. Valve shall be equipped with an internal bleeder to permit operation in the field without power at the controller.

I. Valve Boxes

1. Valve boxes shall be fabricated from a durable plastic material resistant to weather, sunlight and chemical action of soils, with black covers.
2. Remote control valves, flow sensors, and master control valves shall be installed in rectangular plastic boxes, Ametek or approved equal, with bolt down hinged covers.
3. Quick coupling valves and flush-out assemblies shall have 10 inch round plastic boxes with exterior as required to properly protect valve, Ametek or approved equal.

J. Drip Emitters & Accessories

1. Emitters shall be pressure compensation type with single outlet supplying flow as noted.
2. Equip all systems with a line strainer and pressure regulator on the discharge side of valves. Strainer shall have a 150 mesh screen and a 1/2 inch outlet for flushing. Pressure regulator shall be preset at a maximum 50 p.s.i. Install both in an additional plastic box.
3. Secure all distribution tubing (if applicable) using a 12 gauge wire tubing stake clad with p.v.c. (approximately 8 inches long), or plastic pin. Locate 3 inches from end of tubing or install in 1-1/2 inch by 10 inch long p.v.c. pipe, whichever is indicated on drawing. Equip end of tubing with a bug cap.

K. In-Line Emitters & Accessories

1. Drip tubing shall be self-cleaning, pressure compensating type. Rows of tubing shall be equally spaced as called out in irrigation legend, with emitters spaced as called out in irrigation legend with flow as specified.
2. Blank tubing of the same type and size shall be used at the end of each row of tubing, and also where emitter outlets are not needed.
3. Drip tubing shall be as specified in the irrigation schedule.

2.2 EXAMINATION

A. All scaled dimensions are approximate. Check and verify all dimensions per Architect's approval prior to proceeding with work under this section.

B. Exercise extreme care in excavating and working near existing utilities. Coordinate excavations with underground service alert and utility companies. Damage to utilities caused by operations or neglect shall be repaired at Contractor’s expense. Check existing utility drawings for locations.

C. Coordinate installation of sprinkler irrigation materials, including pipe, so there will be NO interference with utilities or other construction, or difficulty in planting trees, shrubs, and ground covers.

D. Carefully check all grades to ensure work on the sprinkler irrigation system may safely commence.

2.3 PREPARATION

A. Water Supply:
1. The Owner will provide new meters and pay all costs incurred.
2. Connect sprinkler irrigation system to water supply points of connection as indicated on the drawings. Verify exact location on site.
3. Connections as shown on drawings are approximate. Minor deviations (plus or minus 20 feet) required by actual site conditions shall be a part of this contract.
4. Coordinate connection to meters, water outlets, etc. with General Contractor and other trades on site to ensure proper connection.
5. Coordinate pipe crossing hardscapes, walks, etc., with appropriate trades to minimize disturbance to finish product. If a preferable route is noted on site, contact Architect to discuss alternative and obtain approval of same.

B. Observation Schedule:
1. Notify the Architect in advance for the following observation meetings, according to the time indicated:
   a. Pre-job conference - 5 days
   b. Backflow assembly and automatic controller location - 48 hours
   c. Pressure supply line and control wire installation and testing - 48 hours
   d. Lateral line and sprinkler installation - 48 hours
   e. Coverage test - 48 hours
   f. Final site review - 5 days
2. When observations are conducted by other than the Architect, show evidence in writing when and by whom these observations were made.
3. Maintain a set of current and up to date plans on the job site at all times. No site observations will commence without record drawings and current plans. In the event the Contractor calls for a site visit without record drawings, without current plans, without completing previously noted corrections, or without preparing the system for said visit, he shall be responsible for reimbursing the Architect based on his current billing rates per hour (portal to portal, plus transportation costs) for the inconvenience. No subsequent site visits will be scheduled until this charge has been paid.

C. Physical Layout:
1. All piping or equipment shown diagrammatically on drawings outside planting areas shall be installed inside planting area whenever possible, to exact dimensions noted in construction details unless otherwise approved.
2. Prior to installation, stake out all pressure supply line routing and sprinkler head locations.
3. Entire layout shall be approved by Architect prior to installation.

2.4 APPLICATION

A. Piping:

1. Install all plastic pipe and fittings according to manufacturer instructions.
2. All lines shall have a minimum clearance of 6 inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.
3. Installation of all on-structure piping (including waterproofing, securing of pipe, etc.) shall be by Others. Coordinate irrigation lines as required with Plumbing Contractor. Stub out all irrigation piping (capped) in planting area, minimum 6 inches from structure line. Refer to irrigation plan for approximate routing.
4. Coordinate installation of piping shown through walls as required with General Contractor to avoid penetrating walls if possible. If penetration is necessary, coordinate and waterproof.
5. Scale of drawing may not permit indicating all sleeving required. Provide sleeves for all piping under paved areas. Refer to sections that pertain to sleeving material, size, etc.
6. All major plumbing work using copper pipe shall be performed by a licensed and bonded Plumbing Contractor. Irrigation Contractor shall obtain all permits required

B. Trenching:

1. Excavate trenches to required depths. Follow approved layout for each system.
2. Trench bottom shall be flat to ensure piping is supported continuously at prepared grade.
3. Where lines occur under paved areas, consider dimension to be below the sub-grade.
4. Provide minimum coverage as follows:
   a. Pressure supply lines (2 inches and smaller): 18 inches, unless otherwise noted on drawing.
   b. Non-pressure lines: 12 inches, unless otherwise noted on drawing.
   c. Landscape dripline tubing: 4 inches (or under mulch cover)
   d. Distribution tubing: 4 inches

C. Tracer Wires:

1. Carefully place tracer wire on bottom of trench under vertical projection of pipe, avoiding stress from backfilling and running wire continuously throughout the length of pipe.
2. Tracer wire shall follow main line pipe and branch lines, terminating in a yard box with a gate valve that controls these main irrigation lines. Provide sufficient wire to reach surface grade, bending back end of wire to form a loop, and attach a Dymo-Tape type plastic label noting “TRACER WIRE.”
3. All splices shall be made using Scotch-lok or equal, encased in epoxy resin to provide a permanent U.L. approved watertight connection.

D. Backfilling:

1. Buried pipe in trenches shall be center loaded only until all required tests are performed. Carefully backfill trenches with approved excavated materials such as earth, loam, sandy clay, sand, or other approved materials free from large clods of earth or stones. Mechanically compact backfill in landscaped areas to a dry density equal to adjacent undisturbed soil in planting areas. Backfill must conform to adjacent grades without dips, depressions, humps or other surface irregularities.

2. Place fine granular material backfill on all lines initially. No foreign matter larger than 1/2 inch in size will be permitted in the initial backfill.
3. Flooding of trenches will be permitted only with approval of the Architect.
4. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn, planting, etc. are necessary, make all such adjustments without cost to the Owner.

E. Trenching and Backfill Under Paving:

1. Backfill trenches located in heavy clay soil under areas where paving, asphaltic concrete or concrete will be installed shall have sand 6 inches below and 3 inches above the pipe. Compact in layers to 95 percent compaction using manual or mechanical tamping devices. Compact trenches for piping to equal the compaction of the existing adjacent undisturbed soil and leave in a firm, unyielding condition. All trenches shall be flush with the adjoining grade. Pressure test all piping under paving prior to the paving work.
2. Install piping under existing walks by jacking, boring or hydraulic driving. Cut or break sidewalks and/or concrete as necessary and replace paving as a part of the contract cost. Obtain permission from the Architect to cut or break sidewalks and/or concrete. No hydraulic driving will be permitted under asphaltic concrete paving.
3. Coordinate installation of piping and sleeves under paved areas with General Contractor.
4. Install all p.v.c. piping crossing hardscape in a sleeve two pipe sizes larger than the piping, or as noted on drawing. Install wires under paving in separate sleeve of size required, or as authorized.

F. Assemblies:

1. Routing of sprinkler irrigation lines as indicated on the drawings is diagrammatic. Install lines and various assemblies to conform with details on plans.
2. Install NO multiple assemblies in plastic lines. Provide each assembly with its own outlet.
3. Perform all directional changes on pressure supply line using 45 degree elbows. No 90 degree elbows will be permitted without approval of Architect.
4. No more than one size may be used when reducing or increasing a fitting outlet, unless approved by Architect.
5. Install all assemblies specified herein in accordance with respective detail. In absence of detail drawings or specifications pertaining to specific items required to complete work, perform such work in accordance with best standard practice, with prior approval of the Architect.
6. Thoroughly clean p.v.c. pipe and fittings of dirt, dust and moisture before installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer.
7. On p.v.c. to metal connections, work the metal connections first. Use Teflon tape or approved equal on all threaded p.v.c. to p.v.c. and on all threaded p.v.c. to metal joints, with only light wrench pressure. Where threaded p.v.c. connections are required, use threaded p.v.c. adapters into which the pipe may be welded.
8. Install backflow assemblies in shrub areas at minimum height permitted by local code, unless otherwise approved. Flush pressure supply line before installing backflow prevention unit as required, to ensure piping is free of debris.
9. Verify exact location of all major equipment with the Architect before installation.
10. Install remote control valves in shrub areas and perpendicular to hardscape unless otherwise approved.

11. Unless otherwise approved, locate quick coupling valves within 12 inches of hardscape or at separation between shrub and lawn areas.
12. Locate tree irrigators at each tree. Install as indicated on drawings, including vents, strainers, etc.

G. Automatic Controller:
1. Install per manufacturer instructions. Connect remote control valves to controller in numerical sequence shown on the drawings.
2. Mount controller inside the electrical box or pedestal.
3.
4.

H. Flushing of System:
1. After all new sprinkler pipe lines and risers are in place and connected, all necessary diversion work has been completed, and prior to installation of sprinkler heads, open the control valves and flush out the system using adequate pressure.
2. Install sprinkler heads only after the system has been flushed to the complete satisfaction of the Architect.

I. Sprinkler Heads (if applicable):
1. Install the sprinkler heads per the drawings and according to their respective detail.
2. Spacing of heads shall not exceed 5 percent of width of planting area. Refer to plan, and bring any discrepancies to the attention of Architect.

J. Valve Boxes:
1. Install all buried valves and equipment in the specified box.
2. Fill area under box with a minimum of 3 cubic feet of 3/4 inch gravel for remote control valves and two cubic feet for gate valves and quick coupling valves, before box is installed.
3. Attach identification tags to each remote control valve, showing number that corresponds with controller sequence. Tags shall be manufactured of polyurethane Behr Desopaid, yellow in color with black letters, 2-3/4 inches by 2-1/4 inches.
4. Brand sequence number of each valve in minimum 2 inch high numerals into box top.
5. Install valve boxes in shrub areas unless otherwise approved.
6. Install valve boxes square to one another and to edges of adjacent hardscape, unless otherwise approved by Architect.

K. Electrical Supply:
1. Place low voltage wiring in the same trench and along side of main lines unless otherwise approved.
2. When more than one wire is placed in a trench, tape wires together at maximum 12 feet on center.
3. Provide a 12 inch expansion loop at each connection and directional change for low voltage wires and two feet for stub outs.
4. Use a continuous wire between controller and remote control valves. Except as otherwise approved, do not splice wire at any point. Enclose all approved splices in an U.L. approved junction box.

5. Provide each controller with separate ground wire.
6. Provide pull box for low voltage wires approximately every 200 feet along continuous lineal runs.
7. Provide electrical service for pumps as noted on drawing.

L. Protective Pipe Covering:
1. Clean buried pipe & fittings of all foreign substances and film.
2. Coat all surfaces with adhesive primer.
3. Wrap pipe & fittings with three layers of polyvinyl chloride tape. Overlap each layer approximately two thirds the width of tape without stretching.
4. Total wrap thickness shall be no less than 10 mils over all surfaces, with no voids.
5. Wrap all piping, fittings, and equipment noted to be frost protected with three layers of burlap, secured with one wrap of p.v.c. tape.

2.5 FIELD QUALITY CONTROL

A. Adjustment of the System:
1. Adjust all sprinkler heads and valves for optimum performance and to minimize overspray onto walks and roadways. Spray on buildings and/or windows will not permitted.
2. If it is determined that adjustments in the irrigation equipment will provide proper or more adequate coverage, make such adjustments prior to planting. Adjustments may include changes in nozzle sizes or trajectory of spray or degrees of arc, as may be required. Use variable arc nozzles where required.

B. Testing of Irrigation System:
1. Test all pressure lines under hydrostatic pressure of 150 pounds per square inch or 50 pounds more than normal static pressure (whichever is greater), and prove watertight.
2. Testing of pressure main lines must occur prior to installation of electric control valves, quick couplers or any other equipment that might prevent a proper test from being performed.
3. Test all piping under paved areas under hydrostatic pressure of 150 pounds per square inch, and prove watertight prior to paving.
4. Sustain pressure in lines for minimum 4 hours, unless otherwise authorized. If leaks develop (more than 5 percent), replace joints and repeat test until entire system is proven watertight.
5. All hydrostatic tests shall be conducted only in the presence of the Architect or other duly authorized representative of the Owner. Do not completely backfill pipe until it has been inspected, tested and approved in writing.
6. Furnish necessary force pump and all other test equipment, if permanent connection is unavailable.
7. When the sprinkler irrigation system is completed, perform a coverage test in the presence of the Architect to confirm that water coverage for planting areas is complete and adequate. Furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from plans, or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate without notifying the Architect. This test shall be accomplished before any planting occurs.

8. Provide handheld walkie-talkie or personnel as necessary to accomplish this task expeditiously.
9. Upon completion of each phase of work, test and adjust entire system to meet site requirements.
10. Test any low voltage wiring more than 50 feet long installed under paving for continuity prior to paving.

C. Final Observation Prior to Acceptance:

1. Operate each system in its entirety for the Architect at time of final observation. Any items deemed unacceptable by the Architect due to noncompliance with the specifications and drawings shall be corrected to the complete satisfaction of the Architect.
2. Operate the following at conclusion of maintenance period to confirm proper performance:
   a. automatic controller
   b. all drip systems
   c. all spray systems
3. Evidence must be shown to the Architect that the Owner has received all required equipment, charts, record drawings, etc. before final observation can occur.

D. Conclusion of Maintenance Period:

1. At end of maintenance period, submit written confirmation to Architect that the system is operating properly, as per final acceptance, and note any changes/adjustments made during maintenance period. Based on this, Architect may request additional site review.

2.6 maintenance

A. The entire sprinkler irrigation system shall be operated automatically for a period of seven days prior to any planting.

B. The Architect reserves the right to waive or shorten the operation period.

C. After maintenance period, demonstrate in presence of the Architect that the system is in proper operating order.

2.7 PROTECTION AND CLEANING

A. Perform cleanup as each portion of the work progresses. Remove refuse and excess dirt from the site, and sweep or wash down all walks and paving. Repair any damage to the work of others and return to original condition.

2.8 OPERATING INSTRUCTIONS

A. Train Owner's maintenance personnel in proper operation of all major equipment. Provide written confirmation of the person(s) so trained to the Architect.

B. During maintenance period, establish infiltration rate of soil in all areas (particularly slopes). Schedule automatic controller to not exceed saturation point, and program repeat cycles as required to meet landscape needs while avoiding runoff. At conclusion of maintenance period,

provide a typed record of the watering schedules for each valve during maintenance, including various schedules due to seasonal changes.

2.9 EXISTING LANDSCAPING

A. Protect all existing landscaping. Any existing landscaping removed or damaged shall be properly replaced, including sod, as directed by the Architect.

B. Verify that fencing has been provided around trees, located at the dripline (line of furthest branch of tree plus 3 feet). Notify Architect to review and approve final location of the proposed irrigation system layout and trenching in the vicinity of existing trees to be retained.

C. Do not excavate or install irrigation materials or equipment within the dripline of existing trees. Do not permit sprinkler heads to spray onto or within 5 feet of the trunks of existing trees. Use all possible care to avoid injury to trees and tree roots. Excavate by hand in areas where 2 inch and larger roots occur. Tunnel under all roots 2 inches and larger in diameter and heavily wrap with burlap, to prevent scarring or excessive drying.

D. Do not use ditching machine within the dripline of existing trees. In no case shall more than two sides of an existing tree be trenched for irrigation lines. Confirm trenching locations at existing trees with Owner to obtain approval prior to trenching. Where roots are encountered outside the dripline, hand trim the wall of the trench adjacent to the tree, making clean cuts through. Paint roots 1 inch and larger in diameter with two coats of Tree Seal, or equivalent. Close trenches adjacent to tree within 24 hours. Where this is not possible, shade the side of the trench adjacent to the tree with burlap or canvas.

2.10 SERVICES/DATA TO BE PROVIDED BY THE CONTRACTOR

A. Water schedules

B. Training of Owner's personnel in proper operation of all major equipment

C. Equipment to be supplied per Section 1.05, E.

D. The Contractor shall leave the site area broom-clean daily leaving the premises in a clean condition. All walks shall be left in a clean and safe condition.

E. After all irrigation operations have been completed, remove all trash and rubbish from the property. The Contractor shall pick up all trash resulting from this work no less frequently than each Friday before leaving the site or the last working day of each week. All trash shall be removed completely from the site.

END OF SECTION 32 8400

SECTION 32 9000 – LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes all labor, material, equipment and services necessary to provide all landscape planting, complete in place, as shown and specified herein, including soil preparation, planting, seeding, staking and cleanup.

1. Landscape Maintenance and Plant Establishment - Section 32 0190.
2. Landscape Irrigation System - Section 32 8400.

B. Any plant deemed Not Available shall be noted in the bid. Failure to qualify availability of specified material shall make the Contractor responsible for all supplying of all material. Maintenance period may not begin until specified materials are installed.

1.3 SUBMITTALS

A. The Owner’s Authorized Representative reserves the right to take and analyze samples of materials for compliance with these specifications at any time. The Contractor shall furnish samples upon request by the Owner’s Authorized Representative. Rejected materials shall be immediately removed from the site at the Contractor's expense. Cost of testing of materials not meeting these specifications shall be paid by Contractor.

B. Provide soil tests as noted on the drawings. Planting recommendations may be revised based on soil test results.

C. Submit documentation to the Owner’s Authorized Representative within forty-five (45) calendar days after date of award of Contract that all plant material is available. The Contractor shall be responsible for all material listed on plant list. Any and all substitutions due to availability shall be requested in writing prior to confirmation of ordering. All materials shall be subject to observation by the Owner’s Authorized Representative at any time after confirmation of ordering.

D. Plants shall be subject to observation and preliminary acceptance by the Owner’s Authorized Representative at place of growth or upon delivery for compliance with these specifications. Such observation shall not impair the right of observation and rejection during progress of the work. Tagging of plant material by the Owner’s Authorized Representative is for design intent only and does not constitute the Owner’s Authorized Representative's approval of the plant materials in regards to their health and vigor. The health and vigor of the plant materials is the sole responsibility of the Contractor. Submit written request for observation of plant material at place of growth to the Owner’s Authorized Representative. Written request shall state the place of

growth and quantity of plants to be observed. The Owner's Authorized Representative reserves the right to refuse observation at this time if, in his judgment, a sufficient quantity of plants is not available for inspection.

E. The Contractor shall submit specifications of any item being used on site upon the request of the Owner's Authorized Representative.

F. The Contractor shall submit color photos of plant materials as noted on the drawings.

G. For contract-grown materials, Contractor shall submit contract growing nursery's name to Owner's Authorized Representative for approval prior to start of contract growing activity. It shall be the Contractor's responsibility to coordinate any contract growing activities so as to meet the approved construction schedule requirements. All cost associated with contract growing shall be the Contractor's responsibility.

1.4 QUALITY ASSURANCE

A. In all cases where observations are required, notify the Owner's Authorized Representative and the Owner at least four working days in advance of the time of observation.

B. Required observations are listed below:
   1. Materials:
      a. Specimen and box size plant materials shall be observed at source prior to delivery to site.
      b. Upon delivery of plant material to site:
         1) All plant material shall be observed and approved by the Owner's Authorized Representative for quality, size and variety prior to installation. Such approval shall not impair the right of observation and rejection during the progress of work for size and condition of ball or root mass, latent effects, diseases, pests or injuries.
         2) A maximum of two observations for approval of plant material will be made by the Owner's Authorized Representative. For the first observation, the Contractor shall present not less than 50% of the total of required plant material. The Contractor shall submit the remainder at the second observation.
         3) If any defective or non-complying plants are found during observations, they will be rejected.
         4) All rejected plant material shall be removed from the site within a minimum of two working days.

C. Workmanship:
   1. Observation of site at critical stages of work.
   2. Observation for approval of landscape finish grading and soil preparation before installation of plant material:
      a. During this observation the Owner's Authorized Representative may request that samples of the prepared soil be analyzed by an approved laboratory to assure its compliance with these Specifications.

b. Notification of exception shall be for the Contractor to correct deficiencies in the soil preparation to render it in compliance with these specifications. Corrections shall be made prior to any planting, or, at the Owner's Authorized Representative's option, the installation of container sized plants may proceed if the corrections can be made later without affecting the quality of the work. The Contractor shall notify the Owner's Authorized Representative in writing when the deficiencies have been corrected.

D. Material and Workmanship:

1. Observation by the Owner's Authorized Representative will be made at substantial completion of all materials, construction and installation work required by the Contract prior to commencement of the plant establishment period. The plant establishment period shall not commence until all deficiencies found by this observation have been corrected and written notice of start of commencement has been received from the Owner's Authorized Representative. All materials shall be installed prior to this observation with the following exceptions:

a. Items waived by the Owner's Authorized Representative for this observation for reasons of substantiated unavailability, or in appropriate season or weather.

b. Items which do not affect the health or growth of the plantings.

2. Periodic observation shall be made of the work of the Contract during plant establishment period. See Landscape Maintenance and Plant Establishment Specification Section 32 090.

E. Certifications:

1. Submit a certificate if requested by the Owner's Authorized Representative of delivery slip with each delivery of material in containers or in bulk. Certificates shall state source, quantity, or weight, type and analysis and date of delivery. Materials which are not pre-packaged shall have analysis completed by an approved independent testing laboratory (see plans). Deliver all certificates to the Owner's Authorized Representative prior to installation, incorporation or application of the material.

a. Quantities of fertilizer.

b. Quantities of soil amendments.

F. Schedules:

1. When observations are conducted by someone other than the Owner's Authorized Representative, the Contractor shall show evidence in writing of when and by whom these observations were made.

2. No site visits shall commence without all items noted in previous Observation Reports either completed or remedied unless such compliance has been waived by the Owner. Failure to accomplish punch list tasks or prepare adequately for desired observations shall make the Contractor responsible for reimbursing the Owner's Authorized Representative at his current billing rates per hour (plus transportation costs). No further observations shall be scheduled until this charge has been paid and received.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. Deliver fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trademark, and compliance with all applicable laws.
2. Deliver all plant blocks with legible identification labels.
    a. State correct plant name and size indicated on plant list.
    b. Use durable waterproof labels with water-resistant ink which will remain legible for at least 60 calendar days.
3. Protect plant material during delivery to prevent damage to rootball, branches, and leaves.
4. The Contractor shall notify the Owner’s Authorized Representative fourteen (14) calendar days in advance of delivery of all plant materials and shall submit an itemized list of the plants in each delivery.

B. Storage:
1. Store plant material in shade and protect from weather.
2. Maintain and protect plant material not to be planted within four (4) hours in a healthy, vigorous condition.

C. Handling:
1. The Contractor shall exercise care in handling, loading, unloading and storing of plant materials. Plant materials that have been damaged in any way shall be discarded and if installed, shall be replaced with undamaged materials at the Contractor's expense.

D. Scheduling:
1. Prior to commencement of landscaping work, the Contractor shall arrange a conference at the site with the Owner’s Authorized Representative. The conference shall include the Contractor, the Superintendent appointed to oversee the work of this Section and the Owner’s Authorized Representative. At least eight (8) working days notice shall be given prior to the conference. The Contractor shall prepare a schedule of work items and this shall be reviewed at the conference.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Perform actual planting only when weather and soil conditions are suitable and will not be detrimental to the plant material. Do not apply during inclement weather or when forecasted conditions will not permit work in accordance with manufacturer's printed instructions.

1.7 WARRANTY

A. All plant material installed under the Contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship. Shrubs and groundcover shall be growth and health guaranteed by installer for a period of 90 days after completion of maintenance period.

B. Within 15 days after notification by Owner, remove and replace failed plantings. Replacement plantings shall be guaranteed as specified for original plantings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The following soil amendments and fertilizers are to be used for bid price basis only. Specific amendments and fertilizer specifications will be made after rough grading operations are complete and soil samples are tested by the Contractor.

B. All materials shall be of standard approved and first-grade quality and shall be in prime condition when installed and accepted. Any commercially processed or packaged material shall be delivered to the site in the original unopened container bearing the manufacturer's guaranteed analysis. The Contractor shall supply the Owner's Authorized Representative with a sample of all supplied materials within fourteen (14) days after award of contract, accompanied by analytical data from an approved laboratory source or bearing the manufacturer's guaranteed analysis. Amendments may be modified based on analysis provided.

C. Organic Amendment:

1. Type 1: Amend' available from Kellogg Supply Company, Torrance, CA 213/830-2200.

    a. Silica: under 2%.

    b. pH: 6.0 to 7.5.

    c. Non-calcareous.

    d. Salinity: The saturation extract conductivity shall not exceed 5.0 millimhos/centimeter at 25 degrees centigrade as determined by saturation extract method.

    e. Ash: 10% min.; 25% max.

D. Soil Amendments:

1. Soil Sulfur: Agricultural grade sulfur containing a minimum of 99% sulfur (expressed as elemental).
2. Iron Sulfate: 20% Iron (expressed as metallic iron), derived from ferric and ferrous sulfate, 10% sulfur (expressed as elemental).
3. Calcium Carbonate Lime: 95% lime as derived from oyster shells.
4. Gypsum: Agricultural grade product containing 90% minimum calcium sulfate.
5. Dolamite Lime:
   21% calcium
   11% magnesium

E. Fertilizer:

1. Planting Fertilizer: Pelleted or granular form shall consist of the following percents by weight and shall be mixed by commercial fertilizer supplier:

a. 6% nitrogen
b. 20% phosphoric acid
c. 20% potash

2. Nitroform: 38-0-0 slow release organic nitrogen.

3. Single Super Phosphate:
   a. Commercial product containing 18-20% available Phosphoric Pentoxide, or equal.

4. DAP (Di-Ammonium Phosphate): 18-46-0
5. Import Top Soil:
   a. Silt plus clay content of the Import soil shall not exceed 20% by weight with a minimum 95% passing the 2.0 millimeter sieve. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECe) of the saturation extract of this soil shall not exceed 3.0 millimhos per centimeter at 25 degrees centigrade. The boron content shall be not greater than 1 part per million as measured on the saturation extract. In order to insure compliance with these specifications, samples of the import soil shall be submitted to an approved laboratory for analysis prior to, and following, backfilling.

6. Herbicide:
   a. Round-up
7. Plant Material:
   a. Plants shall be in accordance with the California State Department of Agriculture's regulation for nursery inspections, rules and rating. All plants shall have a normal habit of growth and shall be sound, healthy, vigorous and free of insect infestations, plant diseases, sunscalds, fresh abrasions of the bark, excessive abrasions, or other objectionable disfigurements. Tree trunks shall be sturdy and have well 'hardened' systems and vigorous and fibrous root systems which are not root or pot-bound. In case the sample plants inspected are found to be defective, the Owner’s Authorized Representative reserves the right to reject the entire lot or lots of plants represented by the defective samples. Any plants rendered unsuitable for planting because of this inspection shall be considered as samples and shall be provided at the expense of the Contractor.
   b. The size of the plants shall correspond with that normally expected for species and variety of commercially available nursery stock or as specified on drawings. The minimum acceptable size of all plants measured before pruning with the branches in normal position, shall comply with the measurements, if any, specified on the drawings in the list of plants to be furnished. Plants larger in size than specified may be used with the approval of the Owner’s Authorized Representative, but the use of larger plants shall not change the contract price.
   c. All plants not in compliance with the requirements herein specified, will be considered defective and such plants, whether in place or not, shall be marked as rejected and immediately removed from the site of the work and replaced with new plants at the Contractor's expense. The plants shall be of the species, variety, size, and conditions specified herein or as shown on the drawings. Under no conditions

shall there be any substitutions of plants or sizes listed on the accompanying plans, except with the express consent of the Owner's Authorized Representative.

d. Pruning: At no time shall plant materials be pruned, trimmed or topped prior to delivery and any alteration of their shape shall be conducted only with the approval and when in the presence of the Owner's Authorized Representative.

e. Plant material shall be true to botanical and common name and variety as specified in "Sunset Western Garden Book" (current edition).

f. Nursery Grown and Collected Stock:

1) Plants shall be grown under climatic conditions similar to those in locality of project.

8. Water: Furnished by Owner, transport as required.

9. Mulch:

a. The mulch shall consist of fibrous, woody bark mixture not derived from Redwood or Eucalyptus, of varied particle size such that:

Physical Properties:

Percent Passing	Sieve Size
90-100	25.4 mm (1")
80-100	12.7 mm (1/2")
20-60	6.35 mm (1/4")

2.2 EXAMINATION

A. The Contractor to obtain Owner's Certification that final grades to +/-0.10' have been established prior to commencing planting operations. Provide for inclusion of all amendments, settling, etc. Contractor shall be responsible for shaping all planting areas as indicated on plans or as directed by the Owner's Authorized Representative.

B. Inspect shrubs and liner stock plant material for injury, insect infestation and trees and shrubs for improper pruning.

C. Do not begin planting until deficiencies are corrected or plants replaced.

2.3 PREPARATION

A. Soil Preparation:

1. If live weeds exist on site, strip and remove and replace top 1" of soil.

2. After approximate finished grades have been established, soil shall be conditioned and fertilized in the following manner. Soil should be slightly damp, but not muddy during rototilling.

a. Prior to amending, the surface soil shall be cross ripped to a minimum nine (9) inch depth.

b. The following shall be uniformly broadcast and blended to a six (6) inch depth per 1,000 sq. ft.:

1) Organic amendment - 6 cu. yds.

2) Planting fertilizer - 15 lbs.
3) Agricultural gypsum - 200 lbs.
4) Soil sulfur - 20 lbs.
5) Urea formaldehyde - 8 lbs.

3. At time of planting, the top two inches of all areas to be planted or seeded shall be free of stones, stumps, earth clods, or other deleterious matter 1" in diameter or larger, and shall be free from all plastic, wire, plaster, obvious foreign matter or similar objects that would be a hindrance to planting or maintenance. The top 12" of soil shall be free of all stones, stumps or other deleterious matter 3" in diameter or larger.

B. Final Grades:

1. Bring soil to grades as indicated on drawings, importing soils as necessary and anticipating the installation of soil amenders and settling and/or compaction.
2. Finish grading shall insure proper drainage of the site as determined by the Owner's Authorized Representative.
3. All areas shall be graded so that the final grades will be 1" below adjacent paved areas, sidewalks, valve boxes, headers, tree well grates, planter rims, clean-outs, drains, manholes, etc., or as indicated on plans for turf, and 1 1/2" for shrubs and groundcovers.
4. Surface drainage shall be away from all building foundations.
5. Eliminate all erosion scars prior to commencing maintenance period.
6. Compact all soil to final grades: min. 65%, max. 75%, unless otherwise required by soils report or for structural reasons.

C. Disposal of Excess Soil:

1. Dispose of any unacceptable or excess soil at an off-site location approved by the Owner.

2.4 APPLICATION

A. General:

1. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice as approved by the Owner's Authorized Representative.
2. Only as many plants as can be planted on that same day shall be distributed in a planting area. All plants shall be watered within 2 hours of planting.
3. Containers shall be opened and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken and they shall be planted and watered as herein specified immediately after removal from the containers. Containers shall not be opened prior to placing the plants in the planting area.

B. Pre-Plant Weed Control:

1. After soil preparation, irrigate and fertilize all planting areas for approximately 7-14 calendar days to achieve weed germination.
2. If live weeds exist on site after irrigating and at the beginning of work, spray with a non-selective systemic contact herbicide, as recommended and applied by an approved licensed landscape pest control advisor and applicator. Leave sprayed plants intact for at least fifteen (15) days to allow systemic kill.

3. Clear and remove all weeds by grubbing off all plant parts at least 1/4" below the surface of the soil to be planted.
4. Repeat process as necessary or as directed by the Owner's Authorized Representative.
5. Do not plant until herbicide manufacturer indicates planting will not be affected by herbicide residue.
6. Maintain site weed-free at all times. Degree of acceptability shall be solely determined by Owner's Authorized Representative.
7.

C. Layout of Major Plantings:
1. Locations for container plants shall be spotted and outlines of groundcover areas to be planted shall be marked on the ground by the Contractor before any planting or excavation begins. All such locations shall be approved by the Owner's Authorized Representative. Layout shall be accomplished by setting container plants or grade stakes with plants identified in locations indicated on plans, and with gypsum lines for groundcover areas. If underground construction or utility lines are encountered in the excavation of planting areas, other locations for planting will be selected as approved by the Owner's Authorized Representative.

D. Planting of Shrubs:
1. Excavate planting pits at twice the diameter of rootball with roughened surfaces and one and one half times the depth.
2. The top of the rootball should be slightly above final grade.
3. Uniformly blend 2 lbs. of iron sulfate and 1/2 lb. planting fertilizer per cubic yard of backfill soil.
4. Organic material is not required in the backfill. A soil blend consisting of no more than 20% by volume organic matter shall be placed in the upper twelve (12) inches of backfill only. Soil below this depth shall not contain any organic matter.
5. Place slow release fertilizer tablets in the upper twelve (12) inches of backfill at manufacturer's recommended rates.
6. Construct a two (2") inch water berm on the outside edge of rootball.
7. Cover the rootball with a mulch.
8. Excess soil generated from the planting holes and not used as backfill or in establishing the final grades shall be removed from the site.
9. Protect all areas from excessive compaction when trucking plants or other material to the planting site. Cross rip all compacted areas to a 12-inch minimum depth.
10. Center plant in pit or trench.
11. Face plants with fullest growth into prevailing wind or as directed by the Owner's Authorized Representative.
12. Set plant plumb and hold rigidly in position until soil has been placed firmly around ball or roots.
13. All plants which settle deeper than the surrounding grade shall be raised to the correct level.
14. Box Removal: Remove bottom of plant boxes before planting. Remove sides of box without damage to rootball after positioning plant and partially backfilling.
15. Pruning: Pruning shall be limited to the minimum necessary to remove injured twigs and branches. Pruning may not be done prior to delivery of plants.

E. Planting of Groundcovers

1. Flat grown plants shall remain in those flats until transplanting. The flat's soil shall contain sufficient moisture so that it will not fall apart when lifting the plants.
2. Groundcover shall be planted in straight rows and evenly spaced, unless otherwise noted, and at intervals called out in the drawings. Triangular spacing shall be used unless otherwise noted on the drawings.
3. Each rooted plant shall be planted with its proportionate amount of flat soil. Plantings shall be immediately sprinkled after planting until the entire area is soaked to the full depth of each hole.
4. Care shall be exercised at all times to protect the plants after planting. Any damage to plants by trampling or other operations of this Contract shall be repaired immediately.

F. Mulch Cover:

1. All groundcover, perennial, and annual beds to be dressed with a minimum of 3” deep layer of mulch after settlement, not later than one week after planting. No mulch shall be applied prior to the first watering of plant materials.

G. Pruning:

1. All dead wood or suckers and all broken or badly bruised branches shall be removed back to a live bud, branch or stem. Never cut a leader and do not trim back the tips of branches.

2.5 PROTECTION AND CLEANING

A. The Contractor shall leave the site area broom-clean daily leaving the premises in a clean condition. All walks shall be left in a clean and safe condition.

B. After all planting operations have been completed, remove all trash, excess soil, empty plant containers and rubbish from the property. All scars, ruts or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site. The Contractor shall pick up all trash resulting from this work no less frequently than each Friday before leaving the site or the last working day of each week. All trash shall be removed completely from the site.

END OF SECTION 32 9000

SECTION 31 91 13 – SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide all soil and soil amendments products, including all imported topsoil as required to make up deficiencies in quantity of soil available on site. Execute all labor to achieve soil preparation, complete, as shown and as specified.

B. Products Installed But Not Furnished Under This Section:

Polystyrene Fill - Section 32 91 23, Polystyrene Fill

Sub Drainage - Section 33 46 00 , Perforated Pipe, Drainage Fabric

C. Related Work:

Section 31 221 9 Finish Grading

Section 32 84 00 Planting Irrigation

Section 32 90 00 Planting

D. Unit Pricing: Price for all accessories and components shall be included in the unit price of that item for which it is furnished.

Item	Unit	Pricing
1. Drainage Fabric	Square	Foot
2. Organic Amendments	Cubic	Yard
3. Soil Mixes	Cubic	Yard
4. Topsoil Import	Cubic Yard	

1.2 DEFINITIONS

A. Existing Soil: Area of undisturbed native soil where no rough grading is to be done. No topsoil is to be placed. Only surface cultivation and soil amending are included in this Section. See Drawings.

B. Subgrade: Soil level resulting from the rough grading work under another Section. Cultivation of all subgrade areas prior to amending is included in this section.

C. Topsoil: Soil stockpiled for spreading over prepared subgrade.
   1. Stockpiled Native Topsoil: Topsoil stripped from the site prior to rough grading work under another Section, to be spread and amended as work under this Section.
   2. Imported Topsoil: Off site topsoil imported and stockpiled under this Section, to be spread and amended also as work under this Section.

D. On-Structure: Planted areas to be installed on top of concrete structure built under another Section.

1.3 SUBMITTALS

A. Product Data: Manufacturer's current catalog cuts and specifications of the following:
   1. Fertilizer
   2. Nitrogen-treated sawdust
   3. Peat moss
   4. Herbicide
   5. Filter Fabric

B. Quality Control Submittals:
   1. Testing Agency: Fruit Growers Laboratory, 853 Corporation St. (PO Box 272) Santa Paula, CA 93060 (805) 525-3824.
   2. Test Reports:
      a. Nitrogen-treated Sawdust: Test for physical and chemical properties.
      b. Lightweight Soil Mix: Test for physical and chemical composition and saturated weight per cu.ft.
      c. Imported Topsoil: Test for parasitic nematodes and herbicide contamination. Acceptability will be determined by Soils and Plant Laboratory.
   3. Certificates: Certify strict compliance with accepted soil mixes and amendments, including rate of application.

1.4 SEQUENCING AND SCHEDULING: Do not install on-structure drainage materials and soil mix prior to acceptance of waterproofing per architect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stockpiled Native Topsoil:
   1. Quantity: The approximate quantity of stockpiled native top-soil will not be known until demolition and rough grading have been completed under Civil work.

2. Stockpiling: Stripped topsoil shall have been stockpiled on the site under Civil work (if any).
3. Composition: Fertile, friable, well-drained soil, of uniform quality, free of stones over 1 in. diameter, sticks, oils, chemicals, plaster, concrete and other deleterious materials.
4. Analysis: Obtain an agricultural suitability analysis of the proposed topsoil from an accepted, accredited Testing Agency at Contractor's cost.
5. Test Results: Request Testing Agency to send one (2) copies of test results direct to the Owner's representative. Imported topsoil shall be amended per soils analysis report.

B. Imported Topsoil:
1. Quantity: Import topsoil as soon as an insufficient quantity of native soil is verified. Quantity of topsoil to complete the work shall be calculated by the Contractor.
2. Cost: Paid for by the Owner on a unit price cost per cubic yard.
3. Stockpiling: Stockpile on site as directed by Owner.
4. Composition: To match or exceed in quality accepted native stockpiled topsoil, as determined by analysis similar to that described above.
5. Samples: The Landscape Architect reserves the right to take samples of the imported topsoil delivered to the site for conformance to the Specifications.
6. Rejected Topsoil: Immediately remove rejected topsoil off the site at Contractor's expense.

2.2 SOIL MIXES

A. Acid-Loving Planting Soil Mix (For Azaleas, Camellias, Rhododendrons, etc.):

Amount per Plant Pit

2 parts Soil from Plant Pit

1 part Fine Sand

1 part Peat Moss

B. On-Structure Planting Soil Mix:

Amount per Cubic Yard

1/2 cu. yd. Fine Sand

1/4 cu. yd. Peat Moss

1/4 cu. yd. Treated Fir/Pine Bark

1 lb. Calcium Nitrate

3 lbs. Single Superphosphate

3/4 lbs. Potassium Sulfate

9 lbs. Dolomite Lime

2.3 ACCESSORIES

A. Fine Sand:
1. Physical Properties (by dry weight basis):

Percent Passing	Sieve Size	
100	4.76	mm(#4, 4 mesh)
95-100	1.00	mm (#18, 16 mesh)
65-100	500	micron (#35, 32 mesh)
0- 50	250	micron (#60, 60 mesh)
0- 20	105	micron (#140, 150 mesh)
0- 5	53	micron (#270, 270 mesh)

2. Chemical Properties: (by Saturation Extract Method):
   a. Soluble Salts/Salinity: Maximum conductivity of 3.0 millimhos/cm at 25 degrees C.
   b. Boron: Maximum concentration of 1.0 ppm.
   c. Sodium Absorption Ratio (SAR): Maximum 6.0.

B. Pre-emergence Weed Control: "Treflan 5G", by Elanco Products Co., (317) 261-3638, or (209) 486-3020 or "Enide 50W", by TUCO, (616) 385-6609.

C. Water: Clean, fresh and potable, as available from Owner. Transport as required.

D. Perforated Drain Pipe: See Section 02720 - Landscape Drainage.

E. Polystyrene Fill: See Section 02235 - Polystyrene Fill.

F. Drain Rock:
1. Description: Hard, durable, clean, screened, uniformly-sized broken stone or crushed gravel free of injurious materials or soil and all deleterious chemicals.
2. Size: One (1) in. diameter, gap-graded.

G. Enkadrain:
1. Description: Two-layer composite polyester non-woven filter fabric bonded to a compression - resistant nylon matting of open, three-dimensional construction.
2. Product: #9010 by American Enka as distributed by American Excelsior Co., (916) 383-3835.

2.4 ORGANIC COMPONENTS

A. Peat Moss:
1. Type: Finely-shredded, brown in color, suitable for horticultural purposes and frequently referred to in the trade as "greenhouse" or "coarse grind".

2. Measurement: Measure peat in air dry condition, containing not more than 35% moisture by weight on an "as-received" basis. Ash content shall not exceed 10%.
3. Physical Properties:

   Percent Passing Sieve Size

95-100	9.51	mm	(3/8		in.)
0- 40	500	micron	(#35,	32	mesh)

4. Organic Content (dry weight basis): 90-100%
5. Chemical Properties:
   Nitrogen (dry weight basis): 0.6-3.0%

   Salinity/Soluble Salts: Saturation extract conductivity 0.0-3.0 millimhos/cm @ 25 degrees C.

   pH: 3.0-4.5
6. Acceptable Substitute: Ground redwood bark by Lindauer Products, Santa Rosa, CA, per specifications for peat moss.

B. Nitrogen-Treated Sawdust:
1. Type: Derived from redwood, fir or cedar wood sawdust.
2. Physical Properties:
   Percent Passing Sieve Size

95-100	6.35	mm.	(1/4		in.)
80-100	2.38	mm.	(#8,	8	mesh)
0- 30	500	micron	(#35,	32	mesh)

3. Chemical Properties:
   Nitrogen content (dry weight basis):
   Wood of Redwood 0.4 - 0.6%
   Wood of Fir/Cedar 0.56 - 0.84%
   Iron content (dry weight basis): 0.08% iron as metallic, minimum.
   Salinity/Soluble salts: Maximum 3.5 millimhos/cm 25 degrees C. as determined by saturation extract method.
   Ash (dry weight basis): 0 - 6.0 percent maximum.

C. Treated Fir/Pine Bark:
1. Physical Properties (dry weight basis):
   Percent Passing Sieve Size

95-100	6.35	mm	(1/4		in.)
80-100	2.38	mm	(#8,	8	mesh)
0- 30	500 micron (#35, 32 mesh)				

2. Organic Content (dry weight basis): 94 percent minimum as determined by ash analysis.
3. Chemical Properties:

   Nitrogen Content (dry weight basis): 0.8 percent minimum.

Soluble Salts/Salinity: Maximum Saturation Extract Conductivity 3.0 millimhos/cm at 25 degrees C, by method.

Iron (dry weight basis): 0.08 percent minimum.

pH: 6.5 - 7.5

4. Wettability:
   a. When applied to a cup or small beaker of water @ 70 degrees F. in the amount of 1 teaspoon, the air-dry product shall become completely wet in a period not exceeding 2 minutes.
   b. All wetting agents to be non-phytotoxic at rate used.

D. Rice Hulls:
1. Type: Standard by-product of rice harvesting.
2. Age: Minimum six (6) months old with maximum 10% chaff.

2.5 COMMERCIAL FERTILIZERS

A. Pre-Plant Fertilizer:
1. Type: Mixed by a commercial fertilizer supplier and consisting of the following percent by weight:

6-20-20 (N-P-K)

2. Manufacturer: Sierra Chemical Co., (408) 263-8080 or W.R. Grace and Co., (800) 527-1893.

2.6 CHEMICAL COMPONENTS: The following additives may or may not be used depending on the outcome of the soils report.

A. Ground Limestone: Agricultural limestone containing not less than 85% of total carbonates, ground to such fineness that 50% will pass #100 sieve and 90% will pass #20 sieve.

B. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35% minimum magnesium carbonate and 49% minimum calcium carbonate, 100% passing #65 sieve. "Kaiser Dolomite 65 AG" by Kaiser, Inc. Mineral Products Department, or accepted equal.

C. Gypsum: Agricultural grade product containing 80% minimum calcium sulphate.

D. D Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20% to 30% iron and 35% to 40% sulphur.

E. Sulphate of Potash: Agricultural grade containing 50% to 53% of water-soluble potash.

F. Single Superphosphate: Commercial product containing 20% to 25% available phosphoric acid.

G. Ammonium Sulphate: Commercial product containing approximately 21% ammonia.

H. Ammonium Nitrate: Commercial product containing approximately 34% ammonia.

I. Calcium Nitrate: Agricultural grade containing 15-1/2% nitrogen.

J. Urea Formaldehyde: Granular commercial product containing 38% nitrogen.

K. I.B.D.U. (Iso Butyldiene Diurea): Commercial product containing 31% nitrogen.

L. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96% sulfur.

M. Iron Sequestrene: Geigy Iron Sequestrene 330 Fe, by Ciba-Geigy Corporation, (919) 292-7100.

PART 3 - EXECUTION

3.1 SOIL MOISTURE CONTENT

A. General: Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tilling and planting.

B. Range: Maintain within 2 percent above or below optimum moisture content at all times during the work.

3.2 CLEARING AND CULTIVATION

A. Clearing: Clear all planting areas of stones 2 in. diameter and larger, weeds, debris and other extraneous materials prior to soil preparation work.

B. Cultivation of Existing Soil:
   1. Cultivation: Rip or cultivate areas of existing soil to receive planting to a depth of 6 in. immediately prior to applying soil amendments.
   2. Trees to Remain: Hand cultivate within the dripline of existing trees to remain. Depth of cultivation shall not exceed 2 in. Cultivate immediately prior to amending existing soil.

C. Cultivation of Subgrade:
   1. Verification:
      a. Verify that subgrades for installation of topsoil have been established under rough grading. Do not spread topsoil prior to acceptance of subgrade work.
      b. Depth: Verify that subgrades are 6 in. minimum below finished grades, + 1 in. Report all variations.
   2. Cultivation: Rip or cultivate subgrade in planting areas to a depth of 6 in. immediately prior to spreading topsoil.

3.3 SPREADING OF TOPSOIL

A. General: Spread Stockpiled topsoil over accepted subgrade prior to incorporating amendments.

B. Restrictions: Do not commence spreading of topsoil prior to acceptance of soil cultivation above. Do not place topsoil under muddy conditions.

C. Topsoil Depth: Minimum depth of 12 in. after natural settlement and light rolling conforming to finished grades shown on Drawings.

3.4 SOIL AMENDMENT

A. Amending of Existing Soil:
   1. Preparation: Do not commence amending of existing soil prior to acceptance of soil cultivation above. Do not work soils under muddy conditions.
   2. Soil Amendments per 1,000 Square Feet: Incorporate thoroughly with top six (6) in. of all existing planting areas:

      cubic yards organic amendment as specified in soil's report

      pounds preplant fertilizer - 6-20-20 (N-P-K) in groundcover/ shrub planting areas, as specified in soil's report.

      Chemical additives per soils report, if any

B. Amending of Spread Topsoil:
   1. Soil Amendments per 1,000 square feet: Incorporate thoroughly with top six (6) in.:

      6 cu.yd. Nitrogen-treated Sawdust

      30 lbs. 6-20-20 Commercial Fertilizer

      50 lbs. Dolomite Lime

      10 bs. Iron Sulfate

      15 lbs. Polymer Amendment

   2. Intent: The above amendments and quantities are approximate and are for bidding purposes only. Following an on-site topsoil analysis by Testing Agency, composition of amendments may change. Contract Price will be adjusted accordingly.

3.5 PRE-EMERGENT HERBICIDE

A. Apply pre-emergent weed control to all (on-grade) areas to receive woody, non-lawn ornamental planting after incorporating soil amendments.

B. Apply strictly according to manufacturer's current printed specifications.

3.6 BLENDING OF SOIL MIXES

A. Acid-loving Planting Mix: Thoroughly bulk blend all mixes in stockpiles on site. Do not blend in individual planters.

B. On-Structure Planting Mix:
   1. Blending: Thoroughly bulk-blend materials uniformly in stockpiles.
   2. Testing: Retain a Testing Agency to certify conformance of materials to Specifications and to prepare one laboratory control sample of planting soil mix in accordance with the Specifications.

3.7 PLACEMENT OF ON-STRUCTURE

A. Perforated Drain Pipe: Install where shown in accordance with manufacturer's latest printed instructions.

B. Enkadrain: Place to locations and depths shown on the Drawings.

C. Filter Fabric: Install over drain pipe in accordance with manufacturer's latest printed instructions. Lap joints 8 in. minimum. Return filter fabric up walls of planting areas to 6 in. below top of walls. Do not install so that longitudinal joint is contiguous with drain pipe.

D. Polystyrene Fill: Install with treated wood skewers as shown on the Drawings. See Section 02235 - Polystyrene Fill.

E. Protection of Filter Fabric: Provide a 2 in. protective layer of specified planting mix over filter fabric.

F. Irrigation: Install irrigation system.

G. Clean out Access: add 8 in. diameter PVC clean out access and cap. Coordinate with Civil and/or Mechanical work.

H. On-Structure Soil Mix: Compact initial placement of soil mix by thoroughly watering or jetting the entire planter. Refill all low spots with soil mix and repeat compacting process until final finish grades are achieved.

I. Depth of On-Structure Soil Mix: Install to a maximum depth of 18 in., exclusive of plant pits, unless placed in raised planters. Balance of fill below 18 in. shall consist of fine sand.

3.8 FIELD QUALITY CONTROL

A. Tests: Right is reserved to take samples of soil mixes for testing for conformity to Specifications.

B. Rejected Materials: Remove off site at Contractor's cost. Pay cost of testing of materials, not meeting Specifications.

END OF SECTION 32 91 13

SECTION 331100 – WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements: Provide water distribution system, complete, as indicated on the Drawings or inferable therefrom and/or as specified in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Product Data: Submit copies of manufacturer's specifications and installation instructions for each material. Include certification or other data verifying compliance with required characteristics. Indicate by transmittal form that copy of each has been distributed to the Installer.

B. Shop Drawings: Submit layout and shop drawings as required under Section Submittals. Include details of reinforced concrete structures.

C. Test Reports: Submit certified Test Reports showing compliance of the following items in accordance with Section General Conditions.

1. Laboratory test for bedding and trench stabilization materials.
2. Concrete design mix.
3. Compression tests.
4. Water Test Reports: Submit results of water sample tests by State or local health authorities

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.
3. The Contractor shall have one copy of the Standard Specifications at the job site.
4. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and pavement sections do not apply to this document.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

E. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify ARCHITECT and OWNER'S REPRESENTATIVE not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without OWNER'S REPRESENTATIVE written permission.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to materials during loading, transportation, and unloading. Store equipment with moving parts off ground on platforms or skids.

1.6 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPE AND FITTINGS

A. PVC, Schedule 40 (NPS 1/8 to NPS 3 ½): ASTM D 1785. Suitable for potable water distribution and manufactured in compliance with NSF Standards.

1. Fittings: PVC, Schedule 40 Socket Fittings: ASTM D 2466.

B. PVC, AWWA Pipe (NPS 4 to NPS 12): AWWA C900, Class 305 DR 14, with bell-and-spigot or double-bell ends.

1. PVC to PVC Fittings: Push-on-Joint, PVC Fittings, ASTM 3139, with elastomeric gasket bell ends, conforming to ASTM D2122 for bell measurements.
2. PVC to Metal Fittings, Valves, and Accessories: Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts. Use corrosion resistant, high strength, low alloy steel, bolts and nuts where in contact with corrosive soil ASTM A 325.

2.3 VALVES

A. AWWA, UL/FM Cast-Iron, Gate Valves:

1. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509 and UL/F.M. approved, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

a. Minimum Working Pressure: 200 pounds per square inch gauge (psig).
b. End Connections: Flanged, push-on rubber gasketed, or mechanical joint, as required.
c. Interior Coating: Complying with AWWA C550.

2.4 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately five-inch diameter barrel. Fabricate valve box cover to fit snugly to prevent displacement by traffic.

1. Operating Wrenches: Steel tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

B. Vertical-Type Indicator Posts: UL 789, FM-approved, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve with tamperproof electrical supervisory switch for connection to the fire alarm control panel system.

2.5 VALVE APPLICATION

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

1. Where specific valve types are not indicated, the following requirements apply:

    a. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated, gate valves with valve box.
    b. Underground Valves, NPS 4 and Larger, for Vertical-Type Indicator Posts: UL/FM, Cast-iron, nonrising-stem gate valves with indicator post.

2.6 WATER METERS

A. Water meter(s) indicated on drawings shall be installed by the local water purveyor for the area, unless noted otherwise.

2.7 BACKFLOW-PREVENTION DEVICES

A. General: FM Approved, AWWA, UL Classified, Approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California.

1. Working Pressure: Maximum working pressure shall be at least 175 pounds per square inch (psi), unless otherwise indicated.
2. Interior Components: Corrosion-resistant materials.
3. Exterior Components: Assembly shall be provided with flanged connections, ductile iron or epoxy coated construction.

B. Reduced-Pressure-Principle Backflow Preventers: Suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2, air-gap fitting located between two positive-seating check valves. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

C. Reduced-Pressure-Detector Assembly Backflow Preventers: Suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; pressure-differential relief valve with ASME A112.1.2, air-gap fitting located between two positive-seating check valves; and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

D. Double-Check-Valve Backflow Prevention Assemblies: Suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

E. Double-Check-Detector Assembly Backflow Preventers: Suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; two positive-seating check valves; and bypass with displacement-type water meter, valves, and double-check backflow preventer. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

2.8 FIRE DEPARTMENT CONNECTIONS

A. Exposed, Freestanding, Fire Department Connections: UL 405, cast-bronze body, with thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch high brass sleeve; and round escutcheon plate, and all appropriate check valves per NFPA 24.

1. Escutcheon Plate Marking: “AUTO SPKR"

2.9 THRUST BLOCKS AND ANCHORS

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.
5. Mix Design: Unless otherwise noted in plans: Portland cement mix design, 2,000 pounds per square inch (PSI) minimum 28-day compressive strength, aggregate gradation “C” per SSPWC 201-1.3.2, maximum slump four inches.

B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examination: Examine substrates, adjoining construction and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected

3.2 PREPARATION

A. Field Measurements: Verify dimensions before proceeding with Work. Obtain field measurements for work required to be accurately fitted to other construction. Be responsible for accuracy of such measurements and precise fitting and assembly of finished work.

3.3 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Copper Tubing Soldered Joints: ASTM B 828. Use flushable flux and lead-free solder.

4. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
5. PVC Schedule 40 and 80 (NPS 1/8 to NPS 3 ½): Use solvent welding techniques in accordance with ASTM D2855 and the manufacturer's recommendations.
6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.4 PIPING INSTALLATION

A. Project site water lines shall terminate approximately five feet from buildings, unless otherwise indicated on Drawings. Install temporary cap or plug terminals for future connection to building.

B. Bury piping with depth of cover over top at least 36 inches, unless otherwise indicated.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.

D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

E. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

F. Install PVC, AWWA pipe according to AWWA M23 and ASTM F 645.

G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports for all lines NPS 3 or greater.

H. Water Main Connection: Arrange and pay for tap in the water main, water meter, and all associated fees from the water purveyor.

3.5 CLEARANCE OF WATER LINE

A. Building or Structure: Two feet minimum horizontal separation.

B. Sewer crossing:

1. Typical Conditions: Lay water mains over sanitary sewers to provide vertical separation minimum three feet.
2. Unusual Conditions: If above separation cannot be met, for sewers less than three feet below the water pipe, use the following:

    a. Install water line with all joints located at least four feet from each side of the sewer pipe.
    b. Sewer pipe encased in six inches concrete around pipe, and extend four feet either side of water main.

C. Parallel to Sewer Line: Water line shall not be installed in a common trench with the building sanitary sewer unless both of the following requirements are met:

1. The bottom of the water pipe, at all points, shall be at least 12 inches above the top of the sewer.
2. The water pipe shall be placed on a solid shelf excavated at one side of the common trench with a minimum clear horizontal distance of at least 12 inches from the sewer.

3.6 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches for all lines NPS 3 or greater. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Fire-Service-Main Piping: According to NFPA 24.

3.7 VALVE INSTALLATION

A. Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. Vertical-Type Indicator Post Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

3.8 BACKFLOW-PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers with relief drain in vault or other space subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support three-inch and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

E. Access and clearance shall be provided for the required testing, maintenance and repair. Access and clearance shall require a minimum of one foot between the lowest portion of the assembly and grade or platform.

F. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

3.9 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install fire department connections of types and features indicated.

B. Install ball drip valves at each check valve for fire department connection to mains.

3.10 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. Refer to Division 31 Section "Earth Moving" for tape specifications.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: The piping shall be subjected for a minimum of two hours to a pressure of one and one-half times the working pressure, but in no case less than 150 pounds per square inch (psi). Examine all exposed pipe, joints, fittings and accessories during the test period. Replace or repair defective portions of the system, and repeat tests until results are satisfactory.

1. Allowable leakage shall be as specified in AWWA C-600, Table 3.

C. Prepare reports of testing activities.

3.12 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:

    a. Fill system or part of system with water/chlorine solution containing at least 50 parts per million (ppm) of chlorine; isolate and allow to stand for 24 hours, or
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 parts per million (ppm) of chlorine; isolate and allow to stand for three hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331100

ECTION 333100 – SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:

1. Cleanouts.
2. Precast concrete manholes.

1.2 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.3 SUBMITTALS

A. Manufacturer’s product data for pipe and fittings.

B. Field quality-control test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.4 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Shielded, Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: Forty-eight inches, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: Six-inch minimum thickness for floor slab and four-inch (100-mm) minimum thickness for walls and base riser section and having separate base slab or base section with integral floor.
4. Riser Sections: Four-inch minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, one-half-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.

10. Grade Rings: Reinforced concrete rings, six- to nine-inch total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: Ferrous; 24-inch ID by seven- to nine-inch riser with four-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording "SANITARY SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile iron or ASTM A 48/A 48M, Class 35 gray-iron, unless otherwise indicated.

2.6 CLEANOUTS

A. Frame and Cover:

1. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

    a. Top-Loading Classification: Light and Medium duty.

2. PVC Cleanouts: PVC body with PVC threaded plug.

B. Pipe and fittings, except as otherwise show on plan, shall be of the same material as the sewer, unless approved adapters are utilized.

2.7 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 3,250 pounds per square inch (psi) minimum unless otherwise noted, Aggregate Gradation “C” per SSPWC 201-1.3.2 and 0.45 maximum water/cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 3,250 pounds per square inch (psi) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

    a. Invert Slope: Two percent through manhole unless otherwise noted.

2. Benches: Concrete, sloped to drain into channel.

    a. Slope: Four percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3,250 pounds per square inch (psi) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

    a. Shielded flexible couplings for same or minor difference OD pipes.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.2 PIPING INSTALLATION

A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

B. Install manholes for changes in direction if shown on plan, otherwise use fittings. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of one percent, unless otherwise indicated.
2. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

E. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
5. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

3.4 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground sanitary utility piping. Locate below finished grade, directly over piping. Refer to Division 31 Section "Earth Moving" for tape specifications.

3.5 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops three inches above finished surface elsewhere, unless otherwise indicated.

3.6 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 15 Section "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus six-inch overlap, with not less than six inches of concrete with 28-day compressive strength of 3,250 pounds per square inch (psi).

3.7 FIELD QUALITY CONTROL

A. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

    a. Allowable leakage is maximum of 50 gallons/inch of nominal pipe size per mile of pipe, during 24-hour period.
    b. Close openings in system and fill with water.
    c. Purge air and refill with water.
    d. Disconnect water supply.
    e. Test and inspect joints for leaks.
    f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 pounds per square inch gauge (psig).

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

B. Leaks and loss in test pressure constitute defects that must be repaired.

C. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

END OF SECTION 333100

SECTION 334100 – STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage pipe and drainage structures outside the building.

1.2 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.3 SUBMITTALS

A. Product Data: For each type of product installed.

B. Field quality-control test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.4 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 CLEANOUTS

A. Frame and Cover:

1. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

    a. Top-Loading Classification: Light and Medium duty.

2. PVC Cleanouts: PVC body with PVC threaded plug.

B. Pipe and fittings, except as otherwise shown on plan, shall be of the same material as the storm drain, unless approved adapters are utilized.

2.6 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: Forty-eight inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: Six-inch minimum thickness for floor slab and four-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

4. Riser Sections: Four-inch minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990 bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, one-half-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, six- to nine-inch total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: Ferrous; 24-inch ID by seven- to nine-inch riser with four-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording "STORM DRAIN."

    a. Material: ASTM A 536, Grade 60-40-18 ductile iron or ASTM A 48, Class 35 gray iron, unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.
5. Pipe Collars, Ballast and Pipe Supports, Precast Manhole Components, Catch Basins, and Sidewalk Culverts: Portland cement design mix, 3,250 pounds per square inch (psi) minimum unless otherwise noted, Aggregate Gradation “C” per SSPWC 201-1.3.2, and with 0.45 maximum water-cementitious materials ratio.

    a. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
    b. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.8 CATCH BASINS

A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Base Section: Six-inch minimum thickness for floor slab and four-inch minimum thickness for walls and base riser section and having separate base slab or base section with integral floor.
2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

B. Frames and Grates:

1. ASTM A 536, Grade 60-40-18, ductile iron designed for A-16 (heavy traffic) structural loading unless otherwise indicated in plans.
2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.
3. Compliant with Americans with Disabilities Act (ADA).
4. Heelproof.
5. Grate size as indicated per plans.
6. Risers shall be seven inches to nine inches tall with four-inch minimum width flange.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

a. Shielded flexible couplings for same or minor difference OD pipes.
b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.2 PIPING INSTALLATION

A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

B. Install manholes for changes in direction if shown on plan, otherwise use fittings. Use fittings for branch connections unless direct tap into existing storm drain is indicated.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of one percent, unless otherwise indicated.
2. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

E. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

3.3 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground storm drainage utility piping. Locate below finished grade, directly over piping. Refer to Division 31 Section "Earth Moving" for tape specifications.

3.4 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
4. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops three inches above finished surface elsewhere, unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

A. Set frames and grates to elevations indicated.

B. Provide storm drain piping connections to catch basins as indicated in the project drawings. Storm drain connections shall be to the catch basin side wall, not base.

3.7 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus six-inch overlap, with not less than six inches of concrete with 28-day compressive strength of 3,250 pounds per square inch (psi).

3.8 WATER QUALITY MANAGEMENT PLAN MITIGATION SYSTEMS INSTALLATION

A. All storm water mitigation systems proposed as a part of this project, and as approved by the local jurisdiction, are to be inspected by the Civil Engineer of Record during the installation process, after installation is complete, and prior to obtaining a certificate of occupancy.

1. Notify the Civil Engineer of Record at least 24-48 hours prior to the following (minimum) stages, in addition to those noted above, for inspection purposes:

    a. Excavation for system installation.
    b. Placement of gravel fills, system liners, piping, inlet and overflow piping, soil backfill, and planting where required.

3.9 FIELD QUALITY CONTROL

A. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sewers according to requirements of authorities having jurisdiction and the following:

    a. Allowable leakage is maximum of 50 gallons/inch of nominal pipe size per mile of pipe, during 24-hour period.
    b. Close openings in system and fill with water.
    c. Purge air and refill with water.
    d. Disconnect water supply.
    e. Test and inspect joints for leaks.

6. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 pounds per square inch gauge (psig).
7. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

B. Leaks and loss in test pressure constitute defects that must be repaired.

C. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

END OF SECTION 334100

ECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes subdrainage systems for foundations, underslab areas, retaining walls, and other subdrainage systems.

1.2 SUBMITTALS

A. Product Data: For perforated pipe, fitting and drainage panel.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated plastic pipe shall be either smooth-wall polyvinyl chloride plastic pipe, corrugated polyvinyl chloride plastic pipe with a smooth interior surface, or corrugated polyethylene plastic tubing.

1. Smooth-wall polyvinyl chloride plastic pipe shall conform to the requirements in AASHTO Designation: M 278.
2. Corrugated polyvinyl chloride plastic pipe with a smooth interior surface shall conform to the material and structural requirements in AASHTO Designation: M 278. The pipe shall have perforations located in the bottom half of the pipe, and the perforations shall consist of slots meeting the size and opening area requirements in AASHTO Designation: M 252. The inside diameter and diameter tolerances shall conform to the requirements of either AASHTO Designation: M 252 or M 278.
3. Corrugated polyethylene plastic tubing shall conform to the requirements in AASHTO Designation: M 252 or M 294.

2.2 PERFORATIONS

A. Perforations per ASTM F 758, section 7.2.4., and Table 5.

1. NPS 4: Two rows of perforations.
2. NPS 6 and 8: Four rows of perforations
3. NPS 10 and larger: Six rows of perforations.

2.3 FITTINGS

A. Polyvinyl chloride pipe shall be connected with belled ends, or with sleeve-type or stop-type couplings conforming to the requirements in AASHTO Designation: M 278. Polyethylene tubing shall be connected with snap-on, screw-on, or wrap-around fittings and couplings conforming to the requirements of AASHTO Designation: M 252 or M 294. Solvent cementing of joints will not be required.

2.4 SPECIAL PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant metal tension band and tightening mechanism on each end.

1. Unshielded Flexible Couplings: Elastomeric sleeve with corrosion-resistant metal tension band and tightening mechanism on each end.
2. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant metal tension band and tightening mechanism on each end.

2.5 DRAINAGE PANELS

A. Molded-Sheet Drainage Panels: Prefabricated geocomposite, 36 to 60 inches wide with drainage core faced with geotextile filter fabric.

1. Manufacturers:

    a. American Wick Drain Corporation – Amerdrain.
    b. Cosella-Dorken.
    c. CCW – MiraDrain.
    d. Eljen Corp.
    e. Greenstreak, Inc.
    f. JDR Enterprises, Inc.
    g. LINQ Industrial Fabrics, Inc.
    h. Midwest Diversified Technologies Incorporated.
    i. TC Mirafi.
    j. Any equivalent manufacturer.

2. Prefabricated Drainage Core: Three-dimensional, nonbiodegradable, molded PP or PS. Select prefabricated drainage core recommended by the manufacturer for the type of application specified elsewhere in the contract documents.

    a. Minimum Compressive Strength: 10,000 pound force (lbf)/square foot according to ASTM D 1621.
    b. Minimum In-Plane Flow Rate: Ten gallons per minute (gpm)/foot according to ASTM D-4716.

3. Filter Fabric: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties:

a. Grab Elongation: 60 percent maximum according to ASTM D-4632.
b. Apparent Opening Size: No. 70 sieve, minimum according to ASTM D-4751.
c. Water Flow Rate: 165 gpm/square foot according to ASTM D-4491.

2.6 SOIL MATERIALS

A. Backfill, drainage course, impervious fill, and satisfactory soil materials are specified in Division 2 Section "Earthwork."

2.7 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gallons per minute (gpm)/square foot when tested according to ASTM D 4491.

1. Structure Type: Nonwoven, needle-punched continuous filament or woven, monofilament or multifilament.
2. Style(s): Flat and sock.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 PIPING APPLICATIONS

A. Underground Subdrainage Piping:

1. Perforated PE pipe and fittings, couplings, and coupled joints.
2. Perforated PVC sewer pipe and fittings for loose, bell-and-spigot joints.

B. Underslab Subdrainage Piping:

1. Perforated PE pipe and fittings, couplings, and coupled joints.
2. Perforated PVC sewer pipe and fittings and loose, bell-and-spigot joints.

C. Header Piping:

1. PE drainage tubing and fittings, couplings, and coupled joints.
2. PVC sewer pipe and fittings, couplings, and coupled joints.

3.3 FOUNDATION DRAINAGE INSTALLATION

A. Install vertical drainage panels per manufacturer’s installation instruction and details or as follows:

1. Coordinate placement with other drainage materials.
2. Separate four inches of fabric at beginning of roll and cut away four inches of core. Wrap fabric around end of remaining core.
3. Attach panel to wall at horizontal mark and at beginning of pipe. Place core side of panel against wall. Use concrete nails with washers through product cylinders to attach panel to wall. Place nails from two to six inches below top of panel, approximately 48 inches apart. Construction adhesives, metal stickpins, or double-sided tape may be used instead of nails. Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer.
4. If additional panels are required on same row, cut away four inches of installed panel core, install new panel against installed panel, and overlap new panel with installed panel fabric.
5. If additional rows of panels are required, overlap lower panel with four inches of fabric.
6. Cut panel as necessary to keep top 12 inches below finish grade.
7. For inside corners, bend panel. For outside corners, cut core to provide three inches for overlap.

B. Place initial backfill material over compacted drainage course. Place material in loose-depth layers not exceeding six inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.4 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches, unless otherwise indicated.
2. Underslab Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
3. Lay perforated pipe with perforations down.
4. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install PE piping according to ASTM D 2321.

D. Install PVC piping according to ASTM D 2321.

3.5 PIPE JOINT CONSTRUCTION

A. Join PE pipe, tubing, and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties."

B. Join perforated, PE pipe and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties"; or according to ASTM D 2321.

C. Join PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.

D. Join perforated PVC pipe and fittings according to ASTM D 2729, with loose bell-and-spigot joints.

E. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties..

B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

C. Where required, connect low elevations of foundation or underslab subdrainage to storm water sump pumps.

3.7 FIELD QUALITY CONTROL.

A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.8 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

Appendix

LIGHTING TYPE A

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT provides consistent, high quality white light in an economical architectural solution.

FEATURES

- A complete range of color temperature options in 80+ and 90+ CRI
- Dim to Warm LED choices
- Downlight, adjustable and wallwash configurations
- Dry/damp/wet location rated for bathrooms and showers
- Dimmable to 1%
- High LED performance with budget-conscious features
- CEC Title 20 Compliant EM battery option

usailighting.com/primarynxt

PRIMARY NXT PERFORMANCE

at 3000K	Classic White		Dim-to-Warm and Dim-to-Warm+
	9W	15W	15W
CRI:	80+	80+	90+
Source Lumens:	1075	1575	1100

CORRELATED COLOR TEMPERATURE MULTIPLIER

Classic White	2700K		3000K		3500K		4000K	
Color Rendering Index:	80+	90+	80+	90+	80+	90+	80+	90+
Multiplier for Lumen Output:	0.98	0.81	1.00	0.84	1.02	0.98	1.06	0.98

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845-565-8500 F: 845-561-1130
info@usailighting.com

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LIGHTING TYPE A

Primary® NXT - P23F
Downlight and Wall Wash

USAI® Lighting

STEP 1. Specify housing type for downlight and/or wall wash

P23UF	15L2	UNV	D22	NCIC	HSG
Product	**Wattage**	**Voltage**	**Dimming Driver**	**Housing Type**	**Housing**
P23UF Primary NXT universal housing - for use with 3" downlight and/or wall wash trims, round and square	**09L2** 9W LED **15L2** 15W LED **15DW2** 15W LED	**UNV** 120V - 277V **120V Only**	**D22** 0-10V and Phase Dimming Driver, dims to 1% Note: Phase dimming option only available when using 120V only power **D21** Phase Dimming Driver, 1%	**NCEC** Economical new construction tray **NCIC** Insulation-contact rated, airtight **NCEM** New Construction with CEC Title 20 Compliant Emergency battery, above ceiling access required	**HSG** Rough-in housing

STEP 2. Specify trim and module type for downlight or wall wash

P3RDF	15L2	35KS	S	BLACK	TRM
Product	**Wattage Options**	**LED +Color Temperature**	**Lens**	**Finish**	**Trim**
P2RDF 1.75" SliverLED round aperture downlight (1) **P2SDF** 1.75" SliverLED square aperture downlight (1) **P2RWF** 1.75" SliverLED round aperture wall wash **P2SWF** 1.75" SliverLED square aperture wall wash **P3RDF** 3" BeveLED Mini round aperture downlight (1) **P3SDF** 3" BeveLED Mini square aperture downlight (1) **P3RWF** 3" BeveLED Mini round aperture wall wash **P3SWF** 3" BeveLED Mini square aperture wall wash	**Classic White** **09L2** 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI	**S** Solite Glass (provided standard with downlights) **D1** Wall Wash Diffusion (provided standard with wallwashers)	**WH** White **BLACK**	**TRM** Trim and LED Module Assembly
	Dim-to-Warm **15DW2** 15W LED	**3018KH** 3000K - 1800K, 90+ CRI			
	Dim-to-Warm + **15DW2** 15W LED	**3020KH** 3000K - 2000K, 90+ CRI			

Note:
1. Downlight trims ship with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes.

2. Housing ships with integral nailer bars provided standard. These mounting accessories are required for grid ceiling applications.

STEP 3. Specify mounting accessories (optional)

PFBK	
Butterfly Brackets Optional	**Channel Bars Optional***
PFBK Pair of butterfly brackets for vertical adjustment of Primary NXT housings (2)	**CB27** 27" Channel Bar **CB32** 32" Channel Bar **CB52** 52" Channel Bar * leave blank to order Butterfly Brackets without channel bar accessories

Replacement Parts for Field Changes (optional)

Trim	Lens / Optic
P2RDF 1.75" SliverLED round aperture downlight **P2SDF** 1.75" SliverLED square aperture downlight **P3RDF** 3" BeveLED Mini round aperture downlight **P3SDF** 3" BeveLED Mini square aperture downlight	**BF** Replacement frosted glass trim lens **SF** Replacement solite frosted trim lens **M** Replacement medium beam reflector, 30° beam **F** Replacement flood beam reflector, 65° beam

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13 Crosby Street
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T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE A

Primary® NXT - P23F Adjustable Downlight

USAI® Lighting

STEP 1. Specify housing type for adjustable downlight

Product	Wattage	Voltage	Dimming Driver	Housing Type	HSG Housing
P2AF 1.75" SliverLED adjustable for round and square trims **P3RAF** 3" BeveLED Mini round aperture adjustable **P3SAF** 3" BeveLED Mini square aperture adjustable	**09L2** 9W LED **15L2** 15W LED **15DW2** 15W LED	**UNV** 120V - 277V	**D22** 0-10V and Phase Dimming Driver, dims to 1% Note: Phase dimming option only available when using 120V only power	**NCAIC** Insulation-contact rated, airtight Adjustable **NCAEM** New Construction Adjustable with CEC Title 20 Compliant Emergency battery, above ceiling access required	**HSG** Rough-in housing
		120V Only	**D21** Phase Dimming Driver, 1%		

STEP 2. Specify trim and module type for adjustable downlight

Product	Wattage Options	LED +Color Temperature	Lens S	Finish WH	Trim TRM
P2RAF 1.75" SliverLED round aperture adjustable (1) **P2SAF** 1.75" SliverLED square aperture adjustable (1) **P3RAF** 3" BeveLED Mini round aperture adjustable (1) **P3SAF** 3" BeveLED Mini square aperture adjustable (1)	Classic White		**S** Solite Glass (provided standard)	**WH** White	**TRM** Trim and LED Module Assembly
	09L2 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI			
	Dim-to-Warm				
	15DW2 15W LED	**3018KH** 3000K - 1800K, 90+ CRI			
	Dim-to-Warm+				
	15DW2 15W LED	**3020KH** 3000K - 2000K, 90+ CRI			

STEP 3. Specify mounting accessories (optional)

Butterfly Brackets Optional	Channel Bars Optional*
PFBK Pair of butterfly brackets for vertical adjustment of Primary NXT housings (2)	**CB27** 27" Channel Bar **CB32** 32" Channel Bar **CB52** 52" Channel Bar * leave blank to order Butterfly Brackets without channel bar accessories

Note:
1.Adjustable fixtures ship with 25° optic installed. For other beam options and accessories, use ordering table below.

2. Housing ships with integral nailer bars provided standard. These mounting accessories are required for grid ceiling applications.

Specify optical accessories (optional)

Optical Accessory Type (optional)

Microdiffusion Lenses
AK20N - 20° Beam
AK30N - 35° Beam
AK40N - 40° Beam
AK55N - 45° Beam

Hexcell Louver
AKHEXN

Linear Spread
AK61N

Snoot included with each accessory kit

Specify housing collar extender accessory (optional)

Adjustable Housing Collar Extender Accessory (optional)

P2AF-1000	SliverLED Primary Collar extender, 1" max ceiling thickness
P2AF-1500	SliverLED Primary Collar extender, 1-1/2" max ceiling thickness
P3RAF-1000	BeveLED Mini Primary Round Collar extender, 1" max ceiling thickness
P3RAF-1500	BeveLED Mini Primary Round Collar extender, 1-1/2" max ceiling thickness
P3SAF-1000	BeveLED Mini Primary Square Collar extender, 1" max ceiling thickness
P3SAF-1500	BeveLED Mini Primary Square Collar extender, 1-1/2" max ceiling thickness

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13 Crosby Street
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T: 845–565–8500 F: 845–561–1130
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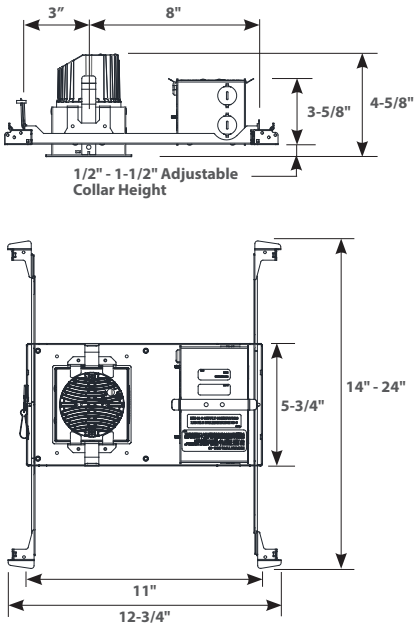
LIGHTING TYPE A

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

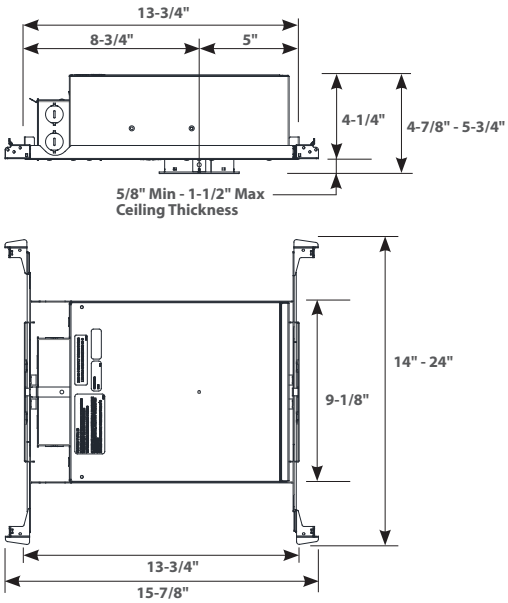
USAI® Lighting

Housing Details for Downlight and Wall Wash

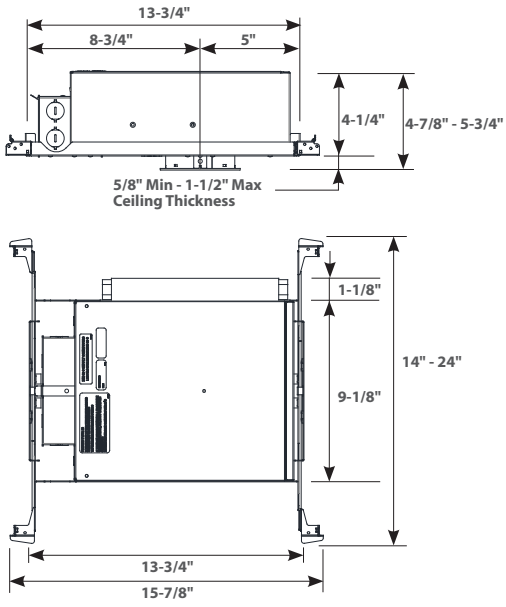
Economy Tray - NCEC



Insulation Contact Rated - NCIC

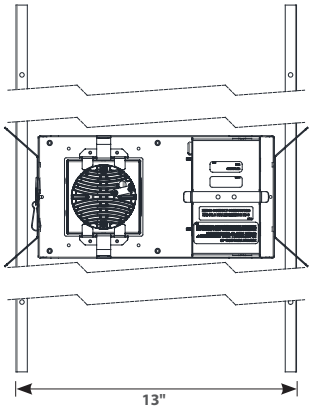


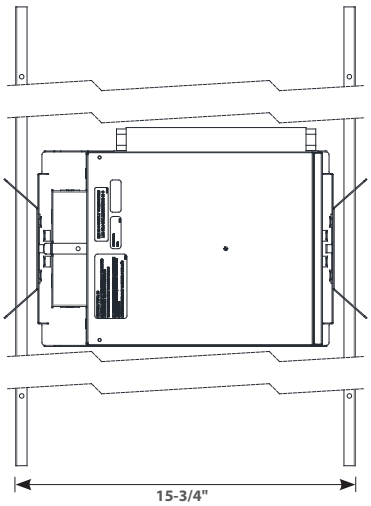
New construction with Emergency Battery - NCEM



Note: Emergency battery requires above ceiling access for service.

Shown with Butterfly Bracket and Channel Bar Kit PFBK-CB27 (optional)





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13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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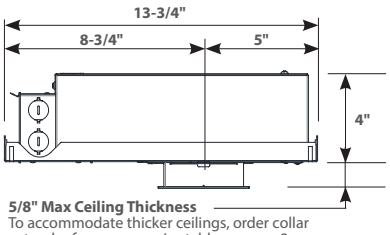
LIGHTING TYPE A

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

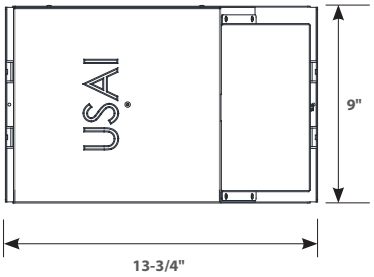
USAI® Lighting

Housing Details for Adjustable Downlight

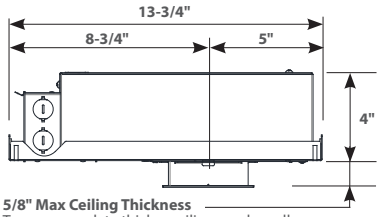
Insulation Contact Rated Adjustable - NCAIC



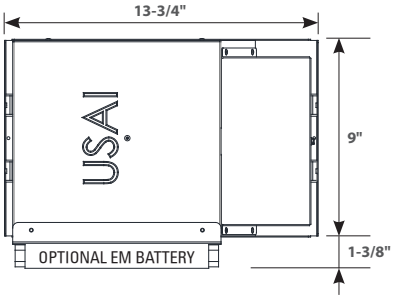
5/8" Max Ceiling Thickness
To accommodate thicker ceilings, order collar extender from accessories table on page 3



New construction with Emergency Battery - NCAEM



5/8" Max Ceiling Thickness
To accommodate thicker ceilings, order collar extender from accessories table on page 3



Note: Emergency battery requires above ceiling access for service.

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13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

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1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE A

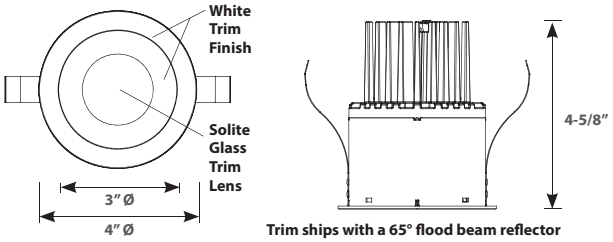
Primary® NXT - P23F

3″ Aperture Downlight and Wall Wash

USAI® Lighting

Trim Details

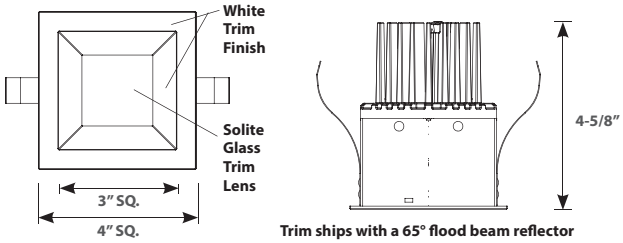
P3RDF ROUND DOWNLIGHT



Trim ships with a 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K. 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	900	775	1325	1100	825
Lumens Per Watt:	101	85	95	80	58

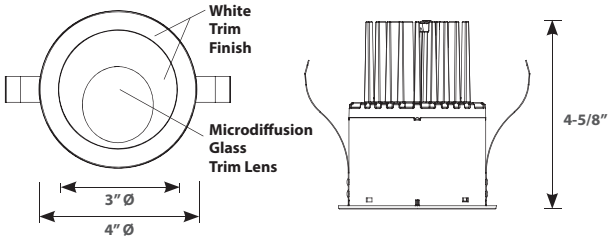
P3SDF SQUARE DOWNLIGHT



Trim ships with a 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K. 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	975	800	1400	1175	825
Lumens Per Watt:	107	90	100	84	59

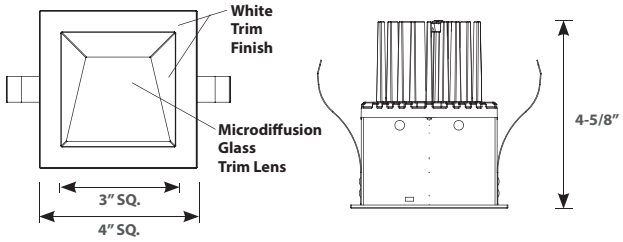
P3RWF ROUND WALL WASH



Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	525	450	775	650	625
Lumens Per Watt:	59	49	54	45	44

P3SWF SQUARE WALL WASH



Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	675	575	975	825	700
Lumens Per Watt:	75	63	69	58	49

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13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

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1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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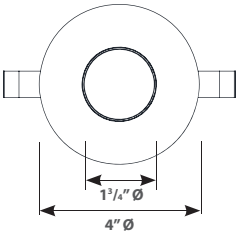
LIGHTING TYPE A

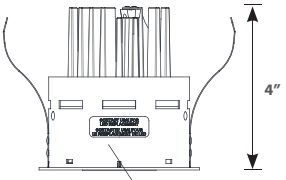
Primary® NXT - P23F
1.75" Aperture Downlight and Wall Wash

USAI® Lighting

Trim Details

P2RDF ROUND DOWNLIGHT

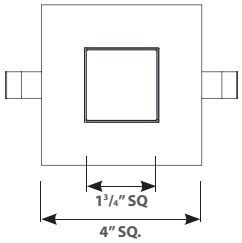


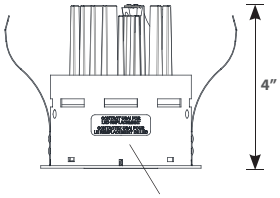


Trim ships with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K, 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	650	550	950	800	750
Lumens Per Watt:	74	62	68	57	51

P2SDF SQUARE DOWNLIGHT

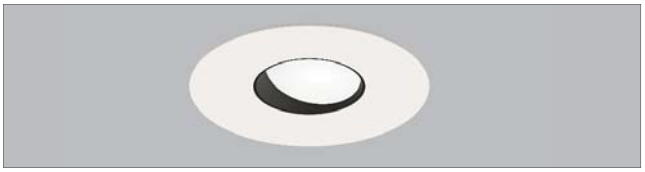


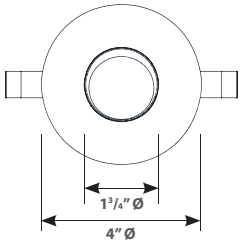


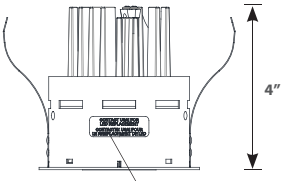
Trim ships with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K, 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	700	575	1000	850	700
Lumens Per Watt:	77	65	71	60	47

P2RWF ROUND WALL WASH



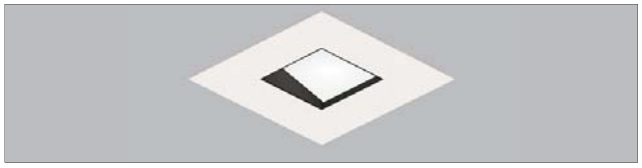


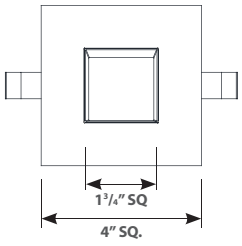


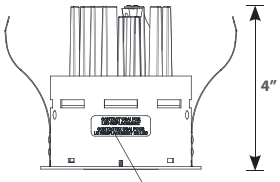
Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	475	400	675	575	600
Lumens Per Watt:	52	44	48	40	40

P2SWF SQUARE WALL WASH







Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	525	425	750	625	650
Lumens Per Watt:	57	48	53	44	43

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showroom@usailighting.com

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LIGHTING TYPE A

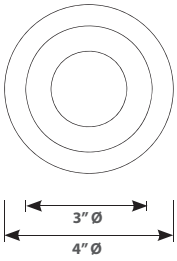
Primary® NXT - P23F

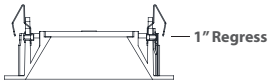
1.75" and 3" Aperture Adjustable Downlight

USAI® Lighting

Trim Details

P3RAF ROUND ADJUSTABLE

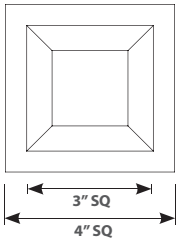


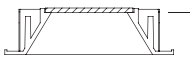


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	875	750	1275	1075	600
Lumens Per Watt:	98	83	92	78	43

P3SAF SQUARE ADJUSTABLE

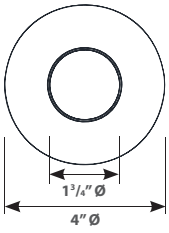


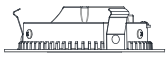


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	950	800	1375	1150	675
Lumens Per Watt:	105	88	98	82	49

P2RAF ROUND ADJUSTABLE

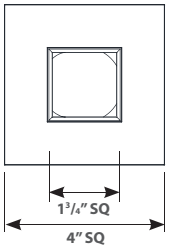


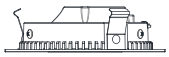


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	625	525	900	750	550
Lumens Per Watt:	70	58	65	55	38

P2SAF SQUARE ADJUSTABLE





Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	675	500	975	800	625
Lumens Per Watt:	74	62	69	58	44

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE A

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT Specifications

TRIM
P3 series trims are a 3" round or square aperture with a 1" regressed die cast aluminum bevel and 1/2" flange, retained by two mounting clips. and is available in white. P2 series trims are a 1.75" round or square aperture pinhole trim with a 1/4" regressed black baffle and a flat, 1-1/8" flange powdercoat painted white.

TRIM LENS
Downlight and adjustable trims are shipped with solite glass lens, and wall wash trim is shipped with integral microdiffusion glass lens.

ADJUSTMENT
Adjustable fixtures are provided with an adjustable optical assembly that can be rotated 362 degrees and tilted to aim up to 45 degrees maximum.

REFLECTOR
Downlight trim is shipped with 65° wide beam reflector installed in trim, and is also provided with interchangeable 30° medium beam reflector for field changes. Wall wash trim is shipped with wall wash optic installed. Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices.

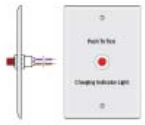
FIELD REPLACEABLE LED LIGHT ENGINE
is serviceable through the aperture with a Phillips screwdriver.

COLOR
All USAI Lighting Classic White LED light engines are tightly binned for industry-leading fixture-to-fixture color consistency within a 2-Step MacAdam Ellipse. The Dim to Warm LED option gradually shifts from 3000K, 90CRI to a natural-feeling 2000K or an even warmer 1800K as you dim and meets 3-Step MacAdam's consistency criteria.

RATED LIFE
Based on IESNA LM80-2008 50,000 hours at 70% lumen maintenance (L70).

FIELD REPLACEABLE DRIVER
Solid state electronic constant current phase or 0-10V dimming driver with a high power factor provided standard. Dimming driver can be connected to 0-10V low voltage wiring for dimming control at any voltage from 120V-277V, or can be used as a phase dimming driver when powered with 120V only power. See wiring diagrams for details. Dimming driver is located within the light fixture housing and can be serviced from below the ceiling through the aperture. Driver complies with IEEE C62.41 surge protection. Some on-time delay may be experienced depending on control system used.

INTEGRAL EMERGENCY BATTERY
An integral emergency battery pack is available as an option with the NCEM and NCAEM housings only, as a sidecar attachment that requires above ceiling access for service. AC Electronics emergency battery provides backup power for 90 minutes and is CEC Title 20 Compliant. EM option is provided with a remote test switch, which comes with a 24" lead length for location of the test switch. Fixtures that have no USAI EM option may be connected to an inverter (by others) for emergency lighting.



Remote Emergency Test Switch included
Above ceiling access required for service.

HOUSING
Primary NXT housings are universal and can accept any trim listed in the ordering table, whether round or square, downlight or wallwash, 3" or 1.75" apertures; simply punch out tabs during installation to configure the housing to work with the specific trim specified. NCEC housing is fabricated of black electrocoated 20 ga. steel with 18 ga. steel J-box. NCIC and NCAIC housings are airtight and are rated for direct contact with insulation. NCEM and NCAEM housings are provided with an emergency battery sidecar that requires above ceiling access for service.

MOUNTING
Adjustable nailer bars with integral nails provided standard with each housing. Nailer bars are extendible from 14" to 24" centers. Butterfly brackets are optionally available and can be used with the nailer bars provided to enable vertical adjustment during installation. Channel bars are available in 27", 32", and 52" lengths as an add-on accessory for use in grid ceiling systems, and these must be ordered as a kit with
butterfly brackets included because they cannot be used without them.

FIXTURE WEIGHT
NCEC housing weighs 5 lbs. NCIC and NCAIC housings weigh 7 lbs, NCEM and NCAEM housings weighs 9 lbs.

WARRANTY
USAI limited warranty covers replacement parts for 5 years from date of shipment.

CEILING CUT OUT
P3RDF, P3RWF, and P3RAF Round: 3-5/8" Ø
P3SDF, P3SWF, and P3SAF Square: 3-1/2" x 3-1/2"
P2RDF, P2RWF, and P2RAF Round: 3-5/8" Ø
P2SDF, P2SWF, and P2SAF Square: 3-5/8" Ø

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13 Crosby Street
New York, NY 10013
845-234-4090
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T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE A

Primary® NXT - P23F

1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT Specifications

LISTINGS

Dry/Damp/Wet. EM test switch is dry/damp only. UL2043 rated for use in air handling plenums. NCIC and NCAIC housings are Airtight. NRTL/CSA-US tested to UL standards. Rated for use in steam rooms and saunas, up to 15W maximum. EM battery pack is CEC Title 20 Compliant. IBEW union made. All USAI Lighting products are Buy American Act (BAA) compliant.

NOTES

- Not for use in corrosive environment
- Use of pressure washer voids warranty

PHOTOMETRICS

Consult factory or website for IES files. Tested in accordance with IESNA LM79.

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LIGHTING TYPE A-EM

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT provides consistent, high quality white light in an economical architectural solution.

FEATURES

- A complete range of color temperature options in 80+ and 90+ CRI
- Dim to Warm LED choices
- Downlight, adjustable and wallwash configurations
- Dry/damp/wet location rated for bathrooms and showers
- Dimmable to 1%
- High LED performance with budget-conscious features
- CEC Title 20 Compliant EM battery option

usailighting.com/primarynxt

PRIMARY NXT PERFORMANCE

at 3000K	Classic White		Dim-to-Warm and Dim-to-Warm+
	9W	15W	15W
CRI:	80+	80+	90+
Source Lumens:	1075	1575	1100

CORRELATED COLOR TEMPERATURE MULTIPLIER

Classic White	2700K		3000K		3500K		4000K	
Color Rendering Index:	80+	90+	80+	90+	80+	90+	80+	90+
Multiplier for Lumen Output:	0.98	0.81	1.00	0.84	1.02	0.98	1.06	0.98

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LIGHTING TYPE A-EM

Primary® NXT - P23F
Downlight and Wall Wash

USAI® Lighting

STEP 1. Specify housing type for downlight and/or wall wash

P23UF	15L2	UNV	D22	NCIC	HSG
Product	**Wattage**	**Voltage**	**Dimming Driver**	**Housing Type**	**Housing**
P23UF Primary NXT universal housing - for use with 3" downlight and/or wall wash trims, round and square	**09L2** 9W LED **15L2** 15W LED **15DW2** 15W LED	**UNV** 120V - 277V **120V Only**	**D22** 0-10V and Phase Dimming Driver, dims to 1% Note: Phase dimming option only available when using 120V only power **D21** Phase Dimming Driver, 1%	**NCEC** Economical new construction tray **NCIC** Insulation-contact rated, airtight **NCEM** New Construction with CEC Title 20 Compliant Emergency battery, above ceiling access required	**HSG** Rough-in housing

STEP 2. Specify trim and module type for downlight or wall wash

P3RDF	15L2	35KS	S	BLACK	TRM
Product	**Wattage Options**	**LED +Color Temperature**	**Lens**	**Finish**	**Trim**
P2RDF 1.75" SliverLED round aperture downlight (1) **P2SDF** 1.75" SliverLED square aperture downlight (1) **P2RWF** 1.75" SliverLED round aperture wall wash **P2SWF** 1.75" SliverLED square aperture wall wash **P3RDF** 3" BeveLED Mini round aperture downlight (1) **P3SDF** 3" BeveLED Mini square aperture downlight (1) **P3RWF** 3" BeveLED Mini round aperture wall wash **P3SWF** 3" BeveLED Mini square aperture wall wash	**Classic White** **09L2** 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI	**S** Solite Glass (provided standard with downlights) **D1** Wall Wash Diffusion (provided standard with wallwashers)	**WH** White **BLACK**	**TRM** Trim and LED Module Assembly
	Dim-to-Warm **15DW2** 15W LED	**3018KH** 3000K - 1800K, 90+ CRI			
	Dim-to-Warm + **15DW2** 15W LED	**3020KH** 3000K - 2000K, 90+ CRI			

Note:
1. Downlight trims ship with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes.

2. Housing ships with integral nailer bars provided standard. These mounting accessories are required for grid ceiling applications.

STEP 3. Specify mounting accessories (optional)

PFBK	
Butterfly Brackets Optional	**Channel Bars Optional***
PFBK Pair of butterfly brackets for vertical adjustment of Primary NXT housings (2)	**CB27** 27" Channel Bar **CB32** 32" Channel Bar **CB52** 52" Channel Bar * leave blank to order Butterfly Brackets without channel bar accessories

Replacement Parts for Field Changes (optional)

Trim	Lens / Optic
P2RDF 1.75" SliverLED round aperture downlight **P2SDF** 1.75" SliverLED square aperture downlight **P3RDF** 3" BeveLED Mini round aperture downlight **P3SDF** 3" BeveLED Mini square aperture downlight	**BF** Replacement frosted glass trim lens **SF** Replacement solite frosted trim lens **M** Replacement medium beam reflector, 30° beam **F** Replacement flood beam reflector, 65° beam

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE A

Primary® NXT - P23F Adjustable Downlight

USAI® Lighting

STEP 1. Specify housing type for adjustable downlight

Product	Wattage	Voltage	Dimming Driver	Housing Type	HSG Housing
P2AF 1.75" SliverLED adjustable for round and square trims **P3RAF** 3" BeveLED Mini round aperture adjustable **P3SAF** 3" BeveLED Mini square aperture adjustable	**09L2** 9W LED **15L2** 15W LED **15DW2** 15W LED	**UNV** 120V - 277V	**D22** 0-10V and Phase Dimming Driver, dims to 1% Note: Phase dimming option only available when using 120V only power	**NCAIC** Insulation-contact rated, airtight Adjustable **NCAEM** New Construction Adjustable with CEC Title 20 Compliant Emergency battery, above ceiling access required	**HSG** Rough-in housing
		120V Only	**D21** Phase Dimming Driver, 1%		

STEP 2. Specify trim and module type for adjustable downlight

Product	Wattage Options	LED +Color Temperature	Lens S	Finish WH	Trim TRM
P2RAF 1.75" SliverLED round aperture adjustable (1) **P2SAF** 1.75" SliverLED square aperture adjustable (1) **P3RAF** 3" BeveLED Mini round aperture adjustable (1) **P3SAF** 3" BeveLED Mini square aperture adjustable (1)	Classic White		**S** Solite Glass (provided standard)	**WH** White	**TRM** Trim and LED Module Assembly
	09L2 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI			
	Dim-to-Warm				
	15DW2 15W LED	**3018KH** 3000K - 1800K, 90+ CRI			
	Dim-to-Warm+				
	15DW2 15W LED	**3020KH** 3000K - 2000K, 90+ CRI			

STEP 3. Specify mounting accessories (optional)

Butterfly Brackets Optional	Channel Bars Optional*
PFBK Pair of butterfly brackets for vertical adjustment of Primary NXT housings (2)	**CB27** 27" Channel Bar **CB32** 32" Channel Bar **CB52** 52" Channel Bar * leave blank to order Butterfly Brackets without channel bar accessories

Note:
1.Adjustable fixtures ship with 25° optic installed. For other beam options and accessories, use ordering table below.

2. Housing ships with integral nailer bars provided standard. These mounting accessories are required for grid ceiling applications.

Specify optical accessories (optional)

Optical Accessory Type (optional)

Microdiffusion Lenses
AK20N - 20° Beam
AK30N - 35° Beam
AK40N - 40° Beam
AK55N - 45° Beam

Hexcell Louver
AKHEXN

Linear Spread
AK61N

Snoot included with each accessory kit

Specify housing collar extender accessory (optional)

Adjustable Housing Collar Extender Accessory (optional)

P2AF-1000	SliverLED Primary Collar extender, 1" max ceiling thickness
P2AF-1500	SliverLED Primary Collar extender, 1-1/2" max ceiling thickness
P3RAF-1000	BeveLED Mini Primary Round Collar extender, 1" max ceiling thickness
P3RAF-1500	BeveLED Mini Primary Round Collar extender, 1-1/2" max ceiling thickness
P3SAF-1000	BeveLED Mini Primary Square Collar extender, 1" max ceiling thickness
P3SAF-1500	BeveLED Mini Primary Square Collar extender, 1-1/2" max ceiling thickness

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showroom@usailighting.com

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info@usailighting.com

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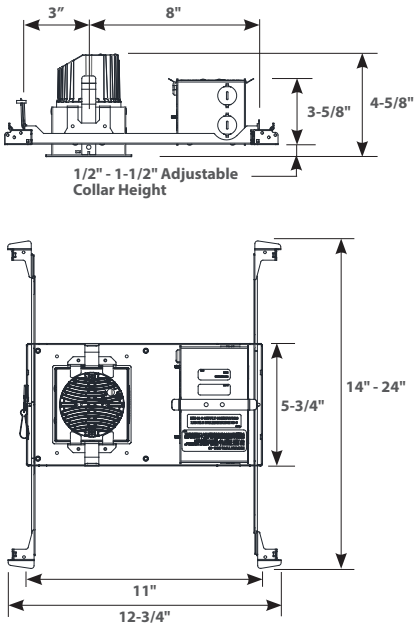
LIGHTING TYPE A-EM

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

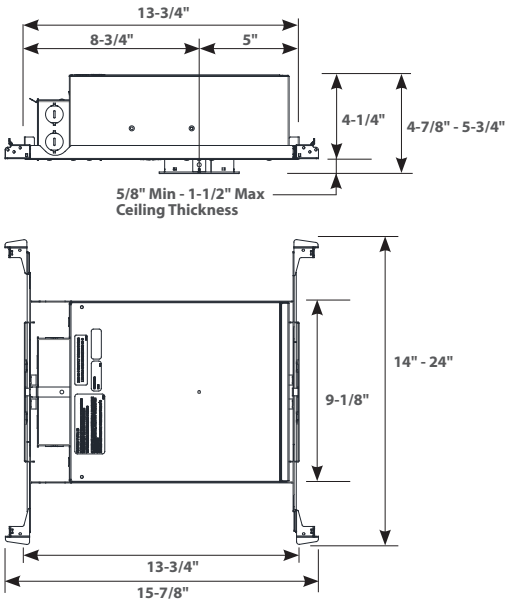
USAI® Lighting

Housing Details for Downlight and Wall Wash

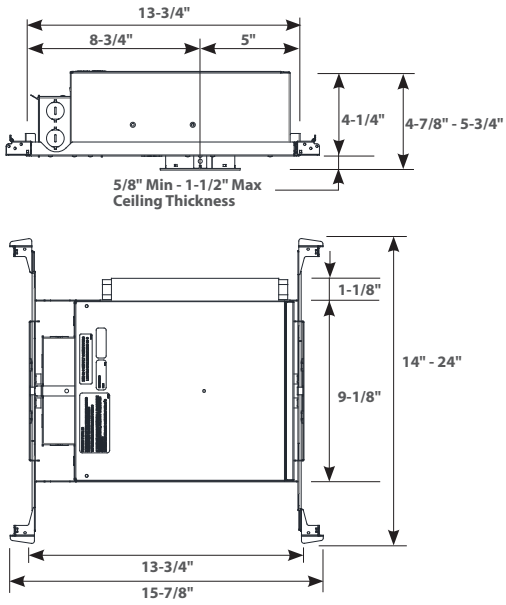
Economy Tray - NCEC



Insulation Contact Rated - NCIC

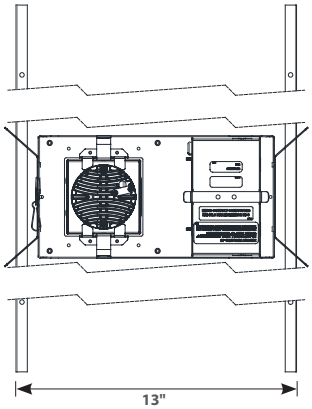


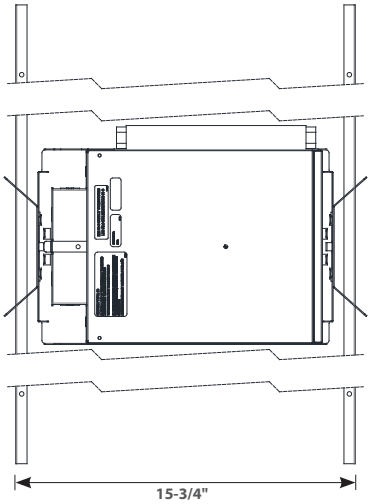
New construction with Emergency Battery - NCEM



Note: Emergency battery requires above ceiling access for service.

Shown with Butterfly Bracket and Channel Bar Kit PFBK-CB27 (optional)





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845-234-4090
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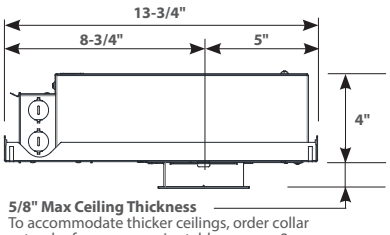
LIGHTING TYPE A-EM

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

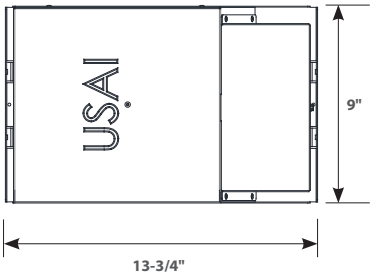
USAI® Lighting

Housing Details for Adjustable Downlight

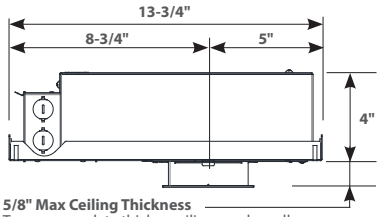
Insulation Contact Rated Adjustable - NCAIC



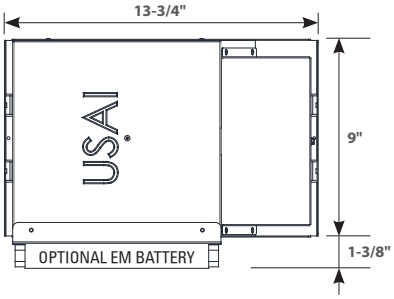
5/8" Max Ceiling Thickness
To accommodate thicker ceilings, order collar extender from accessories table on page 3



New construction with Emergency Battery - NCAEM



5/8" Max Ceiling Thickness
To accommodate thicker ceilings, order collar extender from accessories table on page 3



Note: Emergency battery requires above ceiling access for service.

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T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE A-EM

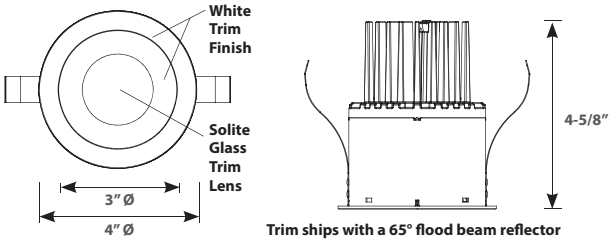
Primary® NXT - P23F

3″ Aperture Downlight and Wall Wash

USAI® Lighting

Trim Details

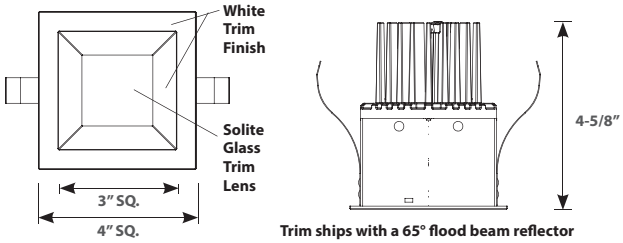
P3RDF ROUND DOWNLIGHT



Trim ships with a 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K. 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	900	775	1325	1100	825
Lumens Per Watt:	101	85	95	80	58

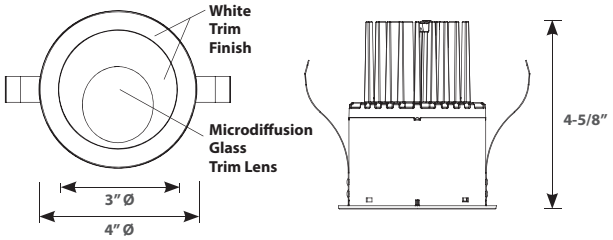
P3SDF SQUARE DOWNLIGHT



Trim ships with a 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K. 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	975	800	1400	1175	825
Lumens Per Watt:	107	90	100	84	59

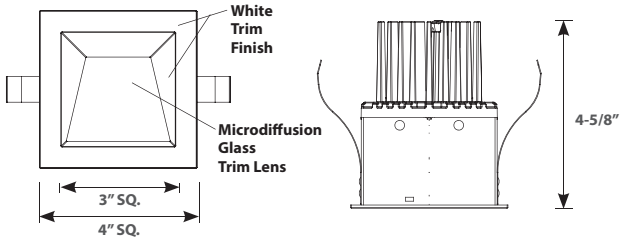
P3RWF ROUND WALL WASH



Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	525	450	775	650	625
Lumens Per Watt:	59	49	54	45	44

P3SWF SQUARE WALL WASH



Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	675	575	975	825	700
Lumens Per Watt:	75	63	69	58	49

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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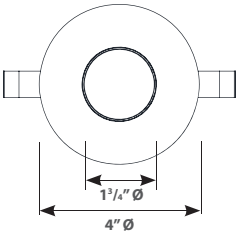
LIGHTING TYPE A-EM

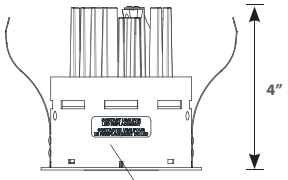
Primary® NXT - P23F
1.75" Aperture Downlight and Wall Wash

USAI® Lighting

Trim Details

P2RDF ROUND DOWNLIGHT

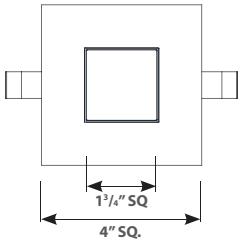


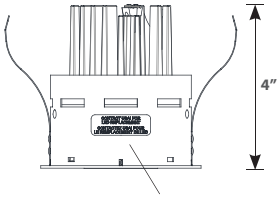


Trim ships with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K, 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	650	550	950	800	750
Lumens Per Watt:	74	62	68	57	51

P2SDF SQUARE DOWNLIGHT

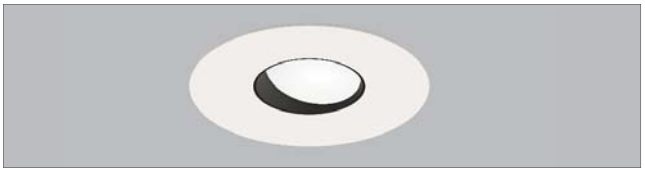


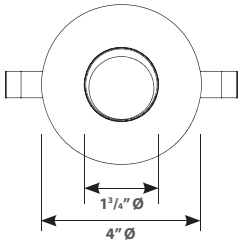


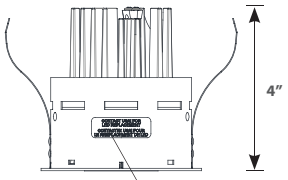
Trim ships with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K, 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	700	575	1000	850	700
Lumens Per Watt:	77	65	71	60	47

P2RWF ROUND WALL WASH



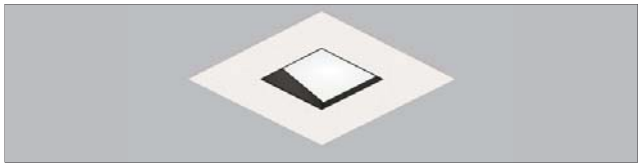


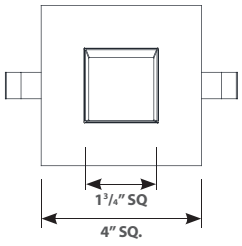


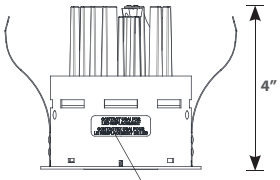
Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	475	400	675	575	600
Lumens Per Watt:	52	44	48	40	40

P2SWF SQUARE WALL WASH







Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	525	425	750	625	650
Lumens Per Watt:	57	48	53	44	43

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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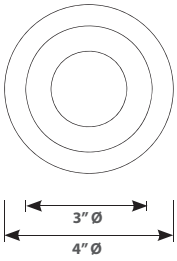
LIGHTING TYPE A-EM

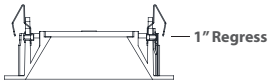
Primary® NXT - P23F
1.75" and 3" Aperture Adjustable Downlight

USAI® Lighting

Trim Details

P3RAF ROUND ADJUSTABLE

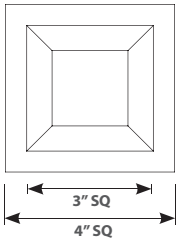


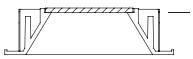


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	875	750	1275	1075	600
Lumens Per Watt:	98	83	92	78	43

P3SAF SQUARE ADJUSTABLE

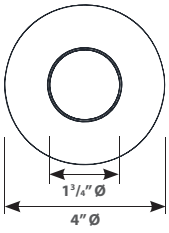


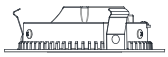


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	950	800	1375	1150	675
Lumens Per Watt:	105	88	98	82	49

P2RAF ROUND ADJUSTABLE

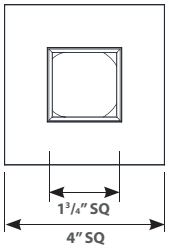


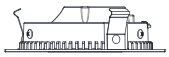


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	625	525	900	750	550
Lumens Per Watt:	70	58	65	55	38

P2SAF SQUARE ADJUSTABLE





Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	675	500	975	800	625
Lumens Per Watt:	74	62	69	58	44

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

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1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE A-EM

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT Specifications

TRIM
P3 series trims are a 3" round or square aperture with a 1" regressed die cast aluminum bevel and 1/2" flange, retained by two mounting clips. and is available in white. P2 series trims are a 1.75" round or square aperture pinhole trim with a 1/4" regressed black baffle and a flat, 1-1/8" flange powdercoat painted white.

TRIM LENS
Downlight and adjustable trims are shipped with solite glass lens, and wall wash trim is shipped with integral microdiffusion glass lens.

ADJUSTMENT
Adjustable fixtures are provided with an adjustable optical assembly that can be rotated 362 degrees and tilted to aim up to 45 degrees maximum.

REFLECTOR
Downlight trim is shipped with 65° wide beam reflector installed in trim, and is also provided with interchangeable 30° medium beam reflector for field changes. Wall wash trim is shipped with wall wash optic installed. Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices.

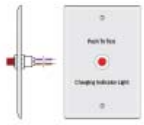
FIELD REPLACEABLE LED LIGHT ENGINE
is serviceable through the aperture with a Phillips screwdriver.

COLOR
All USAI Lighting Classic White LED light engines are tightly binned for industry-leading fixture-to-fixture color consistency within a 2-Step MacAdam Ellipse. The Dim to Warm LED option gradually shifts from 3000K, 90CRI to a natural-feeling 2000K or an even warmer 1800K as you dim and meets 3-Step MacAdam's consistency criteria.

RATED LIFE
Based on IESNA LM80-2008 50,000 hours at 70% lumen maintenance (L70).

FIELD REPLACEABLE DRIVER
Solid state electronic constant current phase or 0-10V dimming driver with a high power factor provided standard. Dimming driver can be connected to 0-10V low voltage wiring for dimming control at any voltage from 120V-277V, or can be used as a phase dimming driver when powered with 120V only power. See wiring diagrams for details. Dimming driver is located within the light fixture housing and can be serviced from below the ceiling through the aperture. Driver complies with IEEE C62.41 surge protection. Some on-time delay may be experienced depending on control system used.

INTEGRAL EMERGENCY BATTERY
An integral emergency battery pack is available as an option with the NCEM and NCAEM housings only, as a sidecar attachment that requires above ceiling access for service. AC Electronics emergency battery provides backup power for 90 minutes and is CEC Title 20 Compliant. EM option is provided with a remote test switch, which comes with a 24" lead length for location of the test switch. Fixtures that have no USAI EM option may be connected to an inverter (by others) for emergency lighting.



Remote Emergency Test Switch included
Above ceiling access required for service.

HOUSING
Primary NXT housings are universal and can accept any trim listed in the ordering table, whether round or square, downlight or wallwash, 3" or 1.75" apertures; simply punch out tabs during installation to configure the housing to work with the specific trim specified. NCEC housing is fabricated of black electrocoated 20 ga. steel with 18 ga. steel J-box. NCIC and NCAIC housings are airtight and are rated for direct contact with insulation. NCEM and NCAEM housings are provided with an emergency battery sidecar that requires above ceiling access for service.

MOUNTING
Adjustable nailer bars with integral nails provided standard with each housing. Nailer bars are extendible from 14" to 24" centers. Butterfly brackets are optionally available and can be used with the nailer bars provided to enable vertical adjustment during installation. Channel bars are available in 27", 32", and 52" lengths as an add-on accessory for use in grid ceiling systems, and these must be ordered as a kit with
butterfly brackets included because they cannot be used without them.

FIXTURE WEIGHT
NCEC housing weighs 5 lbs. NCIC and NCAIC housings weigh 7 lbs, NCEM and NCAEM housings weighs 9 lbs.

WARRANTY
USAI limited warranty covers replacement parts for 5 years from date of shipment.

CEILING CUT OUT
P3RDF, P3RWF, and P3RAF Round: 3-5/8" Ø
P3SDF, P3SWF, and P3SAF Square: 3-1/2" x 3-1/2"
P2RDF, P2RWF, and P2RAF Round: 3-5/8" Ø
P2SDF, P2SWF, and P2SAF Square: 3-5/8" Ø

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
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New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE A-EM

Primary® NXT - P23F

1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT Specifications

LISTINGS

Dry/Damp/Wet. EM test switch is dry/damp only. UL2043 rated for use in air handling plenums. NCIC and NCAIC housings are Airtight. NRTL/CSA-US tested to UL standards. Rated for use in steam rooms and saunas, up to 15W maximum. EM battery pack is CEC Title 20 Compliant. IBEW union made. All USAI Lighting products are Buy American Act (BAA) compliant.

NOTES

- Not for use in corrosive environment
- Use of pressure washer voids warranty

PHOTOMETRICS

Consult factory or website for IES files. Tested in accordance with IESNA LM79.

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13 Crosby Street
New York, NY 10013
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LIGHTING TYPE B

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT provides consistent, high quality white light in an economical architectural solution.

FEATURES

- A complete range of color temperature options in 80+ and 90+ CRI
- Dim to Warm LED choices
- Downlight, adjustable and wallwash configurations
- Dry/damp/wet location rated for bathrooms and showers
- Dimmable to 1%
- High LED performance with budget-conscious features
- CEC Title 20 Compliant EM battery option

usailighting.com/primarynxt

PRIMARY NXT PERFORMANCE

at 3000K	Classic White		Dim-to-Warm and Dim-to-Warm+
	9W	15W	15W
CRI:	80+	80+	90+
Source Lumens:	1075	1575	1100

CORRELATED COLOR TEMPERATURE MULTIPLIER

Classic White	2700K		3000K		3500K		4000K	
Color Rendering Index:	80+	90+	80+	90+	80+	90+	80+	90+
Multiplier for Lumen Output:	0.98	0.81	1.00	0.84	1.02	0.98	1.06	0.98

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LIGHTING TYPE B

Primary® NXT - P23F
Downlight and Wall Wash

USAI® Lighting

STEP 1. Specify housing type for downlight and/or wall wash

P23UF	15L2	UNV	D22	NCIC	HSG
Product	**Wattage**	**Voltage**	**Dimming Driver**	**Housing Type**	**Housing**
P23UF Primary NXT universal housing - for use with 3" downlight and/or wall wash trims, round and square	**09L2** 9W LED **15L2** 15W LED **15DW2** 15W LED	**UNV** 120V - 277V **120V Only**	**D22** 0-10V and Phase Dimming Driver, dims to 1% Note: Phase dimming option only available when using 120V only power **D21** Phase Dimming Driver, 1%	**NCEC** Economical new construction tray **NCIC** Insulation-contact rated, airtight **NCEM** New Construction with CEC Title 20 Compliant Emergency battery, above ceiling access required	**HSG** Rough-in housing

STEP 2. Specify trim and module type for downlight or wall wash

P3RWF	15L2	35KS	D1	BLACK	TRM
Product	**Wattage Options**	**LED +Color Temperature**	**Lens**	**Finish**	**Trim**
P2RDF 1.75" SliverLED round aperture downlight (1) **P2SDF** 1.75" SliverLED square aperture downlight (1) **P2RWF** 1.75" SliverLED round aperture wall wash **P2SWF** 1.75" SliverLED square aperture wall wash **P3RDF** 3" BeveLED Mini round aperture downlight (1) **P3SDF** 3" BeveLED Mini square aperture downlight (1) **P3RWF** 3" BeveLED Mini round aperture wall wash **P3SWF** 3" BeveLED Mini square aperture wall wash	**Classic White** **09L2** 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI	**S** Solite Glass (provided standard with downlights) **D1** Wall Wash Diffusion (provided standard with wallwashers)	**WH** White	**TRM** Trim and LED Module Assembly
	Dim-to-Warm **15DW2** 15W LED	**3018KH** 3000K - 1800K, 90+ CRI			
	Dim-to-Warm + **15DW2** 15W LED	**3020KH** 3000K - 2000K, 90+ CRI			

Note:
1. Downlight trims ship with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes.

2. Housing ships with integral nailer bars provided standard. These mounting accessories are required for grid ceiling applications.

STEP 3. Specify mounting accessories (optional)

PFBK	
Butterfly Brackets Optional	**Channel Bars Optional***
PFBK Pair of butterfly brackets for vertical adjustment of Primary NXT housings (2)	**CB27** 27" Channel Bar **CB32** 32" Channel Bar **CB52** 52" Channel Bar * leave blank to order Butterfly Brackets without channel bar accessories

Replacement Parts for Field Changes (optional)

Trim	**Lens / Optic**
P2RDF 1.75" SliverLED round aperture downlight **P2SDF** 1.75" SliverLED square aperture downlight **P3RDF** 3" BeveLED Mini round aperture downlight **P3SDF** 3" BeveLED Mini square aperture downlight	**BF** Replacement frosted glass trim lens **SF** Replacement solite frosted trim lens **M** Replacement medium beam reflector, 30° beam **F** Replacement flood beam reflector, 65° beam

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE B

Primary® NXT - P23F Adjustable Downlight

USAI® Lighting

STEP 1. Specify housing type for adjustable downlight

Product	Wattage	Voltage	Dimming Driver	Housing Type	HSG Housing
P2AF 1.75" SliverLED adjustable for round and square trims **P3RAF** 3" BeveLED Mini round aperture adjustable **P3SAF** 3" BeveLED Mini square aperture adjustable	**09L2** 9W LED **15L2** 15W LED **15DW2** 15W LED	**UNV** 120V - 277V	**D22** 0-10V and Phase Dimming Driver, dims to 1% Note: Phase dimming option only available when using 120V only power	**NCAIC** Insulation-contact rated, airtight Adjustable **NCAEM** New Construction Adjustable with CEC Title 20 Compliant Emergency battery, above ceiling access required	**HSG** Rough-in housing
		120V Only	**D21** Phase Dimming Driver, 1%		

STEP 2. Specify trim and module type for adjustable downlight

Product	Wattage Options	LED +Color Temperature	S Lens	WH Finish	TRM Trim
P2RAF 1.75" SliverLED round aperture adjustable (1) **P2SAF** 1.75" SliverLED square aperture adjustable (1) **P3RAF** 3" BeveLED Mini round aperture adjustable (1) **P3SAF** 3" BeveLED Mini square aperture adjustable (1)	Classic White		**S** Solite Glass (provided standard)	**WH** White	**TRM** Trim and LED Module Assembly
	09L2 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI			
	Dim-to-Warm				
	15DW2 15W LED	**3018KH** 3000K - 1800K, 90+ CRI			
	Dim-to-Warm+				
	15DW2 15W LED	**3020KH** 3000K - 2000K, 90+ CRI			

STEP 3. Specify mounting accessories (optional)

Butterfly Brackets Optional	Channel Bars Optional*
PFBK Pair of butterfly brackets for vertical adjustment of Primary NXT housings (2)	**CB27** 27" Channel Bar **CB32** 32" Channel Bar **CB52** 52" Channel Bar * leave blank to order Butterfly Brackets without channel bar accessories

Note:
1.Adjustable fixtures ship with 25° optic installed. For other beam options and accessories, use ordering table below.

2. Housing ships with integral nailer bars provided standard. These mounting accessories are required for grid ceiling applications.

Specify optical accessories (optional)

Optical Accessory Type (optional)

Microdiffusion Lenses
AK20N - 20° Beam
AK30N - 35° Beam
AK40N - 40° Beam
AK55N - 45° Beam

Hexcell Louver
AKHEXN

Linear Spread
AK61N

Snoot included with each accessory kit

Specify housing collar extender accessory (optional)

Adjustable Housing Collar Extender Accessory (optional)

P2AF-1000	SliverLED Primary Collar extender, 1" max ceiling thickness
P2AF-1500	SliverLED Primary Collar extender, 1-1/2" max ceiling thickness
P3RAF-1000	BeveLED Mini Primary Round Collar extender, 1" max ceiling thickness
P3RAF-1500	BeveLED Mini Primary Round Collar extender, 1-1/2" max ceiling thickness
P3SAF-1000	BeveLED Mini Primary Square Collar extender, 1" max ceiling thickness
P3SAF-1500	BeveLED Mini Primary Square Collar extender, 1-1/2" max ceiling thickness

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

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1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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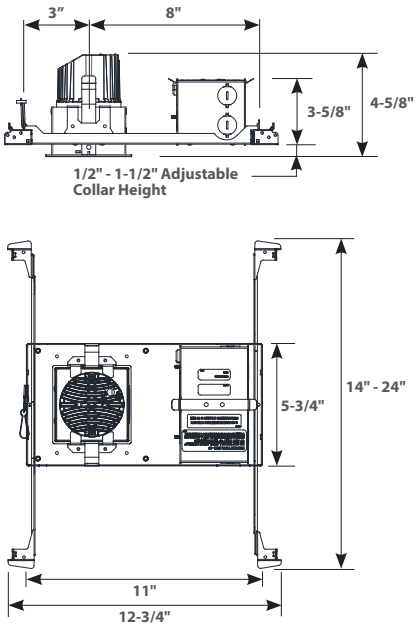
LIGHTING TYPE B

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

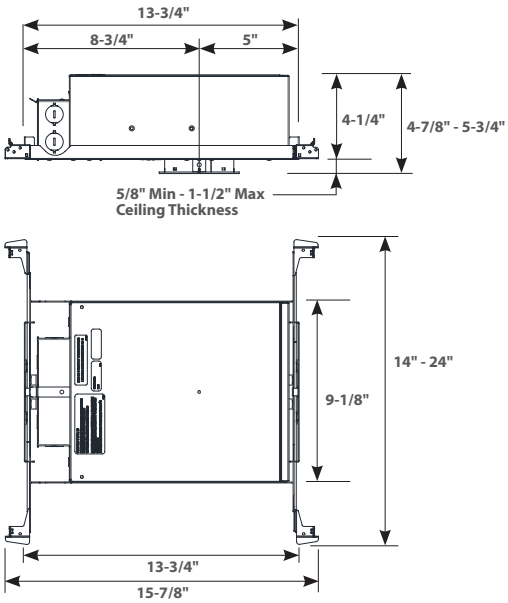
USAI® Lighting

Housing Details for Downlight and Wall Wash

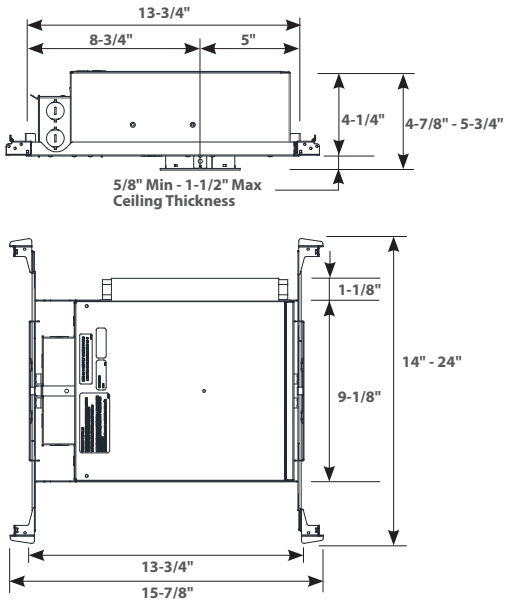
Economy Tray - NCEC



Insulation Contact Rated - NCIC

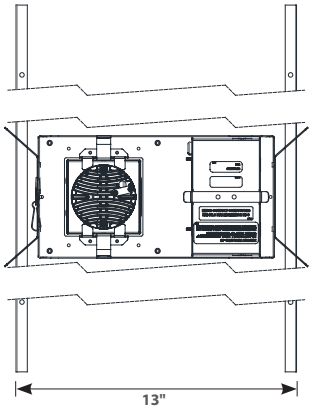


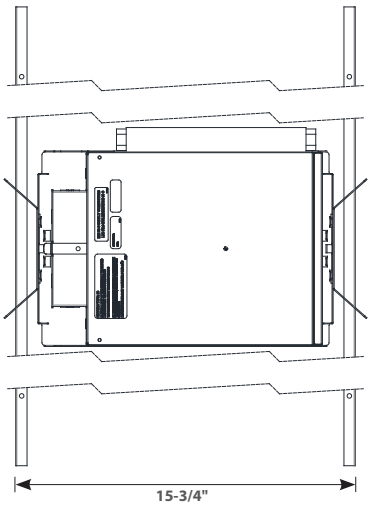
New construction with Emergency Battery - NCEM



Note: Emergency battery requires above ceiling access for service.

Shown with Butterfly Bracket and Channel Bar Kit PFBK-CB27 (optional)





USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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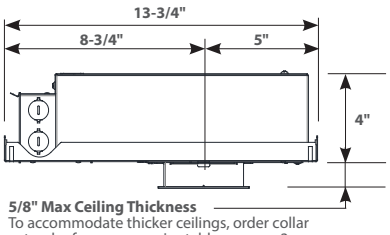
LIGHTING TYPE B

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

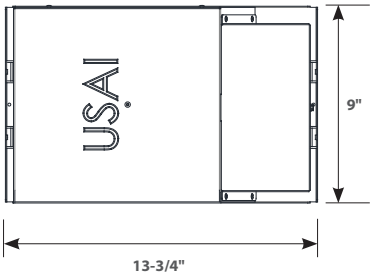
USAI® Lighting

Housing Details for Adjustable Downlight

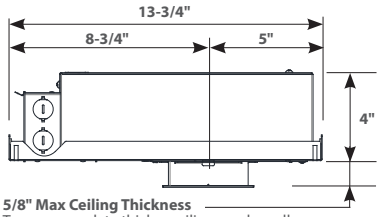
Insulation Contact Rated Adjustable - NCAIC



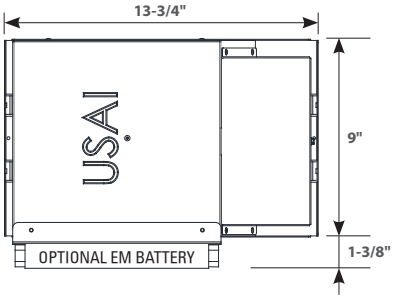
5/8" Max Ceiling Thickness
To accommodate thicker ceilings, order collar extender from accessories table on page 3



New construction with Emergency Battery - NCAEM



5/8" Max Ceiling Thickness
To accommodate thicker ceilings, order collar extender from accessories table on page 3



Note: Emergency battery requires above ceiling access for service.

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13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

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1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE B

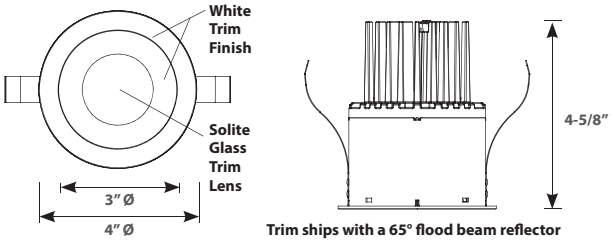
Primary® NXT - P23F

3″ Aperture Downlight and Wall Wash

USAI® Lighting

Trim Details

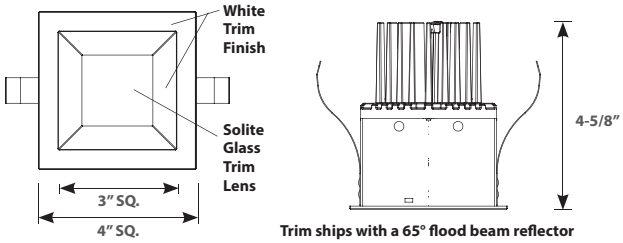
P3RDF ROUND DOWNLIGHT



Trim ships with a 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K. 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	900	775	1325	1100	825
Lumens Per Watt:	101	85	95	80	58

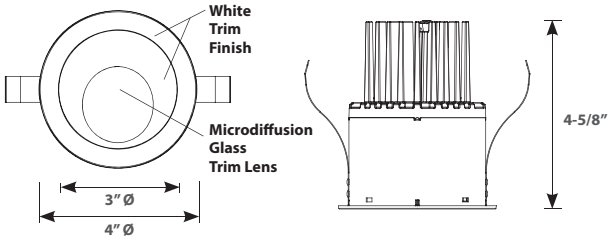
P3SDF SQUARE DOWNLIGHT



Trim ships with a 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K. 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	975	800	1400	1175	825
Lumens Per Watt:	107	90	100	84	59

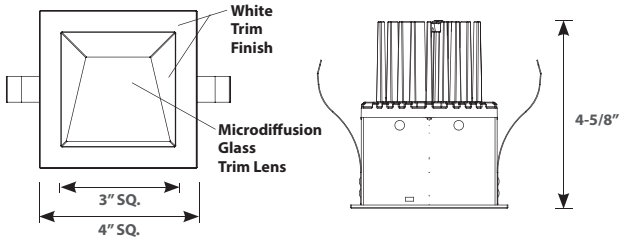
P3RWF ROUND WALL WASH



Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	525	450	775	650	625
Lumens Per Watt:	59	49	54	45	44

P3SWF SQUARE WALL WASH



Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	675	575	975	825	700
Lumens Per Watt:	75	63	69	58	49

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

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1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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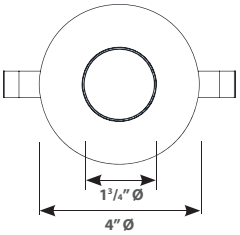
LIGHTING TYPE B

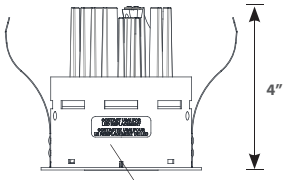
Primary® NXT - P23F
1.75" Aperture Downlight and Wall Wash

USAI® Lighting

Trim Details

P2RDF ROUND DOWNLIGHT

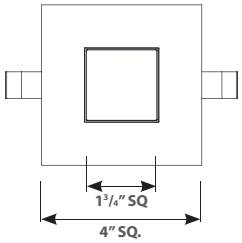


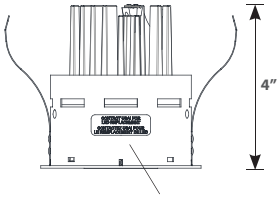


Trim ships with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K, 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	650	550	950	800	750
Lumens Per Watt:	74	62	68	57	51

P2SDF SQUARE DOWNLIGHT

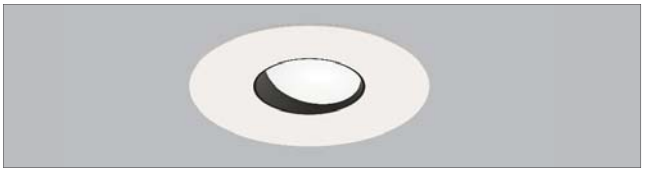


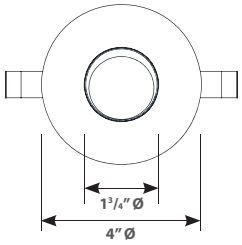


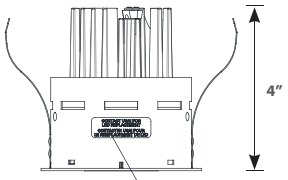
Trim ships with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K, 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	700	575	1000	850	700
Lumens Per Watt:	77	65	71	60	47

P2RWF ROUND WALL WASH



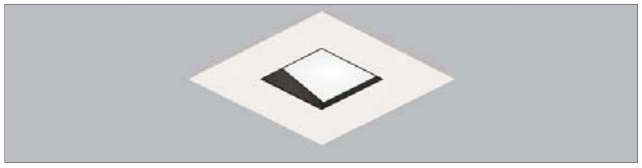


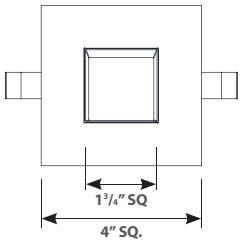


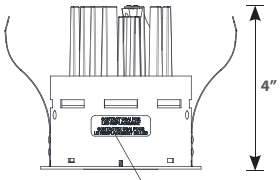
Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	475	400	675	575	600
Lumens Per Watt:	52	44	48	40	40

P2SWF SQUARE WALL WASH







Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	525	425	750	625	650
Lumens Per Watt:	57	48	53	44	43

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13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

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1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE B

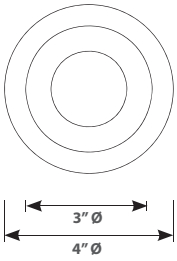
Primary® NXT - P23F

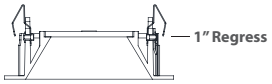
1.75" and 3" Aperture Adjustable Downlight

USAI® Lighting

Trim Details

P3RAF ROUND ADJUSTABLE

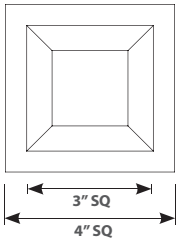


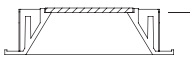


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	875	750	1275	1075	600
Lumens Per Watt:	98	83	92	78	43

P3SAF SQUARE ADJUSTABLE

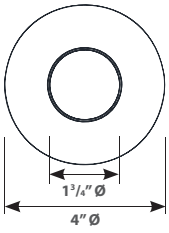


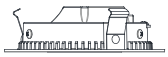


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	950	800	1375	1150	675
Lumens Per Watt:	105	88	98	82	49

P2RAF ROUND ADJUSTABLE

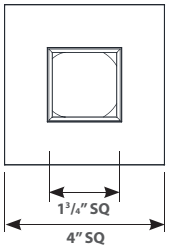


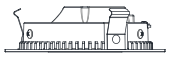


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	625	525	900	750	550
Lumens Per Watt:	70	58	65	55	38

P2SAF SQUARE ADJUSTABLE





Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	675	500	975	800	625
Lumens Per Watt:	74	62	69	58	44

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE B

Primary® NXT - P23F

1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT Specifications

TRIM
P3 series trims are a 3" round or square aperture with a 1" regressed die cast aluminum bevel and 1/2" flange, retained by two mounting clips. and is available in white. P2 series trims are a 1.75" round or square aperture pinhole trim with a 1/4" regressed black baffle and a flat, 1-1/8" flange powdercoat painted white.

TRIM LENS
Downlight and adjustable trims are shipped with solite glass lens, and wall wash trim is shipped with integral microdiffusion glass lens.

ADJUSTMENT
Adjustable fixtures are provided with an adjustable optical assembly that can be rotated 362 degrees and tilted to aim up to 45 degrees maximum.

REFLECTOR
Downlight trim is shipped with 65° wide beam reflector installed in trim, and is also provided with interchangeable 30° medium beam reflector for field changes. Wall wash trim is shipped with wall wash optic installed. Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices.

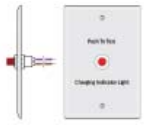
FIELD REPLACEABLE LED LIGHT ENGINE
is serviceable through the aperture with a Phillips screwdriver.

COLOR
All USAI Lighting Classic White LED light engines are tightly binned for industry-leading fixture-to-fixture color consistency within a 2-Step MacAdam Ellipse. The Dim to Warm LED option gradually shifts from 3000K, 90CRI to a natural-feeling 2000K or an even warmer 1800K as you dim and meets 3-Step MacAdam's consistency criteria.

RATED LIFE
Based on IESNA LM80-2008 50,000 hours at 70% lumen maintenance (L70).

FIELD REPLACEABLE DRIVER
Solid state electronic constant current phase or 0-10V dimming driver with a high power factor provided standard. Dimming driver can be connected to 0-10V low voltage wiring for dimming control at any voltage from 120V-277V, or can be used as a phase dimming driver when powered with 120V only power. See wiring diagrams for details. Dimming driver is located within the light fixture housing and can be serviced from below the ceiling through the aperture. Driver complies with IEEE C62.41 surge protection. Some on-time delay may be experienced depending on control system used.

INTEGRAL EMERGENCY BATTERY
An integral emergency battery pack is available as an option with the NCEM and NCAEM housings only, as a sidecar attachment that requires above ceiling access for service. AC Electronics emergency battery provides backup power for 90 minutes and is CEC Title 20 Compliant. EM option is provided with a remote test switch, which comes with a 24" lead length for location of the test switch. Fixtures that have no USAI EM option may be connected to an inverter (by others) for emergency lighting.



Remote Emergency Test Switch included
Above ceiling access required for service.

HOUSING
Primary NXT housings are universal and can accept any trim listed in the ordering table, whether round or square, downlight or wallwash, 3" or 1.75" apertures; simply punch out tabs during installation to configure the housing to work with the specific trim specified. NCEC housing is fabricated of black electrocoated 20 ga. steel with 18 ga. steel J-box. NCIC and NCAIC housings are airtight and are rated for direct contact with insulation. NCEM and NCAEM housings are provided with an emergency battery sidecar that requires above ceiling access for service.

MOUNTING
Adjustable nailer bars with integral nails provided standard with each housing. Nailer bars are extendible from 14" to 24" centers. Butterfly brackets are optionally available and can be used with the nailer bars provided to enable vertical adjustment during installation. Channel bars are available in 27", 32", and 52" lengths as an add-on accessory for use in grid ceiling systems, and these must be ordered as a kit with
butterfly brackets included because they cannot be used without them.

FIXTURE WEIGHT
NCEC housing weighs 5 lbs. NCIC and NCAIC housings weigh 7 lbs, NCEM and NCAEM housings weighs 9 lbs.

WARRANTY
USAI limited warranty covers replacement parts for 5 years from date of shipment.

CEILING CUT OUT
P3RDF, P3RWF, and P3RAF Round: 3-5/8" Ø
P3SDF, P3SWF, and P3SAF Square: 3-1/2" x 3-1/2"
P2RDF, P2RWF, and P2RAF Round: 3-5/8" Ø
P2SDF, P2SWF, and P2SAF Square: 3-5/8" Ø

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE B

Primary® NXT - P23F

1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT Specifications

LISTINGS

Dry/Damp/Wet. EM test switch is dry/damp only. UL2043 rated for use in air handling plenums. NCIC and NCAIC housings are Airtight. NRTL/CSA-US tested to UL standards. Rated for use in steam rooms and saunas, up to 15W maximum. EM battery pack is CEC Title 20 Compliant. IBEW union made. All USAI Lighting products are Buy American Act (BAA) compliant.

NOTES

- Not for use in corrosive environment
- Use of pressure washer voids warranty

PHOTOMETRICS

Consult factory or website for IES files. Tested in accordance with IESNA LM79.

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13 Crosby Street
New York, NY 10013
845-234-4090
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T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE C

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT provides consistent, high quality white light in an economical architectural solution.

FEATURES

- A complete range of color temperature options in 80+ and 90+ CRI
- Dim to Warm LED choices
- Downlight, adjustable and wallwash configurations
- Dry/damp/wet location rated for bathrooms and showers
- Dimmable to 1%
- High LED performance with budget-conscious features
- CEC Title 20 Compliant EM battery option

usailighting.com/primarynxt

PRIMARY NXT PERFORMANCE

at 3000K	Classic White		Dim-to-Warm and Dim-to-Warm+
	9W	15W	15W
CRI:	80+	80+	90+
Source Lumens:	1075	1575	1100

CORRELATED COLOR TEMPERATURE MULTIPLIER

Classic White	2700K		3000K		3500K		4000K	
Color Rendering Index:	80+	90+	80+	90+	80+	90+	80+	90+
Multiplier for Lumen Output:	0.98	0.81	1.00	0.84	1.02	0.98	1.06	0.98

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T: 845-565-8500 F: 845-561-1130
info@usailighting.com

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LIGHTING TYPE C

Primary® NXT - P23F
Downlight and Wall Wash

USAI® Lighting

STEP 1. Specify housing type for downlight and/or wall wash

P23UF	15L2	UNV	D22	NCIC	HSG
Product	**Wattage**	**Voltage**	**Dimming Driver**	**Housing Type**	**Housing**
P23UF Primary NXT universal housing - for use with 3" downlight and/or wall wash trims, round and square	**09L2** 9W LED **15L2** 15W LED **15DW2** 15W LED	**UNV** 120V - 277V **120V Only**	**D22** 0-10V and Phase Dimming Driver, dims to 1% Note: Phase dimming option only available when using 120V only power **D21** Phase Dimming Driver, 1%	**NCEC** Economical new construction tray **NCIC** Insulation-contact rated, airtight **NCEM** New Construction with CEC Title 20 Compliant Emergency battery, above ceiling access required	**HSG** Rough-in housing

STEP 2. Specify trim and module type for downlight or wall wash

P3RDF	15L2	35KS	S	BLACK	TRM
Product	**Wattage Options**	**LED +Color Temperature**	**Lens**	**Finish**	**Trim**
P2RDF 1.75" SliverLED round aperture downlight (1) **P2SDF** 1.75" SliverLED square aperture downlight (1) **P2RWF** 1.75" SliverLED round aperture wall wash **P2SWF** 1.75" SliverLED square aperture wall wash **P3RDF** 3" BeveLED Mini round aperture downlight (1) **P3SDF** 3" BeveLED Mini square aperture downlight (1) **P3RWF** 3" BeveLED Mini round aperture wall wash **P3SWF** 3" BeveLED Mini square aperture wall wash	**Classic White** **09L2** 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI	**S** Solite Glass (provided standard with downlights) **D1** Wall Wash Diffusion (provided standard with wallwashers)	**WH** White	**TRM** Trim and LED Module Assembly
	Dim-to-Warm **15DW2** 15W LED	**3018KH** 3000K - 1800K, 90+ CRI			
	Dim-to-Warm + **15DW2** 15W LED	**3020KH** 3000K - 2000K, 90+ CRI			

Note:
1. Downlight trims ship with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes.

2. Housing ships with integral nailer bars provided standard. These mounting accessories are required for grid ceiling applications.

STEP 3. Specify mounting accessories (optional)

PFBK	
Butterfly Brackets Optional	**Channel Bars Optional***
PFBK Pair of butterfly brackets for vertical adjustment of Primary NXT housings (2)	**CB27** 27" Channel Bar **CB32** 32" Channel Bar **CB52** 52" Channel Bar * leave blank to order Butterfly Brackets without channel bar accessories

Replacement Parts for Field Changes (optional)

Trim	Lens / Optic
P2RDF 1.75" SliverLED round aperture downlight **P2SDF** 1.75" SliverLED square aperture downlight **P3RDF** 3" BeveLED Mini round aperture downlight **P3SDF** 3" BeveLED Mini square aperture downlight	**BF** Replacement frosted glass trim lens **SF** Replacement solite frosted trim lens **M** Replacement medium beam reflector, 30° beam **F** Replacement flood beam reflector, 65° beam

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE C

Primary® NXT - P23F Adjustable Downlight

USAI® Lighting

STEP 1. Specify housing type for adjustable downlight

Product	Wattage	Voltage	Dimming Driver	Housing Type	HSG Housing
P2AF 1.75" SliverLED adjustable for round and square trims **P3RAF** 3" BeveLED Mini round aperture adjustable **P3SAF** 3" BeveLED Mini square aperture adjustable	**09L2** 9W LED **15L2** 15W LED **15DW2** 15W LED	**UNV** 120V - 277V	**D22** 0-10V and Phase Dimming Driver, dims to 1% Note: Phase dimming option only available when using 120V only power	**NCAIC** Insulation-contact rated, airtight Adjustable **NCAEM** New Construction Adjustable with CEC Title 20 Compliant Emergency battery, above ceiling access required	**HSG** Rough-in housing
		120V Only	**D21** Phase Dimming Driver, 1%		

STEP 2. Specify trim and module type for adjustable downlight

Product	Wattage Options	LED +Color Temperature	S Lens	WH Finish	TRM Trim
P2RAF 1.75" SliverLED round aperture adjustable (1) **P2SAF** 1.75" SliverLED square aperture adjustable (1) **P3RAF** 3" BeveLED Mini round aperture adjustable (1) **P3SAF** 3" BeveLED Mini square aperture adjustable (1)	Classic White		**S** Solite Glass (provided standard)	**WH** White	**TRM** Trim and LED Module Assembly
	09L2 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI				
	Dim-to-Warm				
	15DW2 15W LED	**3018KH** 3000K - 1800K, 90+ CRI			
	Dim-to-Warm+				
	15DW2 15W LED	**3020KH** 3000K - 2000K, 90+ CRI			

STEP 3. Specify mounting accessories (optional)

Butterfly Brackets Optional	Channel Bars Optional*
PFBK Pair of butterfly brackets for vertical adjustment of Primary NXT housings (2)	**CB27** 27" Channel Bar **CB32** 32" Channel Bar **CB52** 52" Channel Bar * leave blank to order Butterfly Brackets without channel bar accessories

Note:
1.Adjustable fixtures ship with 25° optic installed. For other beam options and accessories, use ordering table below.

2. Housing ships with integral nailer bars provided standard. These mounting accessories are required for grid ceiling applications.

Specify optical accessories (optional)

Optical Accessory Type (optional)

Microdiffusion Lenses
AK20N - 20° Beam
AK30N - 35° Beam
AK40N - 40° Beam
AK55N - 45° Beam

Hexcell Louver
AKHEXN

Linear Spread
AK61N

Snoot included with each accessory kit

Specify housing collar extender accessory (optional)

Adjustable Housing Collar Extender Accessory (optional)

P2AF-1000	SliverLED Primary Collar extender, 1" max ceiling thickness
P2AF-1500	SliverLED Primary Collar extender, 1-1/2" max ceiling thickness
P3RAF-1000	BeveLED Mini Primary Round Collar extender, 1" max ceiling thickness
P3RAF-1500	BeveLED Mini Primary Round Collar extender, 1-1/2" max ceiling thickness
P3SAF-1000	BeveLED Mini Primary Square Collar extender, 1" max ceiling thickness
P3SAF-1500	BeveLED Mini Primary Square Collar extender, 1-1/2" max ceiling thickness

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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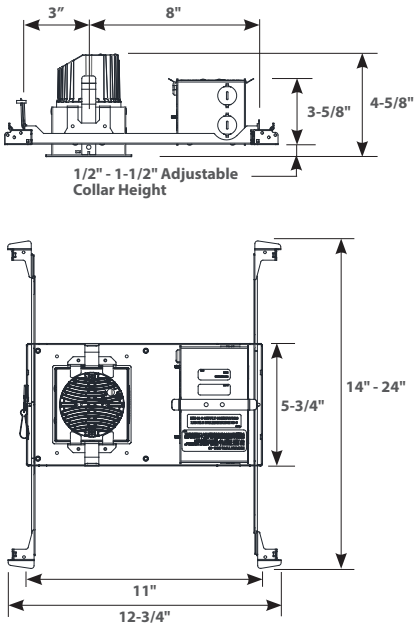
LIGHTING TYPE C

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

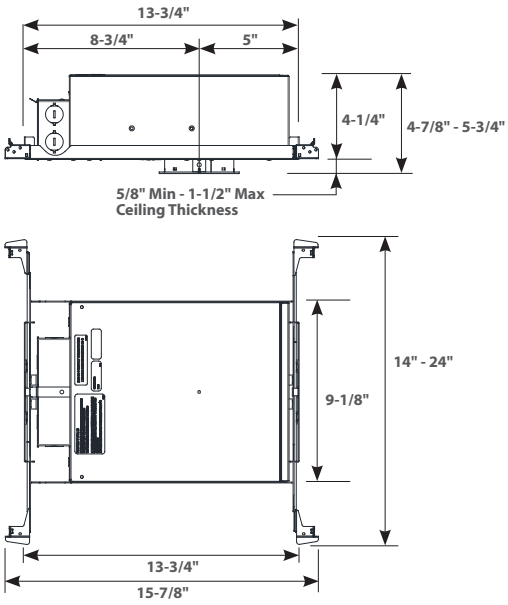
USAI® Lighting

Housing Details for Downlight and Wall Wash

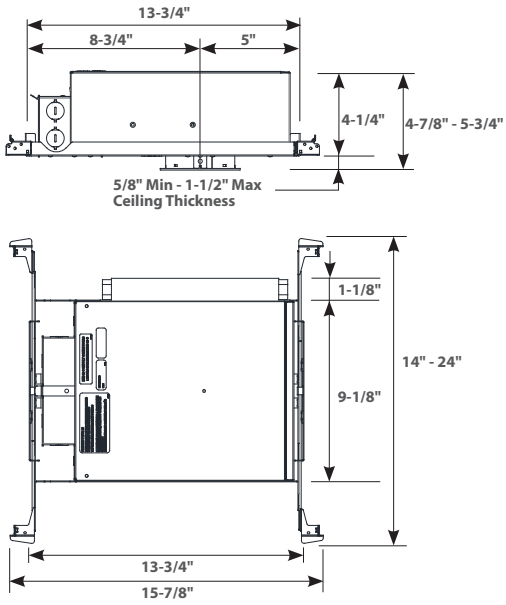
Economy Tray - NCEC



Insulation Contact Rated - NCIC

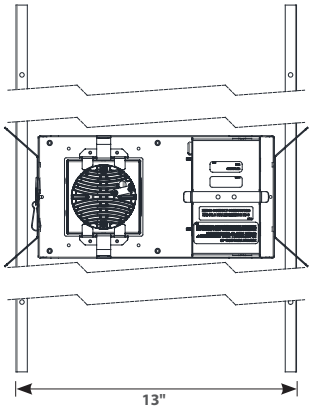


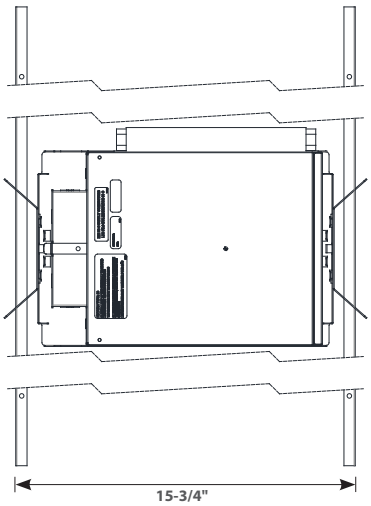
New construction with Emergency Battery - NCEM



Note: Emergency battery requires above ceiling access for service.

Shown with Butterfly Bracket and Channel Bar Kit PFBK-CB27 (optional)





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13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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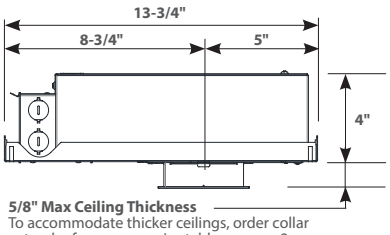
LIGHTING TYPE C

Primary® NXT - P23F
1.75" and 3" Aperture Recessed Family

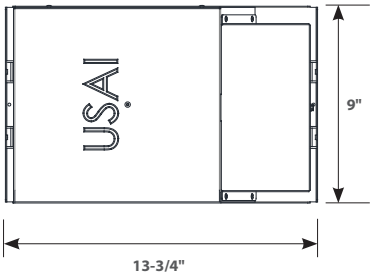
USAI® Lighting

Housing Details for Adjustable Downlight

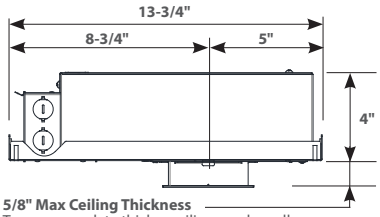
Insulation Contact Rated Adjustable - NCAIC



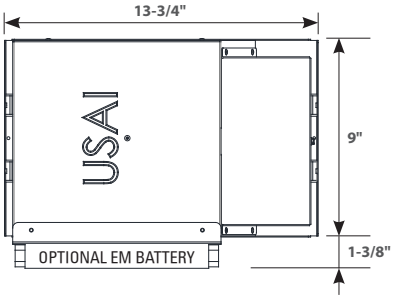
5/8" Max Ceiling Thickness
To accommodate thicker ceilings, order collar extender from accessories table on page 3



New construction with Emergency Battery - NCAEM



5/8" Max Ceiling Thickness
To accommodate thicker ceilings, order collar extender from accessories table on page 3



Note: Emergency battery requires above ceiling access for service.

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13 Crosby Street
New York, NY 10013
845-234-4090
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LIGHTING TYPE C

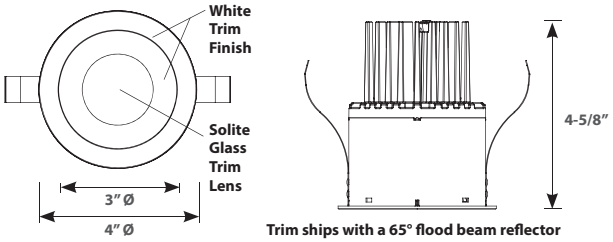
Primary® NXT - P23F

3″ Aperture Downlight and Wall Wash

USAI® Lighting

Trim Details

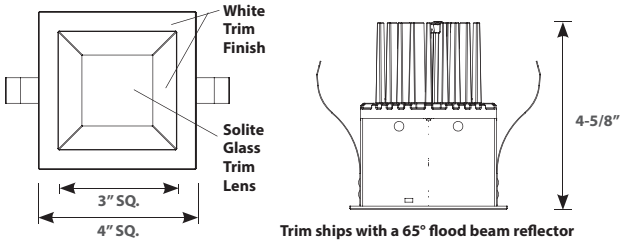
P3RDF ROUND DOWNLIGHT



Trim ships with a 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K. 65° Flood Beam	Classic White 9W		Classic White 15W		Dim-to-Warm and Dim-to-Warm+ 15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	900	775	1325	1100	825
Lumens Per Watt:	101	85	95	80	58

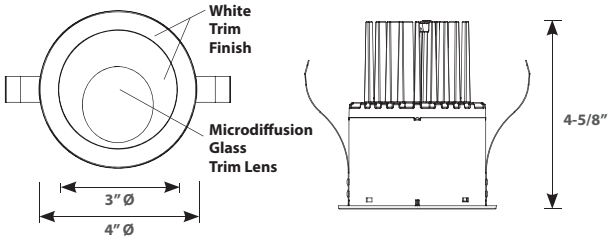
P3SDF SQUARE DOWNLIGHT



Trim ships with a 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K. 65° Flood Beam	Classic White 9W		Classic White 15W		Dim-to-Warm and Dim-to-Warm+ 15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	975	800	1400	1175	825
Lumens Per Watt:	107	90	100	84	59

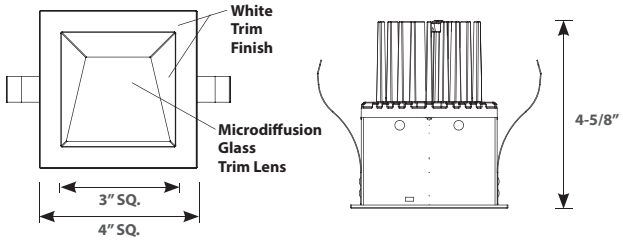
P3RWF ROUND WALL WASH



Trim ships with wall wash reflector installed

Performance at 3000K	Classic White 9W		Classic White 15W		Dim-to-Warm and Dim-to-Warm+ 15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	525	450	775	650	625
Lumens Per Watt:	59	49	54	45	44

P3SWF SQUARE WALL WASH



Trim ships with wall wash reflector installed

Performance at 3000K	Classic White 9W		Classic White 15W		Dim-to-Warm and Dim-to-Warm+ 15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	675	575	975	825	700
Lumens Per Watt:	75	63	69	58	49

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE C

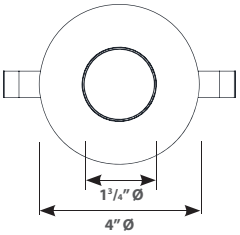
Primary® NXT - P23F

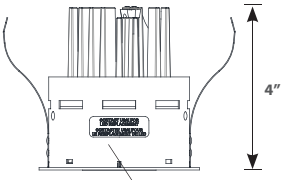
1.75" Aperture Downlight and Wall Wash

USAI® Lighting

Trim Details

P2RDF ROUND DOWNLIGHT

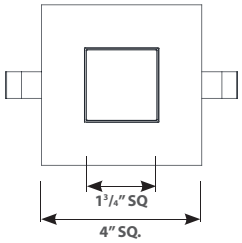


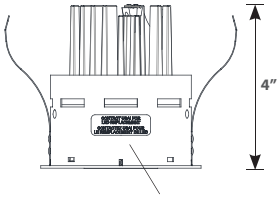


Trim ships with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K, 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	650	550	950	800	750
Lumens Per Watt:	74	62	68	57	51

P2SDF SQUARE DOWNLIGHT

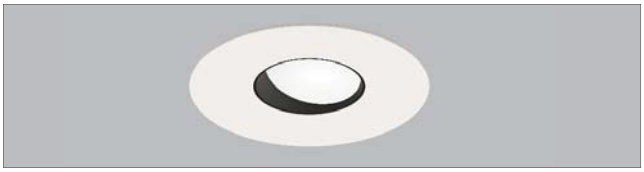


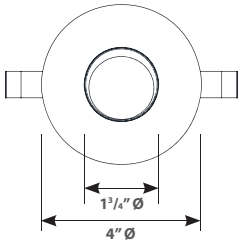


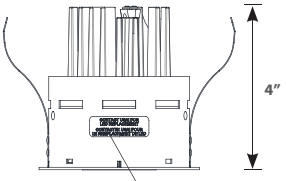
Trim ships with 65° flood beam reflector installed; field replaceable 30° medium beam optic included with trim for field changes

Performance at 3000K, 65° Flood Beam	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	700	575	1000	850	700
Lumens Per Watt:	77	65	71	60	47

P2RWF ROUND WALL WASH



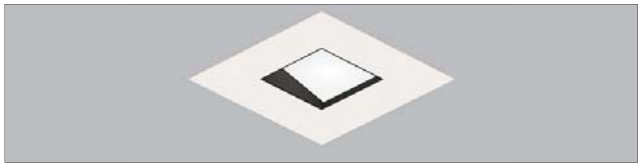


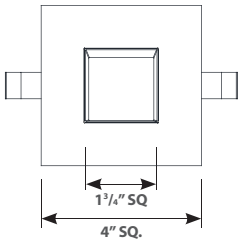


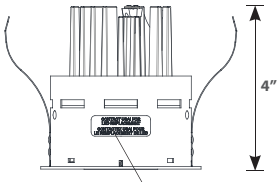
Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	475	400	675	575	600
Lumens Per Watt:	52	44	48	40	40

P2SWF SQUARE WALL WASH







Trim ships with wall wash reflector installed

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	525	425	750	625	650
Lumens Per Watt:	57	48	53	44	43

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE C

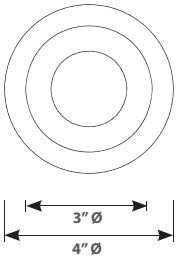
Primary® NXT - P23F

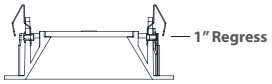
1.75" and 3" Aperture Adjustable Downlight

USAI® Lighting

Trim Details

P3RAF ROUND ADJUSTABLE

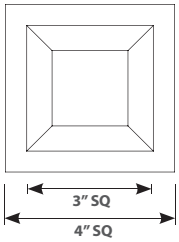


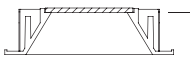


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	875	750	1275	1075	600
Lumens Per Watt:	98	83	92	78	43

P3SAF SQUARE ADJUSTABLE

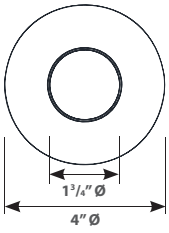


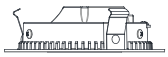


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	950	800	1375	1150	675
Lumens Per Watt:	105	88	98	82	49

P2RAF ROUND ADJUSTABLE

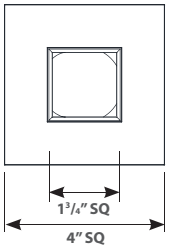


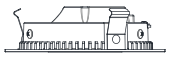


Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	625	525	900	750	550
Lumens Per Watt:	70	58	65	55	38

P2SAF SQUARE ADJUSTABLE





Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices

Performance at 3000K	Classic White				Dim-to-Warm and Dim-to-Warm+
	9W		15W		15W
CRI:	80+	90+	80+	90+	90+
Delivered Lumens:	675	500	975	800	625
Lumens Per Watt:	74	62	69	58	44

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE C

Primary® NXT - P23F

1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT Specifications

TRIM
P3 series trims are a 3" round or square aperture with a 1" regressed die cast aluminum bevel and 1/2" flange, retained by two mounting clips. and is available in white. P2 series trims are a 1.75" round or square aperture pinhole trim with a 1/4" regressed black baffle and a flat, 1-1/8" flange powdercoat painted white.

TRIM LENS
Downlight and adjustable trims are shipped with solite glass lens, and wall wash trim is shipped with integral microdiffusion glass lens.

ADJUSTMENT
Adjustable fixtures are provided with an adjustable optical assembly that can be rotated 362 degrees and tilted to aim up to 45 degrees maximum.

REFLECTOR
Downlight trim is shipped with 65° wide beam reflector installed in trim, and is also provided with interchangeable 30° medium beam reflector for field changes. Wall wash trim is shipped with wall wash optic installed. Adjustable downlight fixtures ship with 25° narrow beam optic; use accessories table to specify other beam choices.

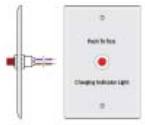
FIELD REPLACEABLE LED LIGHT ENGINE
is serviceable through the aperture with a Phillips screwdriver.

COLOR
All USAI Lighting Classic White LED light engines are tightly binned for industry-leading fixture-to-fixture color consistency within a 2-Step MacAdam Ellipse. The Dim to Warm LED option gradually shifts from 3000K, 90CRI to a natural-feeling 2000K or an even warmer 1800K as you dim and meets 3-Step MacAdam's consistency criteria.

RATED LIFE
Based on IESNA LM80-2008 50,000 hours at 70% lumen maintenance (L70).

FIELD REPLACEABLE DRIVER
Solid state electronic constant current phase or 0-10V dimming driver with a high power factor provided standard. Dimming driver can be connected to 0-10V low voltage wiring for dimming control at any voltage from 120V-277V, or can be used as a phase dimming driver when powered with 120V only power. See wiring diagrams for details. Dimming driver is located within the light fixture housing and can be serviced from below the ceiling through the aperture. Driver complies with IEEE C62.41 surge protection. Some on-time delay may be experienced depending on control system used.

INTEGRAL EMERGENCY BATTERY
An integral emergency battery pack is available as an option with the NCEM and NCAEM housings only, as a sidecar attachment that requires above ceiling access for service. AC Electronics emergency battery provides backup power for 90 minutes and is CEC Title 20 Compliant. EM option is provided with a remote test switch, which comes with a 24" lead length for location of the test switch. Fixtures that have no USAI EM option may be connected to an inverter (by others) for emergency lighting.



Remote Emergency Test Switch included
Above ceiling access required for service.

HOUSING
Primary NXT housings are universal and can accept any trim listed in the ordering table, whether round or square, downlight or wallwash, 3" or 1.75" apertures; simply punch out tabs during installation to configure the housing to work with the specific trim specified. NCEC housing is fabricated of black electrocoated 20 ga. steel with 18 ga. steel J-box. NCIC and NCAIC housings are airtight and are rated for direct contact with insulation. NCEM and NCAEM housings are provided with an emergency battery sidecar that requires above ceiling access for service.

MOUNTING
Adjustable nailer bars with integral nails provided standard with each housing. Nailer bars are extendible from 14" to 24" centers. Butterfly brackets are optionally available and can be used with the nailer bars provided to enable vertical adjustment during installation. Channel bars are available in 27", 32", and 52" lengths as an add-on accessory for use in grid ceiling systems, and these must be ordered as a kit with
butterfly brackets included because they cannot be used without them.

FIXTURE WEIGHT
NCEC housing weighs 5 lbs. NCIC and NCAIC housings weigh 7 lbs, NCEM and NCAEM housings weighs 9 lbs.

WARRANTY
USAI limited warranty covers replacement parts for 5 years from date of shipment.

CEILING CUT OUT
P3RDF, P3RWF, and P3RAF Round: 3-5/8" Ø
P3SDF, P3SWF, and P3SAF Square: 3-1/2" x 3-1/2"
P2RDF, P2RWF, and P2RAF Round: 3-5/8" Ø
P2SDF, P2SWF, and P2SAF Square: 3-5/8" Ø

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE C

Primary® NXT - P23F

1.75" and 3" Aperture Recessed Family

USAI® Lighting

Primary NXT Specifications

LISTINGS

Dry/Damp/Wet. EM test switch is dry/damp only. UL2043 rated for use in air handling plenums. NCIC and NCAIC housings are Airtight. NRTL/CSA-US tested to UL standards. Rated for use in steam rooms and saunas, up to 15W maximum. EM battery pack is CEC Title 20 Compliant. IBEW union made. All USAI Lighting products are Buy American Act (BAA) compliant.

NOTES

- Not for use in corrosive environment
- Use of pressure washer voids warranty

PHOTOMETRICS

Consult factory or website for IES files. Tested in accordance with IESNA LM79.

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

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New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE D

Primary NXT Cylinder - CPRD
Round Downlight

USAI® Lighting

Surface Mount

Surface Mount Conduit Cutout with Surface J-Box

Rigid Pendant Stem

Rigid Pendant Stem Conduit Cutout with Surface J-Box

Cable Mount Pendant

Cable Mount Pendant Conduit Cutout with Surface J-Box

PRIMARY NXT CYLINDER PERFORMANCE DATA	Classic White												Dim-to-Warm and Dim-to-Warm+	
Input Wattage	9W						15W						15W	
Correlated Color Temperature:	3000K						3000K						3000K	
Color Rendering Index (CRI):	80+			90+			80+			90+			90+	
Source Lumens:	1075			900			1575			1325			1150	
Beam Spread:	M	W	F	M	W	F	M	W	F	M	W	F	M	F
Delivered Lumens:	900	950	750	750	800	625	1300	1375	1075	1100	1150	900	800	650
Lumens Per Watt:	100	106	83	84	89	70	94	100	79	79	84	66	55	45

CORRELATED COLOR TEMPERATURE MULTIPLIER*	Classic White							
	2700K		3000K		3500K		4000K	
Color Rendering Index:	80+	90+	80+	90+	80+	90+	80+	90+
Multiplier for Lumen Output:	0.98	0.81	1.00	0.84	1.02	0.98	1.06	0.98

* Apply to 3000K, 80+ CRI values only in table above to approximate output at other color temperatures and CRIs

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D

Primary NXT Cylinder - CPRD
Round Downlight with Integral Driver

USAI® Lighting

1. Specify fixture part number. (All boxes must be filled in to correctly order)

CPRD8	15L2	35KS	F	S	BLACK	CR3	UNV	D22
Fixture Size	**Wattage Options**	**LED Color Options**	**Beam Options**	**Lens Options**	**Finish**	**Mounting Options**	**Voltage Options** *Select one*	**Dimming Driver Options**

CPRD8
8" Length Round Downlight Cylinder

Classic White Light

09L2 9W LED
15L2 15W LED

27KS 2700K, 80+ CRI
27KH 2700K, 90+ CRI
30KS 3000K, 80+ CRI
30KH 3000K, 90+ CRI
35KS 3500K, 80+ CRI
35KH 3500K, 90+ CRI
40KS 4000K, 80+ CRI
40KH 4000K, 90+ CRI

M Medium Beam, 35°
W Wide Beam, 50°
F Flood Beam, 65°

Dim-to-Warm

15DW2 15W LED

3018KH 3000K - 1800K, 90+ CRI

M Medium Beam, 30°
F Flood Beam, 65°

Dim-to-Warm+

15DW2 15W LED

3020KH 3000K - 2000K, 90+ CRI

S Solite (provided standard)

WH White

SM Surface Mount to recessed junction box

CC Conduit Cutout for surface mounted 4" octagonal junction box

Rigid Stem Mount + Conduit Cutout Canopy Style (Field Cuttable)
PJ1A 2' Nominal Length
PJ2A 4' Nominal Length
PJ3A 8' Nominal Length

Rigid Stem Mount + Recessed JBox Canopy Style (Field Cuttable)
PR1A 2' Nominal Length
PR2A 4' Nominal Length
PR3A 8' Nominal Length

Cable Mount + Conduit Cutout Canopy Style (Field Cuttable)
CJ1 2' Nominal Length
CJ2 4' Nominal Length
CJ3 8' Nominal Length

Cable Mount + Recessed JBox Canopy Style (Field Cuttable)
CR1 2' Nominal Length
CR2 4' Nominal Length
CR3 8' Nominal Length

UNV 120V-277V

For use with Universal Voltage 120V - 277V
D22 0-10V Dimming Driver, dims to 1%

120V

For use with 120V only
D21 Phase Dimming Driver, 1%

Surface Mount (SM)

Conduit Cutout Surface Mount (CC)

Rigid Pendant Stem Mount (PR1A, PR2A, PR3A)

Rigid Pendant Stem Conduit Cutout Surface Mount (PJ1A, PJ2A, PJ3A)

Cable Mount (CR1, CR2, CR3)

Cable Mount Conduit Cutout (CJ1, CJ2, CJ3)

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
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New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D

Primary NXT Cylinder - CPRD
Round Downlight with Remote Driver

USAI® Lighting

1. Specify fixture part number. (All boxes must be filled in to correctly order)

CPRD8				S	WH		RM
Fixture Size	**Wattage Options**	**LED Color Options**	**Beam Options**	**Lens Options**	**Finish**	**Mounting Options**	**Remote Power Supply**
CPRD8 8" Length Round Downlight Cylinder	**Classic White Light**			**S** Solite (provided standard)	**WH** White	**SM** Surface Mount to recessed junction box	**RM** Remote Power Supply (Specify in table below)
	09L2 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI	**M** Medium Beam, 35° **W** Wide Beam, 50° **F** Flood Beam, 65°			**CC** Conduit Cutout for surface mounted 4" octagonal junction box
	Dim-to-Warm					**Rigid Stem Mount + Conduit Cutout Canopy Style (Field Cuttable)**	
						PJ1A 2' Nominal Length **PJ2A** 4' Nominal Length **PJ3A** 8' Nominal Length	
	15DW2 15W LED	**3018KH** 3000K - 1800K, 90+ CRI	**M** Medium Beam, 30° **F** Flood Beam, 65°			**Rigid Stem Mount + Recessed JBox Canopy Style (Field Cuttable)**	
						PR1A 2' Nominal Length **PR2A** 4' Nominal Length **PR3A** 8' Nominal Length	
	Dim-to-Warm +					**Cable Mount + Conduit Cutout Canopy Style (Field Cuttable)**	
	15DW2 15W LED	**3020KH** 3000K - 2000K, 90+ CRI				**CJ1** 2' Nominal Length **CJ2** 4' Nominal Length **CJ3** 8' Nominal Length	
						Cable Mount + Recessed JBox Canopy Style (Field Cuttable)	
						CR1 2' Nominal Length **CR2** 4' Nominal Length **CR3** 8' Nominal Length	

Surface Mount (SM)

Conduit Cutout Surface Mount (CC)

Rigid Pendant Stem Mount (PR1A, PR2A, PR3A)

Rigid Pendant Stem Conduit Cutout Surface Mount (PJ1A, PJ2A, PJ3A)

Cable Mount (CR1, CR2, CR3)

Cable Mount Conduit Cutout (CJ1, CJ2, CJ3)

USAI Power Supply Must Be Specified

2. Specify Remote Power Supply

RPB-01		UNV	D6E		
Remote Power Supply	**Wattage Options**	**Voltage**	**Remote Dimming Type and Level**	**Remote Emergency Option**	**Remote Driver Mounting Accessories***
RPB-01 Primary NXT Cylinder Remote Power Supply	**Classic White** **09L2** 9W LED **15L2** 15W LED	**UNV** 120V - 277V	**D6E** EldoLED 0-10V, 1%	**EM10C** T20 Compliant EM battery requires remote enclosure by others, minimum size 14.5" L x 6.5" W x 3" H (1, 2)	**MP** Junction Box Mounting Plate, 5-1/8" x 5-1/8" **ENC** Single Driver enclosure, 4-1/8" x 9-11/16" x 2-3/8"
	Dim-to-Warm **15DW2** 15W LED				* If Remote Driver Mounting Accessories selection is left blank, driver will be provided with accessories for mounting in enclosure by others. See page 6 for remote driver enclosure sizing requirements.

1 Not available with MP jbox accessory 2 Not available with ENC single driver enclosure; enclosure by others required.

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D

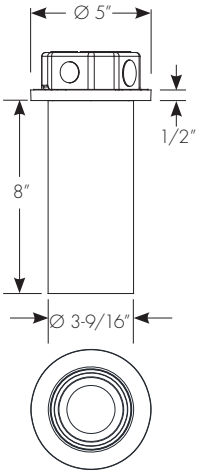
Primary NXT Cylinder - CPRD
Round Downlight

USAI® Lighting

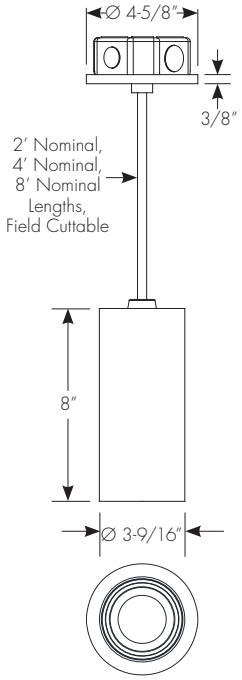
CYLINDER DIMENSIONS

FOR USE WITH RECESSED MOUNTED J-BOXES

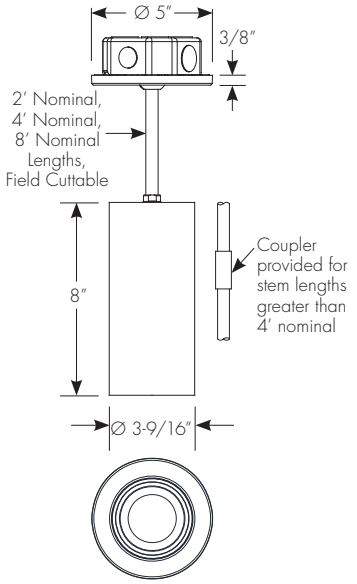
Surface Mount
SM



Cable Mount
CR1, CR2, CR3

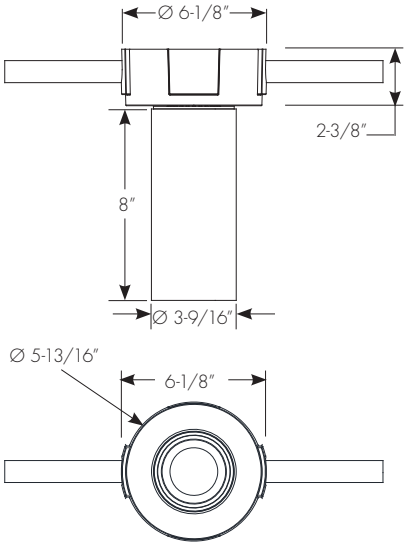


Stem Mount
PR1A, PR2A, PR3A

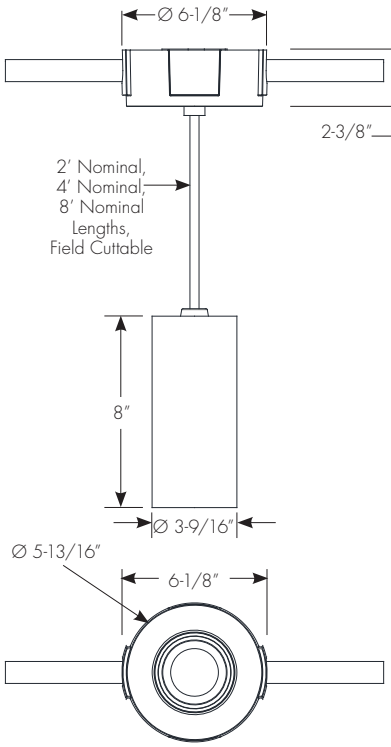


FOR USE WITH SURFACE MOUNTED J-BOXES

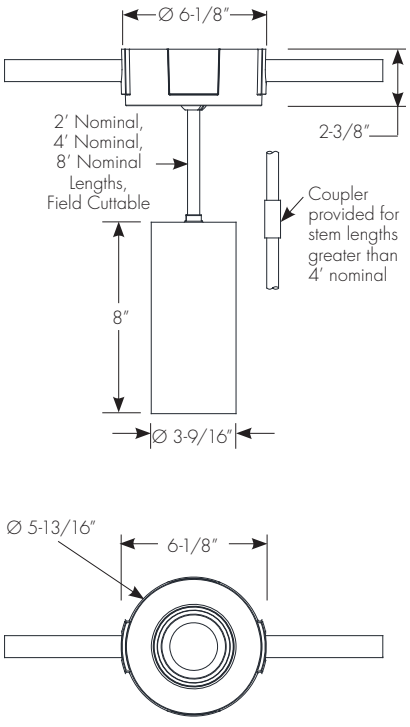
Conduit Cutout Surface Mount
CC



Conduit Cutout Canopy Cable Mount
CJ1, CJ2, CJ3



Conduit Cutout Canopy Stem Mount
PJ1A, PJ2A, PJ3A



USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D

Primary NXT Cylinder - CPRD
Round Downlight

USAI® Lighting

SPECIFICATIONS

FIELD REPLACEABLE LED LIGHT ENGINE
Light engine is serviceable with a Philips screwdriver.

COLOR
All USAI Lighting Classic White LED light engines are tightly binned for industry-leading fixture-to-fixture color consistency within a 2-Step MacAdam Ellipse. The Dim to Warm LED option gradually shifts from 3000K, 90CRI to a warm and natural-feeling 2000K as you dim or 1800K as you dim and meets 3-Step MacAdam's consistency criteria.

FIELD REPLACEABLE OPTICS
Cylinder beamspreads are interchangeable. USAI's proprietary tooled optical reflectors can be easily swapped out in the field without tools. See ordering table for exact beamspread options available with each light engine.

BODY
3-9/16"Ø extruded aluminum body available in 8" length. Cylinder body and canopy are provided in white powder coated paint finish.

MOUNTING
Hardware included for mounting to 4" octagonal junction box.

SURFACE MOUNT
If the Surface Mount option (SM) is specified, Primary NXT Cylinder fixture is provided with a 5"Ø x 1/2" deep round canopy in body finish specified. The installation is completed with no visible hardware.

PENDANT STEM MOUNT
1/2" Ø (1/4" IPS) steel stem is provided with 30° hang straight in length specified (2' nominal, 4' nominal, or 8' nominal) and is field cuttable to a minimum length of 6". and is provided in white finish.

CABLE MOUNT
White cable is field cuttable and is provided in length specified (2' Nominal, 4' Nominal or 8' Nominal). Installers must cut the cable in the field to desired length.

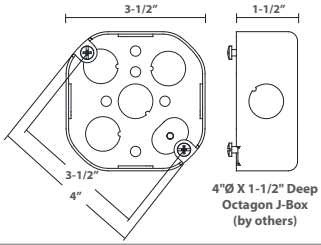
RECESSED JBOX PENDANT CANOPY
If recessed J-box canopy style is specified (PR1A, PR2A, PR3A or CR1, CR2, CR3 options) a 5" Ø or 4-5/8" Ø round x 3/8" deep canopy is provided for mounting to recessed mounted junction box. in white powdercoat painted finish.

CONDUIT CUTOUT SURFACE MOUNT
Conduit cutout fixtures are designed to mount to surface-mounted 4"octagonal junction boxes with surface-mounted conduit connections. If the conduit cutout surface mount option (CC) is specified, Primary NXT Cylinder is provided with a 5-13/16" Ø x 2-1/2" deep conduit cutout canopy base in white powder coat painted finish. CC bases have 4 keyslots, one in each side, and ship with one conduit cutout key and three solid cover keys installed. 2 additional conduit cutout keys are shipped with the fixture, and the different key types are interchangeable in the field. Please see installation instructions for drawings and more details.

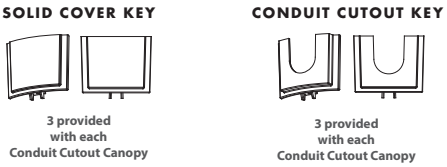
CONDUIT CUTOUT PENDANT CANOPY
If Conduit Cutout Canopy is specified (PJ1A, PJ2A, PJ3A or CJ1, CJ2, CJ3 options) a 5-13/16" Ø round x 2-3/8" deep canopy is provided for mounting to standard 4" octagonal surface mounted junction box. Conduit cutout canopy has 4 key slots, one in each side, and ships with three conduit cutout keys and three solid cover keys which are field interchangeable and can be configured to accommodate any ceiling layout using ½" or ¾" conduit. Conduit cutout canopy is provided white powdercoat painted finish.

CONDUIT CUTOUT MOUNTING EXAMPLE

4"OCTAGONAL JUNCTION BOX



KEY COVER DETAIL



USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D

Primary NXT Cylinder - CPRD Round Downlight

USAI® Lighting

SPECIFICATIONS

FIELD REPLACEABLE INTEGRAL DRIVER

100%-1% solid state electronic constant current dimming driver with a high power factor is provided standard. All integral dimming drivers are located within the cylinder body and are serviceable from below the ceiling. Some on-time delay may be experienced depending on control system used. All dimming drivers comply with IEEE C62.41 surge protection.

REMOTE LOCATION DRIVER

Primary NXT Cylinder is available for use with remotely located driver. Remote dimming driver power supply option must be clearly specified in the "RP" table. Remote power supplies require enclosures by others that meet local codes and must be located in an accessible service panel within 100ft of the light fixture; see remote driver table below for coordination of enclosure sizes and wire gauges required. All dimming drivers comply with IEEE C62.41 surge protection.

Remote Power Supply Requirements and Wiring Diagram
enclosure sizes and wire gauge with **1 fixture** per power supply.

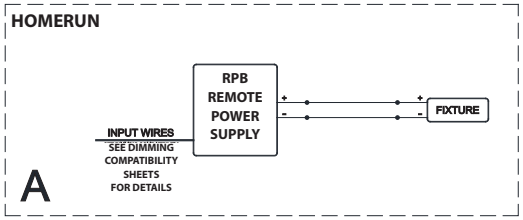
Remote Power Supply Dimming Option	Wire Gauge Required*	Minimum Enclosure Size Required (by others) RP Only	RP with EM10C Option**
UNV-D6E EldoLED 0-10V, 1%	18/16	6.25"W x 4"L x 2"H	14.5"W x 6.5"L x 3"H

Not all dimming options are available with all LED light engine options. See RP ordering table for details.

* Wire gauge 18/16 = Maximum distance from light fixture to remote power supply is 100' using 16 gauge wire, 50' using 18 gauge wire.

** Emergency battery remote power supplies cannot be located any more than 50 feet from light fixture.

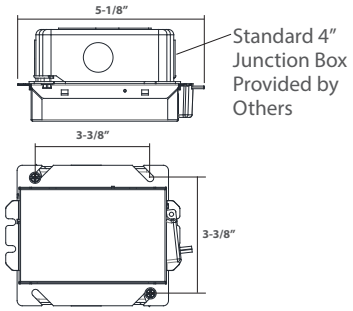
Note: All light fixtures must be wired in homeruns per wiring diagram here:



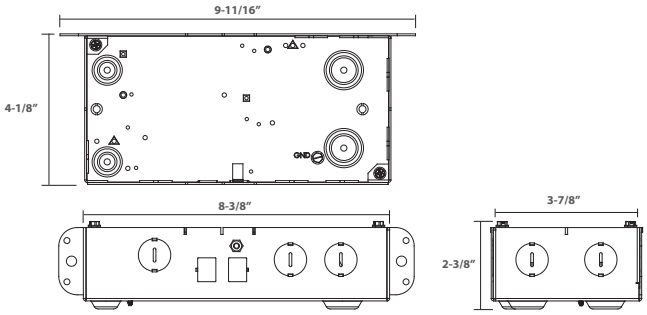
ENCLOSURES FOR REMOTE DRIVERS

Remote drivers require enclosures per local code. Enclosures can be provided by others, or for convenience, USAI can provide them to you. The choices available depend on the dimming driver specified. In the case of the metal encased drivers, USAI can offer a metal mounting plate sized 5-1/8" x 5-1/8" which attaches to the back of each dimming driver and can be installed directly inside a standard 4" square junction box. For the other dimming drivers we offer, USAI can provide an enclosure sized 4-1/8" wide x 9-11/16" long x 2-3/8" deep to accommodate one dimming driver each. Please refer to remote dimming driver ordering tables for clarification on which driver installation accessories, mounting plate or enclosure, are available for each remote dimming driver option. When choosing to use USAI remote dimming driver mounting accessories, whether enclosures or mounting plates, specify the accessory in the accessories column of the remote dimming driver ordering table to indicate selection. Field wiring should be according to NEC code; per article 411.7. EC is responsible for adherence to all local codes. Refer to remote dimming driver tables for maximum distances, locations, and wire gauges required, which varies by driver type.

MP JUNCTION BOX MOUNTING PLATE



ENC SINGLE DRIVER ENCLOSURE



USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D

Primary NXT Cylinder - CPRD
Round Downlight

SPECIFICATIONS

FIXTURE WEIGHT
Cylinder weighs 3 lbs (not including rigid pendant stem accessory).

WARRANTY
Based on IESNA LM80-2008, Primary NXT Cylinder has a 50,000 hour rated life at 70% lumen maintenance (L70). USAI Lighting Warranty covers replacement parts for 5 years from date of shipment. Warranty is void if USAI Cylinder is used with any power supply other than that which is provided by USAI.

LISTINGS
Dry/Damp. NRTL/CSA-US tested to UL standards. IBEW union made. All USAI Lighting products are Buy American Act (BAA) compliant.

NOTES
- Ambient temperatures at fixture location should not exceed 40°C during normal operation.
- For interior use only

PHOTOMETRICS
Consult factory or website for IES files. Tested in accordance with IESNA LM79-2008.

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D-EM

Primary NXT Cylinder - CPRD
Round Downlight

USAI® Lighting

Surface Mount

Surface Mount Conduit Cutout with Surface J-Box

Rigid Pendant Stem

Rigid Pendant Stem Conduit Cutout with Surface J-Box

Cable Mount Pendant

Cable Mount Pendant Conduit Cutout with Surface J-Box

PRIMARY NXT CYLINDER PERFORMANCE DATA	Classic White												Dim-to-Warm and Dim-to-Warm+	
Input Wattage	9W						15W						15W	
Correlated Color Temperature:	3000K						3000K						3000K	
Color Rendering Index (CRI):	80+			90+			80+			90+			90+	
Source Lumens:	1075			900			1575			1325			1150	
Beam Spread:	M	W	F	M	W	F	M	W	F	M	W	F	M	F
Delivered Lumens:	900	950	750	750	800	625	1300	1375	1075	1100	1150	900	800	650
Lumens Per Watt:	100	106	83	84	89	70	94	100	79	79	84	66	55	45

CORRELATED COLOR TEMPERATURE MULTIPLIER*	Classic White							
	2700K		3000K		3500K		4000K	
Color Rendering Index:	80+	90+	80+	90+	80+	90+	80+	90+
Multiplier for Lumen Output:	0.98	0.81	1.00	0.84	1.02	0.98	1.06	0.98

* Apply to 3000K, 80+ CRI values only in table above to approximate output at other color temperatures and CRIs

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13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D-EM

Primary NXT Cylinder - CPRD
Round Downlight with Integral Driver

USAI® Lighting

1. Specify fixture part number. (All boxes must be filled in to correctly order)

CPRD8	15L2	35KS	F	S	BLACK	CR3	UNV	D22
Fixture Size	**Wattage Options**	**LED Color Options**	**Beam Options**	**Lens Options**	**Finish**	**Mounting Options**	**Voltage Options** *Select one*	**Dimming Driver Options**

CPRD8
8" Length Round Downlight Cylinder

Classic White Light

09L2 9W LED
15L2 15W LED

27KS 2700K, 80+ CRI
27KH 2700K, 90+ CRI
30KS 3000K, 80+ CRI
30KH 3000K, 90+ CRI
35KS 3500K, 80+ CRI
35KH 3500K, 90+ CRI
40KS 4000K, 80+ CRI
40KH 4000K, 90+ CRI

M Medium Beam, 35°
W Wide Beam, 50°
F Flood Beam, 65°

Dim-to-Warm

15DW2 15W LED

3018KH 3000K - 1800K, 90+ CRI

M Medium Beam, 30°
F Flood Beam, 65°

Dim-to-Warm+

15DW2 15W LED

3020KH 3000K - 2000K, 90+ CRI

S Solite (provided standard)

WH White

SM Surface Mount to recessed junction box

CC Conduit Cutout for surface mounted 4" octagonal junction box

Rigid Stem Mount + Conduit Cutout Canopy Style (Field Cuttable)
PJ1A 2' Nominal Length
PJ2A 4' Nominal Length
PJ3A 8' Nominal Length

Rigid Stem Mount + Recessed JBox Canopy Style (Field Cuttable)
PR1A 2' Nominal Length
PR2A 4' Nominal Length
PR3A 8' Nominal Length

Cable Mount + Conduit Cutout Canopy Style (Field Cuttable)
CJ1 2' Nominal Length
CJ2 4' Nominal Length
CJ3 8' Nominal Length

Cable Mount + Recessed JBox Canopy Style (Field Cuttable)
CR1 2' Nominal Length
CR2 4' Nominal Length
CR3 8' Nominal Length

UNV 120V-277V

For use with Universal Voltage 120V - 277V
D22 0-10V Dimming Driver, dims to 1%

120V

For use with 120V only
D21 Phase Dimming Driver, 1%

Surface Mount (SM)

Conduit Cutout Surface Mount (CC)

Rigid Pendant Stem Mount (PR1A, PR2A, PR3A)

Rigid Pendant Stem Conduit Cutout Surface Mount (PJ1A, PJ2A, PJ3A)

Cable Mount (CR1, CR2, CR3)

Cable Mount Conduit Cutout (CJ1, CJ2, CJ3)

USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D-EM

Primary NXT Cylinder - CPRD
Round Downlight with Remote Driver

USAI Lighting

1. Specify fixture part number. (All boxes must be filled in to correctly order)

CPRD8				S	WH		RM
Fixture Size	**Wattage Options**	**LED Color Options**	**Beam Options**	**Lens Options**	**Finish**	**Mounting Options**	**Remote Power Supply**
CPRD8 8" Length Round Downlight Cylinder	**Classic White Light**			**S** Solite (provided standard)	**WH** White	**SM** Surface Mount to recessed junction box	**RM** Remote Power Supply (Specify in table below)
	09L2 9W LED **15L2** 15W LED	**27KS** 2700K, 80+ CRI **27KH** 2700K, 90+ CRI **30KS** 3000K, 80+ CRI **30KH** 3000K, 90+ CRI **35KS** 3500K, 80+ CRI **35KH** 3500K, 90+ CRI **40KS** 4000K, 80+ CRI **40KH** 4000K, 90+ CRI	**M** Medium Beam, 35° **W** Wide Beam, 50° **F** Flood Beam, 65°			**CC** Conduit Cutout for surface mounted 4" octagonal junction box
	Dim-to-Warm					**Rigid Stem Mount + Conduit Cutout Canopy Style (Field Cuttable)** **PJ1A** 2' Nominal Length **PJ2A** 4' Nominal Length **PJ3A** 8' Nominal Length	
	15DW2 15W LED	**3018KH** 3000K - 1800K, 90+ CRI	**M** Medium Beam, 30° **F** Flood Beam, 65°			**Rigid Stem Mount + Recessed JBox Canopy Style (Field Cuttable)** **PR1A** 2' Nominal Length **PR2A** 4' Nominal Length **PR3A** 8' Nominal Length	
	Dim-to-Warm +					**Cable Mount + Conduit Cutout Canopy Style (Field Cuttable)** **CJ1** 2' Nominal Length **CJ2** 4' Nominal Length **CJ3** 8' Nominal Length	
	15DW2 15W LED	**3020KH** 3000K - 2000K, 90+ CRI				**Cable Mount + Recessed JBox Canopy Style (Field Cuttable)** **CR1** 2' Nominal Length **CR2** 4' Nominal Length **CR3** 8' Nominal Length	

Surface Mount (SM)

Conduit Cutout Surface Mount (CC)

Rigid Pendant Stem Mount (PR1A, PR2A, PR3A)

Rigid Pendant Stem Conduit Cutout Surface Mount (PJ1A, PJ2A, PJ3A)

Cable Mount (CR1, CR2, CR3)

Cable Mount Conduit Cutout (CJ1, CJ2, CJ3)

USAI Power Supply Must Be Specified

2. Specify Remote Power Supply

RPB-01		UNV	D6E		
Remote Power Supply	**Wattage Options**	**Voltage**	**Remote Dimming Type and Level**	**Remote Emergency Option**	**Remote Driver Mounting Accessories***
RPB-01 Primary NXT Cylinder Remote Power Supply	**Classic White** **09L2** 9W LED **15L2** 15W LED Dim-to-Warm **15DW2** 15W LED	**UNV** 120V - 277V	**D6E** EldoLED 0-10V, 1%	**EM10C** T20 Compliant EM battery requires remote enclosure by others, minimum size 14.5" L x 6.5" W x 3" H (1, 2)	**MP** Junction Box Mounting Plate, 5-1/8" x 5-1/8" **ENC** Single Driver enclosure, 4-1/8" x 9-11/16" x 2-3/8" * If Remote Driver Mounting Accessories selection is left blank, driver will be provided with accessories for mounting in enclosure by others. See page 6 for remote driver enclosure sizing requirements.

1 Not available with MP jbox accessory 2 Not available with ENC single driver enclosure; enclosure by others required.

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13 Crosby Street
New York, NY 10013
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showroom@usailighting.com

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T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D-EM

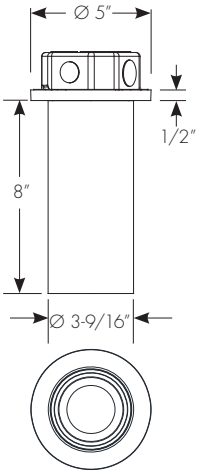
Primary NXT Cylinder - CPRD Round Downlight

USAI Lighting

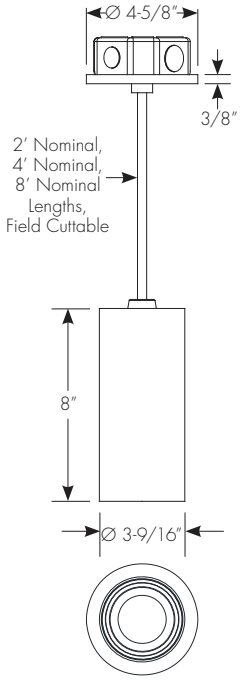
CYLINDER DIMENSIONS

FOR USE WITH RECESSED MOUNTED J-BOXES

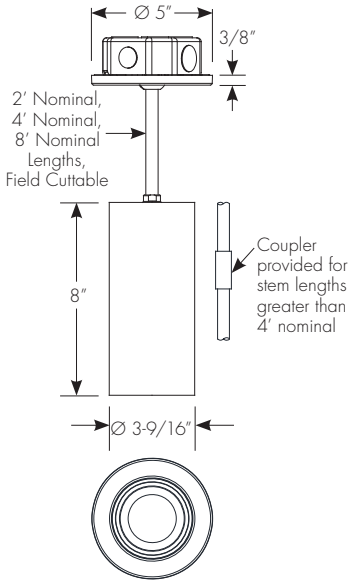
Surface Mount SM



Cable Mount CR1, CR2, CR3

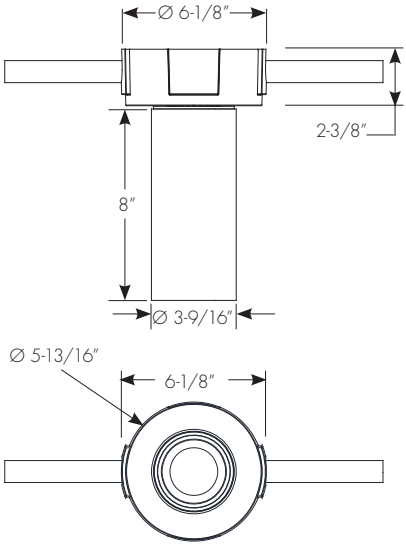


Stem Mount PR1A, PR2A, PR3A

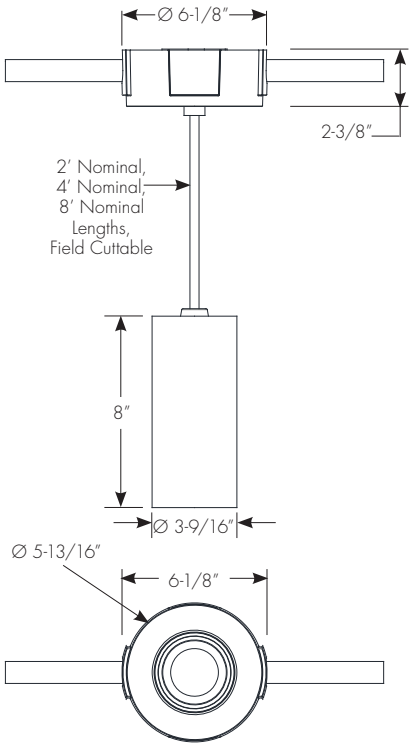


FOR USE WITH SURFACE MOUNTED J-BOXES

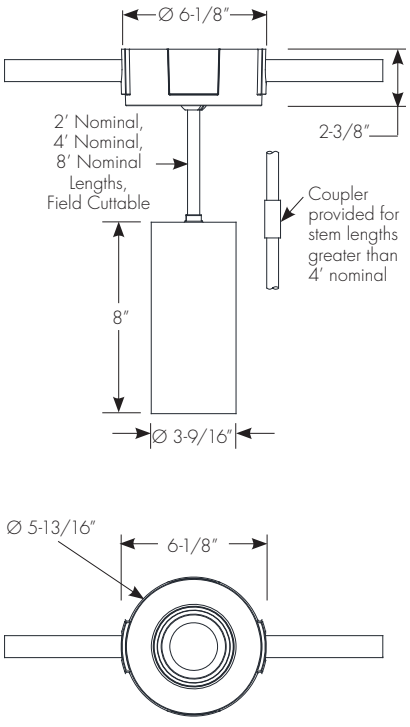
Conduit Cutout Surface Mount CC



Conduit Cutout Canopy Cable Mount CJ1, CJ2, CJ3



Conduit Cutout Canopy Stem Mount PJ1A, PJ2A, PJ3A



USAI LIGHTING COLLABORATORY
13 Crosby Street
New York, NY 10013
845-234-4090
showroom@usailighting.com

USAI LIGHTING HEADQUARTERS
1126 River Road
New Windsor, NY 12553
T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D-EM

Primary NXT Cylinder - CPRD Round Downlight

USAI® Lighting

SPECIFICATIONS

FIELD REPLACEABLE LED LIGHT ENGINE
Light engine is serviceable with a Philips screwdriver.

COLOR
All USAI Lighting Classic White LED light engines are tightly binned for industry-leading fixture-to-fixture color consistency within a 2-Step MacAdam Ellipse. The Dim to Warm LED option gradually shifts from 3000K, 90CRI to a warm and natural-feeling 2000K as you dim or 1800K as you dim and meets 3-Step MacAdam's consistency criteria.

FIELD REPLACEABLE OPTICS
Cylinder beamspreads are interchangeable. USAI's proprietary tooled optical reflectors can be easily swapped out in the field without tools. See ordering table for exact beamspread options available with each light engine.

BODY
3-9/16"Ø extruded aluminum body available in 8" length. Cylinder body and canopy are provided in white powder coated paint finish.

MOUNTING
Hardware included for mounting to 4" octagonal junction box.

SURFACE MOUNT
If the Surface Mount option (SM) is specified, Primary NXT Cylinder fixture is provided with a 5"Ø x 1/2" deep round canopy in body finish specified. The installation is completed with no visible hardware.

PENDANT STEM MOUNT
1/2" Ø (1/4" IPS) steel stem is provided with 30° hang straight in length specified (2' nominal, 4' nominal, or 8' nominal) and is field cuttable to a minimum length of 6". and is provided in white finish.

CABLE MOUNT
White cable is field cuttable and is provided in length specified (2' Nominal, 4' Nominal or 8' Nominal). Installers must cut the cable in the field to desired length.

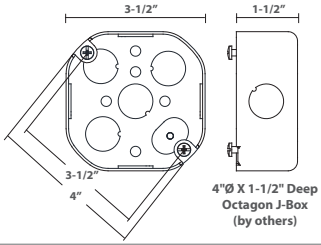
RECESSED JBOX PENDANT CANOPY
If recessed J-box canopy style is specified (PR1A, PR2A, PR3A or CR1, CR2, CR3 options) a 5" Ø or 4-5/8" Ø round x 3/8" deep canopy is provided for mounting to recessed mounted junction box. in white powdercoat painted finish.

CONDUIT CUTOUT SURFACE MOUNT
Conduit cutout fixtures are designed to mount to surface-mounted 4"octagonal junction boxes with surface-mounted conduit connections. If the conduit cutout surface mount option (CC) is specified, Primary NXT Cylinder is provided with a 5-13/16" Ø x 2-1/2" deep conduit cutout canopy base in white powder coat painted finish. CC bases have 4 keyslots, one in each side, and ship with one conduit cutout key and three solid cover keys installed. 2 additional conduit cutout keys are shipped with the fixture, and the different key types are interchangeable in the field. Please see installation instructions for drawings and more details.

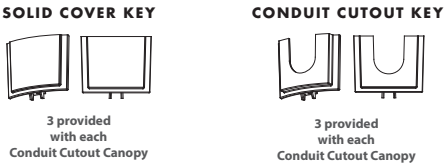
CONDUIT CUTOUT PENDANT CANOPY
If Conduit Cutout Canopy is specified (PJ1A, PJ2A, PJ3A or CJ1, CJ2, CJ3 options) a 5-13/16" Ø round x 2-3/8" deep canopy is provided for mounting to standard 4" octagonal surface mounted junction box. Conduit cutout canopy has 4 key slots, one in each side, and ships with three conduit cutout keys and three solid cover keys which are field interchangeable and can be configured to accommodate any ceiling layout using ½" or ¾" conduit. Conduit cutout canopy is provided white powdercoat painted finish.

CONDUIT CUTOUT MOUNTING EXAMPLE

4"OCTAGONAL JUNCTION BOX



KEY COVER DETAIL



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showroom@usailighting.com

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1126 River Road
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T: 845–565–8500 F: 845–561–1130
info@usailighting.com

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LIGHTING TYPE D-EM

Primary NXT Cylinder - CPRD
Round Downlight

USAI® Lighting

SPECIFICATIONS

FIELD REPLACEABLE INTEGRAL DRIVER

100%-1% solid state electronic constant current dimming driver with a high power factor is provided standard. All integral dimming drivers are located within the cylinder body and are serviceable from below the ceiling. Some on-time delay may be experienced depending on control system used. All dimming drivers comply with IEEE C62.41 surge protection.

REMOTE LOCATION DRIVER

Primary NXT Cylinder is available for use with remotely located driver. Remote dimming driver power supply option must be clearly specified in the "RP" table. Remote power supplies require enclosures by others that meet local codes and must be located in an accessible service panel within 100ft of the light fixture; see remote driver table below for coordination of enclosure sizes and wire gauges required. All dimming drivers comply with IEEE C62.41 surge protection.

Remote Power Supply Requirements and Wiring Diagram
enclosure sizes and wire gauge with **1 fixture** per power supply.

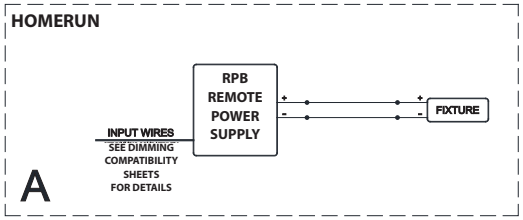
Remote Power Supply Dimming Option	Wire Gauge Required*	Minimum Enclosure Size Required (by others) RP Only	RP with EM10C Option**
UNV-D6E EldoLED 0-10V, 1%	18/16	6.25"W x 4"L x 2"H	14.5"W x 6.5"L x 3"H

Not all dimming options are available with all LED light engine options. See RP ordering table for details.

* Wire gauge 18/16 = Maximum distance from light fixture to remote power supply is 100' using 16 gauge wire, 50' using 18 gauge wire.

** Emergency battery remote power supplies cannot be located any more than 50 feet from light fixture.

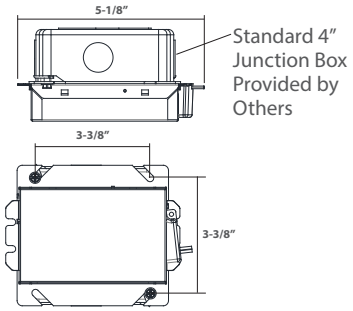
Note: All light fixtures must be wired in homeruns per wiring diagram here:



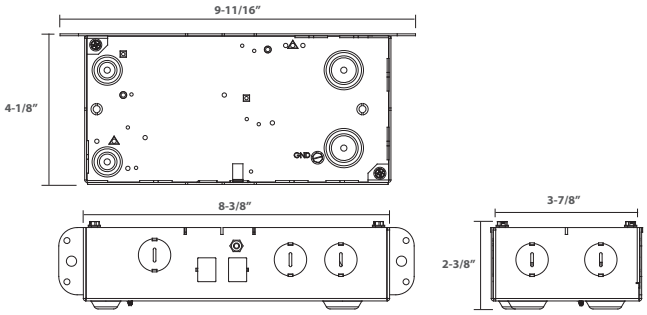
ENCLOSURES FOR REMOTE DRIVERS

Remote drivers require enclosures per local code. Enclosures can be provided by others, or for convenience, USAI can provide them to you. The choices available depend on the dimming driver specified. In the case of the metal encased drivers, USAI can offer a metal mounting plate sized 5-1/8" x 5-1/8" which attaches to the back of each dimming driver and can be installed directly inside a standard 4" square junction box. For the other dimming drivers we offer, USAI can provide an enclosure sized 4-1/8" wide x 9-11/16" long x 2-3/8" deep to accommodate one dimming driver each. Please refer to remote dimming driver ordering tables for clarification on which driver installation accessories, mounting plate or enclosure, are available for each remote dimming driver option. When choosing to use USAI remote dimming driver mounting accessories, whether enclosures or mounting plates, specify the accessory in the accessories column of the remote dimming driver ordering table to indicate selection. Field wiring should be according to NEC code; per article 411.7. EC is responsible for adherence to all local codes. Refer to remote dimming driver tables for maximum distances, locations, and wire gauges required, which varies by driver type.

MP JUNCTION BOX MOUNTING PLATE



ENC SINGLE DRIVER ENCLOSURE



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T: 845–565–8500 F: 845–561–1130
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LIGHTING TYPE D-EM

Primary NXT Cylinder - CPRD Round Downlight

SPECIFICATIONS

FIXTURE WEIGHT
Cylinder weighs 3 lbs (not including rigid pendant stem accessory).

WARRANTY
Based on IESNA LM80-2008, Primary NXT Cylinder has a 50,000 hour rated life at 70% lumen maintenance (L70). USAI Lighting Warranty covers replacement parts for 5 years from date of shipment. Warranty is void if USAI Cylinder is used with any power supply other than that which is provided by USAI.

LISTINGS
Dry/Damp. NRTL/CSA-US tested to UL standards. IBEW union made. All USAI Lighting products are Buy American Act (BAA) compliant.

NOTES
- Ambient temperatures at fixture location should not exceed 40°C during normal operation.
- For interior use only

PHOTOMETRICS
Consult factory or website for IES files. Tested in accordance with IESNA LM79-2008.

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T: 845–565–8500 F: 845–561–1130
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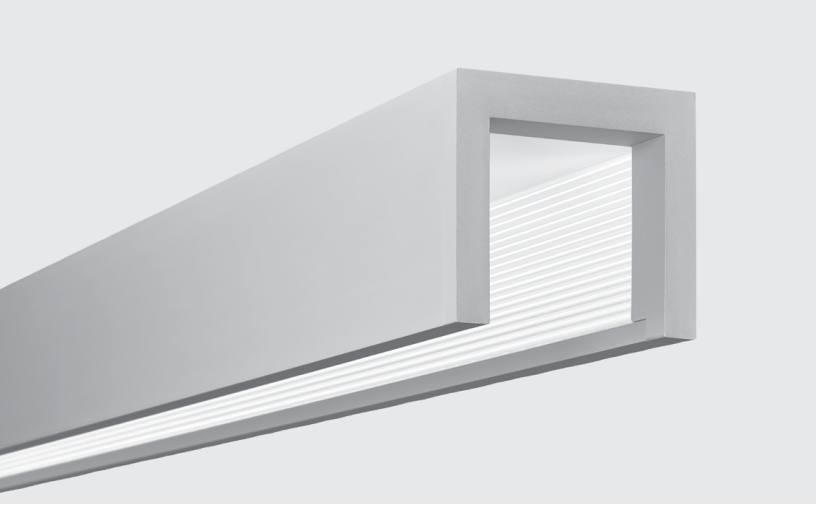
LIGHTING TYPE F

FLUXWERX®

TYPE
F

SPECIFICATION DATA
PROFILE AREA (PF1|PF3)

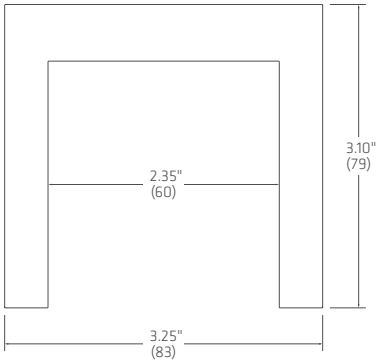


CATALOG #
PF1-F-D-D-35-B-04-S-F2-M-03

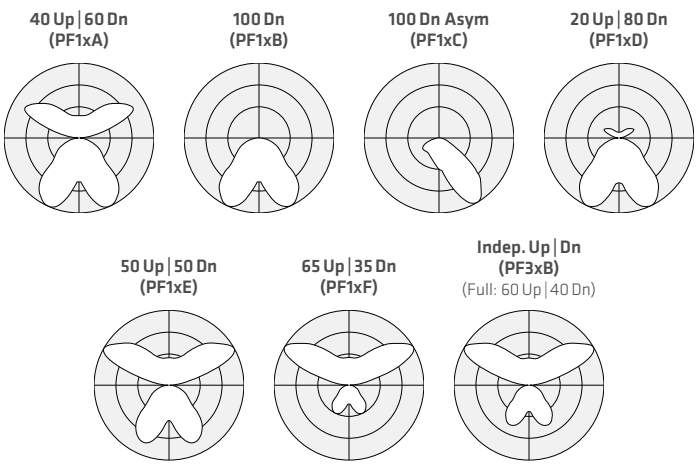
PROJECT
SANTA ANA ZOO EDUCATION HUB

NOTES

CROSS SECTION



DISTRIBUTIONS



PERFORMANCE FOCUS

40 Up|60 Dn, 80 CRI 4000 K (PF1xAx40)

	Energy (W/4ft)	Light (lm/4ft)	Efficacy (lm/W)
A	**19 W**	2300	128
B	**23 W**	2900	127
C	**29 W**	3500	126
D	**38 W**	4500	123

Color Matching (SDCM)	Lumen Maintenance (hr) L90 per TM21	L70 Estimate
< 2	> 60,000	> 200,000

Nominal values, refer to back pages for full performance data.

FEATURES

- An open aperture design with fully luminous interior. No horizontal lenses or diffusers.
- Fluxwerx Anidolic extraction optics provide precisely controlled optical distributions with no view of the LED point source, for low glare and wide row spacing.
- Up to 15 ft o.c. spacing, delivering 40 fc at less than 0.4 W/ft^2.
- Five endcap styles, preinstalled for perfect fit & finish.
- Direct and direct/indirect general area lighting versions.
- Also available in vertical surface illumination (VSI) symmetric and asymmetric distributions.
- Precision machined, clear anodized extruded aluminum body.

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PROFILE AREA (PF1|PF3)

ORDER GUIDE

1	2	3	4	5	6	7	8	9	10	11	OPTIONS	CONTROLS
PF1	F	D	D	35	B	04	S	F2	M	03		

1 FAMILY

PF1	Profile Area
PF3	Profile Up|Dn

2 ENDCAP

A	Angle
B	Bevel
F	Flat
P	Capsule
S	Square

3 DISTRIBUTION

A	40 Up | 60 Dn
B	100 Dn
C	100 Dn Asymmetric
D	20 Up | 80 Dn
E	50 Up | 50 Dn
F	65 Up | 35 Dn
B	Independent Up|Dn Control

4 ENERGY [1]

A	19 W
B	23 W
C	29 W
D	38 W
D	38 W

[1] Nominal input power /4 ft. Add 4 W for Battery Pack, W1 or 347 V.

5 CRI-CCT

30	80 CRI 3000 K
35	80 CRI 3500 K
40	80 CRI 4000 K
93	90 CRI 3000 K
90	90 CRI 3500 K
94	90 CRI 4000 K
W2	80 CRI 2700–6500 K [12]

6 FINISH [2]

A	Clear Anodized
B	Black Powdercoat
S	Metallic Silver Powdercoat
W	White Powdercoat
C	Custom Color (RAL)

[2] Fixture finish only. Canopies are standard white.

7 LENGTH

04	4 ft
06	6 ft
08	8 ft
XX	x ft [3]

[3] Specify run length in 2' nominal increments. Important: Row lengths cannot be modified on site (factory installed endcaps & joiners).

8 CEILING TYPE [4]

D	Drywall
G	Grid
S	Structure
R	Remote

[4] Integrated driver with mounting, power feed, suspension + canopy, except for remote.

9 DRIVER

F1	Non-Dim
F2	0–10 V Dim 3%
F4	Line Voltage Dim (Fwd/Rev) 3% 120 V
E1	eldoLED ECO 0–10 V Dim 1%
E2	eldoLED SOLO 0–10 V Dim 0.1%
E3	eldoLED ECO DALI-2 DT6 Dim 1%
E4	eldoLED SOLO DALI-2 DT6 Dim 0.1%
L1	Lutron Hi-Lume 1% EcoSystem (LDE1)
W1	eldoLED DUAL DALI Dynamic White 0.1% [12]

10 VOLTAGE

M	120–277 V
1	120 V [5]
2	277 V [5]
3	347 V [6]

[5] Fixed voltage only for (F4) Line Dim Driver or nLight controls.
[6] 347 V transformer, not with Up|Dn Control or Drywall ceiling.

11 SUSPENSION

03	≤ 3 ft
06	≤ 6 ft
12	≤ 12 ft
25	≤ 25 ft

OPTIONS

WIRING & EMERGENCY [7]

A#	Alternate Wiring Module Qty [8] (2nd circuit in 8 ft modules for EM/NL or presentation switching)
B#	Battery Pack Qty
H#	Emergency Switch Qty (GTD or Controller)

[7] BP & GTD available for 120–277 V in Grid (G), Structure (S) and Remote (R) ceilings.
[8] Alt. Wiring: not with Up|Dn Control.

ROW LAYOUT

C	Chicago CCEA
F	4 ft End Module
G	6 ft Modules [9]
N	Non-Power End

[9] For 12 ft & 18 ft rows.

CONTROLS

SENSORS & CONTROLLERS

SE1	Canopy Integrated Enlighted Smart Sensor [10]
RE1	Remote Enlighted Smart Sensor
VN1	Acuity nLight Wired Converter [11]

[10] For Enlighted in drywall ceilings, use Remote (R) ceiling option. Enlighted with Independent Up|Dn or 8 ft Alternate Wiring (A) requires 2 sensors per luminaire and only one can be canopy integrated (SE1).
[11] For nLight in Drywall (D) and Structure (S) ceilings, contact Fluxwerx.

DYNAMIC WHITE [12]

WN1	Acuity nLight
WC1	0–10 V Linear Dim
WC2	0–10 V Log Dim
WD1	DALI Linear Dim
WD2	DALI Inverse Log Dim

[12] Dynamic White is available with 40|60 (A) & 100 Dn (B) distributions. Use W1 driver. Refer to later section for DW spec & performance details.

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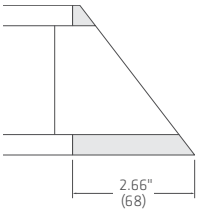
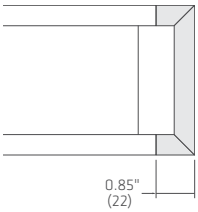
ENDCAPS

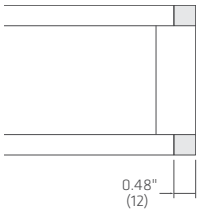
(A) ANGLE



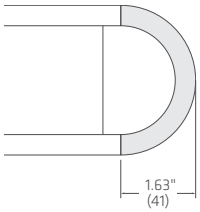
(B) BEVEL



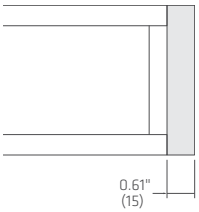
(F) FLAT



(P) CAPSULE

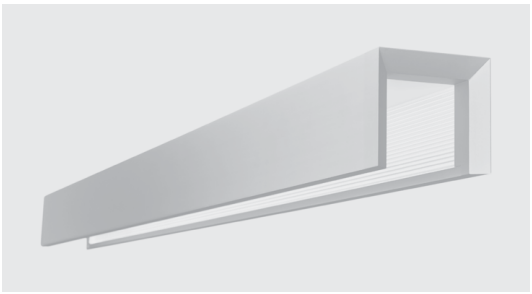


(S) SQUARE

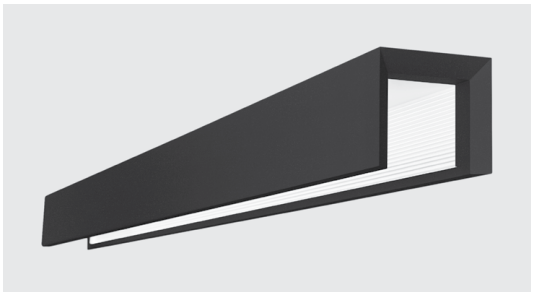


FINISHES

All finishes high temperature powder coated.

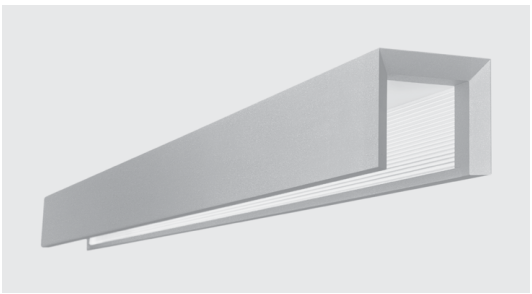


(A) CLEAR ANODIZED

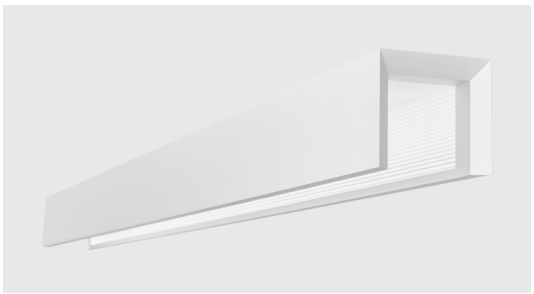


(B) BLACK

CUSTOM



(S) SILVER



(W) WHITE

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SPECIFICATION DATA

PROFILE AREA (PF1|PF3)

PRODUCT DETAILS

Vertical Anidolic Optic

RUN LENGTHS

Standalone fixtures are available in 4', 6' + 8' nominal lengths.

IMPORTANT

Endcaps and joiners are integral luminaire components. Do not remove them to change run layouts.

4'

6'

8'

Run lengths are available in 2' nominal increments.

10'	6'	4'		
12'	8'	4'		
12'	6'	6'		* Alternate option (G)
14'	8'	6'		
16'	8'	8'		
18'	8'	4'	6'	
18'	6'	6'	6'	* Alternate option (G)
20'	8'	4'	8'	
22'	8'	8'	6'	
24'	8'	8'	8'	

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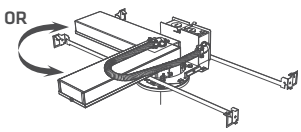
INTEGRATED DRIVER, MOUNTING, POWER FEEDS + SUSPENSION

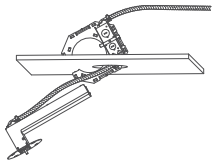
Refer to separate product specification datasheets for detailed dimensions of mounting hardware components, driver enclosures, canopies and wiring.

(D) DRYWALL — New or Retrofit

Integrated driver, power feed and mounting suspension points suitable for GWB or plaster thicknesses of < 0.875" (22 mm).



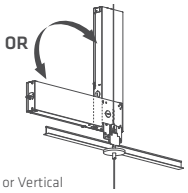
Perpendicular or Parallel



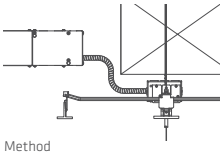
Retrofit Method

(G) GRID — ON or OFF Grid

Integrated clip, driver, power feed and mounting suspension points suitable for accessible ceiling grid heights of <1.75" (44 mm).



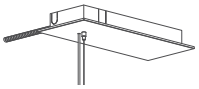
Horizontal or Vertical



Detached Method

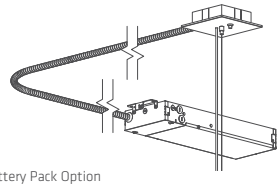
(S) STRUCTURE — Exposed Ceilings

Integrated driver with mounting, power feed, suspension + canopy suitable for exposed surface conduit or recessed junction boxes.



Power Feed Canopy

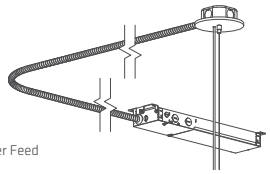
Suspension Canopy



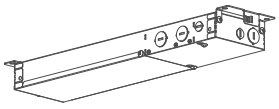
Battery Pack Option

(R) REMOTE

External remote mounted driver. Power feed and suspension points suitable for exposed conduit or recessed junction boxes. See Notes for wire gauge guide.



Power Feed



Multivolt 120–277 V Driver

DRIVER OPTIONS

(D) DRYWALL			(G) GRID			(S) STRUCTURE			(R) REMOTE		
✗ 347V	✗ Battery Pack	✗ Emergency Switch	✓ 347V (VM1)	✓ Battery Pack	✓ Emergency Switch	✓ 347V (VM1)	✓ Battery Pack	✓ Emergency Switch	✓ 347V (VM1)	✓ Battery Pack	✓ Emergency Switch
✓ Lutron	✓ eldoLED		✓ Lutron	✓ eldoLED		✓ Lutron	✓ eldoLED		✓ Lutron	✓ eldoLED	

ENLIGHTED SENSOR OPTION

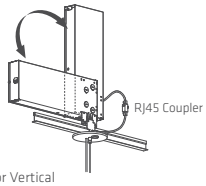
(D) DRYWALL ✗

For Enlighted Sensors in drywall ceilings, use REMOTE (R) mounting enclosure options.

(G) GRID ✓

Canopy Integrated Sensor

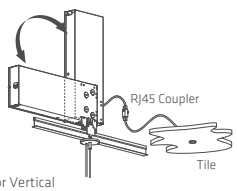
5.5" round canopy preinstalled with Enlighted wireless sensor and large driver enclosure with Enlighted control unit. Plenum rated cable whips and RJ45 plugs enable quick field connection.



Horizontal or Vertical

Remote Sensor

Enlighted wireless sensor supplied with tile mount collar for remote sensor placement in a ceiling tile. Plenum rated cable whips and RJ45 plugs enable quick field connection.

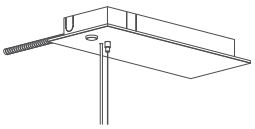


Horizontal or Vertical

(S) STRUCTURE ✓

Canopy Integrated Sensor

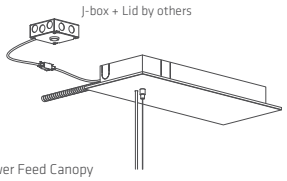
Large driver enclosure with Enlighted control unit and enclosure shroud preinstalled with Enlighted wireless sensor. Hidden cable whips and RJ45 plugs enable quick field connection.



Power Feed Canopy

Remote Sensor

Enlighted wireless sensor supplied with tile mount collar for remote sensor placement to a horizontal surface or J-box lid (by others). Plenum rated cable whips and RJ45 plugs enable quick sensor field connection.

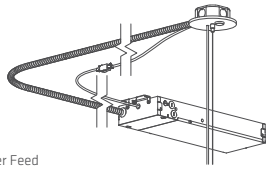


Power Feed Canopy

(R) REMOTE ✓

Canopy Integrated Sensor

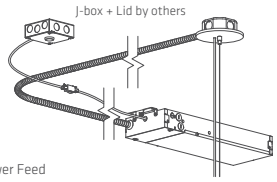
5.5" round canopy preinstalled with Enlighted wireless sensor for a 4" octagon J-box (by others). Remote mounted, large driver enclosure with Enlighted control unit. Plenum rated cable whips and RJ45 plugs enable quick sensor field connection.



Power Feed

Remote Sensor

Enlighted wireless sensor supplied with tile mount collar for remote sensor placement to a horizontal surface or J-box lid (by others). Plenum rated cable whips and RJ45 plugs enable quick sensor field connection.



Power Feed

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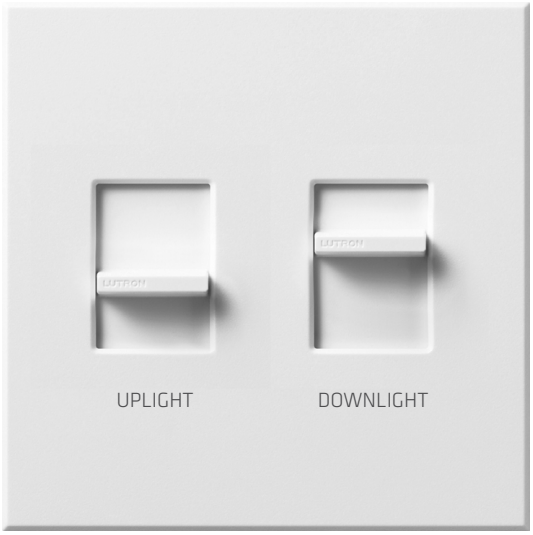
CONTROLS & SENSORS

INDEPENDENT UP|DOWN LIGHTING CONTROL

Profile Up|Dn provides fully dimmable or switchable independent control of the indirect and direct distributions. Ideal for multipurpose rooms and spaces with presentation, projection or video conferencing requirements; the separated circuitry allows simple adjustment of the proportions of up|down light to suit the lighting and energy needs of the space and people in the environment.

Profile Up|Dn is available with a native distribution of 60 Up|40 Dn with a maximum total delivered output of 4450 lumens.

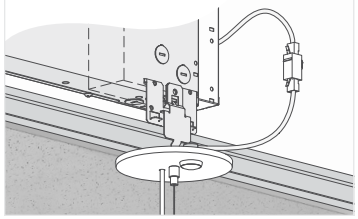


SYSTEMS & SENSORS

Fluxwerx products are designed for simple integration with a wide range of sensors, lighting controls and building management systems. Many projects incorporate occupancy sensing, daylight harvesting, individual or central adjustment of light levels and luminaire or space monitoring in order to save energy, reduce costs and maximize occupant comfort. Fluxwerx offers a number of standard driver and controller options to support various wired and wireless network protocols. In our suspended products, the packaging of drivers and controls in the mounting system maintains clean aesthetics, simplifies installation & maintenance, increases flexibility and supports future system upgrades.

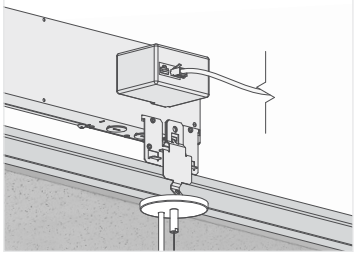
enlighted

Enlighted wireless, networked smart sensor integrates occupancy sensing, daylight harvesting, energy usage, temperature and light level control.
Option: Canopy-integrated or remote Enlighted sensor (SE1 or RE1)
Model: SU-5E-CL



nLIGHT

nLight wired, 2-way network supports luminaire light level control as well as occupancy and daylight sensors.
Option: Acuity nLight Converter (VN1)
Model: nPS-80-EZ or nPS-80-EZ-ER



eldoLED

EldoLED drivers support common wired protocols, 0–10 V and DALI. They also provide access to finer dimming control, dynamic white and Bluetooth low-energy (BLE) wireless.
Options: ECO 1% (E1), SOLO 0.1% (E2)

LUTRON

Lutron EcoSystem network protocol enables on/off, dimming, occupancy sensing and daylight harvesting.
Option: EcoSystem Hi Lume 1% (L1)

legrand® Wattstopper® Pass & Seymour® LEVITON® EATON® DISTECH CONTROLS™ CRESTRON®

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PROFILE AREA (PF1|PF3)

NOTES

CONSTRUCTION

- Anodized, extruded + machined architectural grade aluminum
- Precision machined aluminum joints and endcaps are factory preinstalled for seamless fit
- Stainless steel fasteners
- 0.04" (1.0 mm) stainless steel aircraft cable suspensions
- Clear anodized surface finish or powdercoated in white, metallic silver or black, canopies in white as standard

OPTICAL

- Anidolic optical structures with linear light extraction elements
- Precision molded high transmittance clear acrylic lenses
- Long life mid-flux LED system designed for typical TM21 lumen maintenance ≥ L90 @ 60,000 h
- Available in 3000 K, 3500 K, 4000 K or 2700–6500 K with CRI ≥ 80 and R9 ≥ 0. Also static white with CRI ≥ 90 and R9 ≥ 50, all with color accurate binning ≤ 2 SDCM

ELECTRICAL

- No electrical connections are required at fixture level for installation; low voltage power cords factory preinstalled
- High efficiency multivolt drivers, integrated with suspension and mounting components, for 50–60 Hz 120–277 V and transformer for 347 V
- Power Factor > 0.90
- Total Harmonic Distortion < 20%
- Dim level: Standard 3%, optional 1% or 0.1%
- Surge Protection: Meets ANSI C82.11 spec and ANSI/IEEE C62.41
- Inrush Current: Meets NEMA 410

EMERGENCY

- Optional Battery Pack delivers 10 W Class 2 rated output for 90 min. Use 12 W input energy to estimate emergency flux, typically 1150–1750 lm (@ 100–150 lm/W).
- Optional GTD (Generator Transfer Switch), 120–277 V, disables 0–10 V control during emergency for full light output

WIRE GAUGE

- Recommended low voltage wire gauge (AWG) for minimal losses over distance when REMOTE mounting:

  30 ft | 18 ga

  50 ft | 14 ga

  80 ft | 12 ga

ENVIRONMENTAL & CARE

- Designed for use in dry or damp indoor locations with ambient temperatures of 0–30° C (32–86° F)
- The luminaire may be damaged by chemicals such as chlorine, solvents, ammonia, alcohol or sulfur in the area of operation or in cleaning products. Damage from contaminants is not covered under warranty.
- Not suitable for natatorium environments, e.g. swimming pools, hot tubs and saunas.
- Clean only by wiping with a slightly water-damp, soft, clean cloth.

WEIGHT

- Fixture only: ~ 2.0 lb/ft (3 kg/m)

WARRANTY

- 5 year limited warranty on all components and workmanship

INDEPENDENT TESTING

- IESNA LM79
- IESNA LM80 (LED @ 10,000 h)

APPROVALS

- UL Listed (USA + Canada)
- CCEA Chicago Plenum

Protected by one or more US patents: 10215344, 10830415, 9733411, 9823406, D731700, D780971, D891670, D890403, D877953, D877954, D877955, 10077891; EU patents: 002263020-0001, 002263020-0002, 002263020-0003.

DRIVERS + EMERGENCY

STANDARD DRIVER OPTIONS	
OPTOTRONIC® ADVANCE ERP POWER	**F1** Non-Dim **F2** 0–10 V Dim 3% **F4** Line Voltage Dim 3% (Forward/Reverse) 120 V
eldoLED	**E1** eldoLED ECO 0–10 V Dim 1% **E2** eldoLED SOLO 0–10 V Dim 0.1% **E3** eldoLED ECO DALI-2 DT6 Dim 1% **E4** eldoLED SOLO DALI-2 DT6 Dim 0.1%
LUTRON	**L1** Lutron Hi-Lume 1% EcoSystem (LDE1)

EMERGENCY OPTIONS	
bodine RIB	**B** Battery Pack Bodine BSL310 (10 W) **H** Emergency Switching Functional Devices ESRB Emergency Lighting Relay

Driver and emergency selection may be limited by product or version. For further options, contact Fluxwerx.

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FAMILY PERFORMANCE

80 CRI

COLOR	4000 K	3500 K	3000 K
Color Rendering (CRI)	83	83	82
Red Index (R9)	5	5	3
Color Matching (SDCM)	< 2		

90 CRI

COLOR	4000 K	3500 K	3000 K
Color Rendering (CRI)	92	92	92
Red Index (R9)	63	63	59
Color Matching (SDCM)	< 2		

Typical colorimetry values.

LUMEN MAINTENANCE

	A 19 W	B 23 W	C 29 W	D 38 W
L90 per TM-21 (hr)	> 60,000			
L70 Estimate (hr)	> 200,000			

OUTPUT MULTIPLIERS

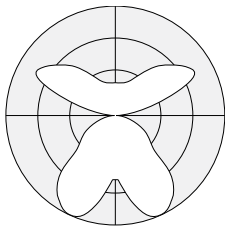
MULTIPLIER		Applies To
90 CRI	0.80	All 80 CRI
Battery Pack	0.66	Energy A (19 W)

For 90 CRI, emergency BP or non-white fixtures, use multipliers to scale published Light (lm), Efficacy (lm/W), Intensity (Cd), Luminance (Cd/m²) and IES files.

VERSION PERFORMANCE

PF1xA – 40 Up|60 Dn, 80 CRI

CONFIGURATION			LIGHT & POWER			VISUAL COMFORT		LIGHT DISTRIBUTION
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	MAX INTENSITY 45–90° (Cd)	MAX LUMINANCE 45–90° (Cd/m²)	
PF1xAx40 4000 K	A	19 W	2338	18.22	128.3	401	4,185	
	B	23 W	2894	22.80	126.9	496	5,180	
	C	29 W	3491	27.78	125.7	599	6,249	
	D	38 W	4525	36.75	123.1	776	8,100	
PF1xAx35 3500 K	A	19 W	2265	18.22	124.3	388	4,053	
	B	23 W	2802	22.80	122.9	480	5,015	
	C	29 W	3380	27.78	121.7	579	6,049	
	D	38 W	4381	36.75	119.2	751	7,842	
PF1xAx30 3000 K	A	19 W	2191	18.29	119.8	376	3,922	
	B	23 W	2709	22.80	118.8	464	4,850	
	C	29 W	3268	27.78	117.6	560	5,850	
	D	38 W	4236	36.68	115.5	726	7,583	



Profile Suspended
42% Up | 58% Dn

Photometry Reports: 11692617.07 (19 W), 11692617.07 (23 W), 11692617.07 (29 W), 11692617.07 (38 W)

Integrating Sphere and Photometric results at 4000K by an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011. Results for 3000K and 3500K scaled based on integrating sphere results at 38W (D). Candlepower Distribution scaled per total lumens of Integrating Sphere results.

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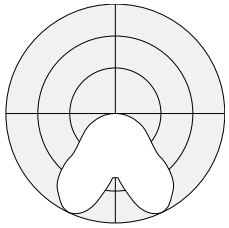
SPECIFICATION DATA

PROFILE AREA (PF1|PF3)

VERSION PERFORMANCE

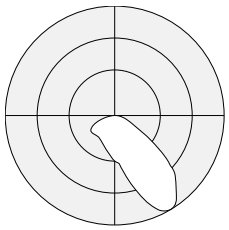
PF1xB – 100 Dn, 80 CRI

CONFIGURATION			LIGHT & POWER			VISUAL COMFORT		LIGHT DISTRIBUTION
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	MAX INTENSITY 45-90° (Cd)	MAX LUMINANCE 45-90° (Cd/m²)	
PF1xBx40 4000 K	A	19 W	2077	18.49	112.3	609	6,380	
	B	23 W	2553	23.13	110.4	749	7,843	
	C	29 W	3106	28.74	108.1	911	9,541	
	D	38 W	3941	37.46	105.2	1,156	12,107	
PF1xBx35 3500 K	A	19 W	2022	18.49	109.4	593	6,212	Profile Suspended 1% Up | 99% Dn
	B	23 W	2521	23.13	109.0	739	7,746	
	C	29 W	3067	28.74	106.7	900	9,423	
	D	38 W	3892	37.46	103.9	1,142	11,956	
PF1xBx30 3000 K	A	19 W	1967	18.50	106.3	577	6,043	
	B	23 W	2490	23.13	107.6	730	7,647	
	C	29 W	3029	28.74	105.4	888	9,304	
	D	38 W	3843	37.48	102.5	1,127	11,805	

Photometry Reports: 11692617.22 (19 W), 11692617.21 (23 W), 11692617.20 (29 W), 11692617.17 (38 W)

Integrating Sphere and Photometric results at 4000K by an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011. Results for 3000K and 3500K scaled based on integrating sphere results at 38W (D). Candlepower Distribution scaled per total lumens of Integrating Sphere results.

PF1xC – 100 Dn Asym, 80 CRI

CONFIGURATION			LIGHT & POWER			LIGHT DISTRIBUTION
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	
PF1xCx40 4000 K	A	19 W	1873	18.49	101.3	
	B	23 W	2326	23.13	100.5	
	C	29 W	2938	28.74	102.2	
	D	38 W	3673	37.46	98.1	
PF1xCx35 3500 K	A	19 W	1825	18.49	98.7	Profile Suspended Asymmetric 100% Dn
	B	23 W	2267	23.13	98.0	
	C	29 W	2864	28.74	99.7	
	D	38 W	3580	37.46	95.6	
PF1xCx30 3000 K	A	19 W	1779	18.49	96.2	
	B	23 W	2209	23.13	95.5	
	C	29 W	2791	28.74	97.1	
	D	38 W	3489	37.48	93.1	

Photometry Reports: 11692617.22 (19 W), 11692617.21 (23 W), 11692617.20 (29 W), 11692617.17 (38 W)

Integrating Sphere and Photometric results at 4000K by an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011. Results for 3000K and 3500K scaled based on integrating sphere results at 38W (D). Candlepower Distribution scaled per total lumens of Integrating Sphere results.

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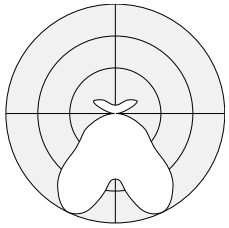
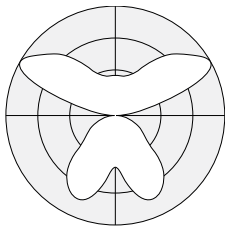
VERSION PERFORMANCE

PF1xD – 20 Up | 80 Dn, 80 CRI

CONFIGURATION			LIGHT & POWER			VISUAL COMFORT		LIGHT DISTRIBUTION
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	MAX INTENSITY 45-90° (Cd)	MAX LUMINANCE 45-90° (Cd/m²)	
PF1xDx40 4000 K	A	19 W	2144	18.49	116.0	517	5,457	
	B	23 W	2635	23.13	113.9	636	6,709	
	C	29 W	3206	28.74	111.6	774	8,161	
	D	38 W	4068	37.27	109.1	982	10,355	
PF1xDx35 3500 K	A	19 W	2117	18.49	114.5	511	5,390	Profile Suspended 18% Up | 82% Dn
	B	23 W	2603	23.13	112.5	628	6,624	
	C	29 W	3166	28.74	110.2	764	8,060	
	D	38 W	4017	37.27	107.8	969	10,226	
PF1xDx30 3000 K	A	19 W	2091	18.49	113.1	504	5,321	
	B	23 W	2570	23.13	111.1	620	6,541	
	C	29 W	3126	28.74	108.8	754	7,958	
	D	38 W	3967	37.27	106.4	957	10,097	

Photometry Reports: 11692617.15 (38 W)
Integrating Sphere and Photometric results at 3000K, 3500K and 4000K scaled from PF1xD 38W (D) and PF1xB results from an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011. Candlepower Distribution scaled per total lumens of Integrating Sphere results.

PF1xE – 50 Up | 50 Dn, 80 CRI

CONFIGURATION			LIGHT & POWER			VISUAL COMFORT		LIGHT DISTRIBUTION
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	MAX INTENSITY 45-90° (Cd)	MAX LUMINANCE 45-90° (Cd/m²)	
PF1xEx40 4000 K	A	19 W	2351	18.49	127.2	336	3,540	
	B	23 W	2890	23.13	124.9	413	4,352	
	C	29 W	3516	28.74	122.3	502	5,294	
	D	38 W	4461	36.50	122.2	637	6,718	
PF1xEx35 3500 K	A	19 W	2322	18.49	125.6	331	3,496	Profile Suspended 51% Up | 49% Dn
	B	23 W	2854	23.13	123.4	407	4,298	
	C	29 W	3472	28.74	120.8	496	5,228	
	D	38 W	4406	36.50	120.7	629	6,634	
PF1xEx30 3000 K	A	19 W	2293	18.49	124.0	327	3,452	
	B	23 W	2818	23.13	121.8	402	4,243	
	C	29 W	3428	28.74	119.3	489	5,163	
	D	38 W	4350	36.50	119.2	621	6,550	

Photometry Reports: 11692617.14 (38 W)
Integrating Sphere and Photometric results at 3000K, 3500K and 4000K scaled from PF1xE 38W (D) and PF1xB results from an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011. Candlepower Distribution scaled per total lumens of Integrating Sphere results.

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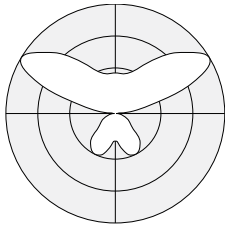
Due to continuous product improvements, specifications and dimensions are subject to change without notice.
Certain options have limited compatibility with some other product selections. Consult www.fluxwerx.com for most current technical information.

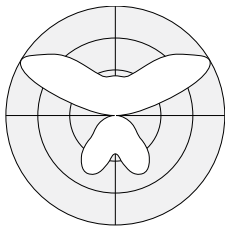
VERSION PERFORMANCE

PF1xF – 65 Up | 35 Dn, 80 CRI

CONFIGURATION			LIGHT & POWER			VISUAL COMFORT		LIGHT DISTRIBUTION
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	MAX INTENSITY 45–90° (Cd)	MAX LUMINANCE 45–90° (Cd/m²)	
PF1xFx40 4000 K	A	19 W	2368	18.22	130.0	228	2,400	 Profile Suspended 67% Up | 33% Dn
	B	23 W	2932	22.80	128.6	282	2,971	
	C	29 W	3537	27.78	127.3	340	3,584	
	D	38 W	4584	36.74	124.8	440	4,646	
PF1xFx35 3500 K	A	19 W	2293	18.22	125.8	220	2,324	
	B	23 W	2838	22.80	124.5	273	2,876	
	C	29 W	3424	27.78	123.2	329	3,470	
	D	38 W	4438	36.74	120.8	426	4,497	
PF1xFx30 3000 K	A	19 W	2217	18.22	121.7	213	2,247	
	B	23 W	2744	22.80	120.4	264	2,781	
	C	29 W	3311	27.78	119.2	318	3,355	
	D	38 W	4291	36.74	116.8	412	4,349	

Photometry Reports: 11790050.01 (38 W)
Integrating Sphere and Photometric results at 3000K, 3500K and 4000K scaled from PF1xF 38W (D) and PF1xA results from an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011. Candlepower Distribution scaled per total lumens of Integrating Sphere results.

PF3xB – Indep. Up | Dn, 80 CRI

CONFIGURATION			LIGHT & POWER			VISUAL COMFORT		LIGHT DISTRIBUTION
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	MAX INTENSITY 45–90° (Cd)	MAX LUMINANCE 45–90° (Cd/m²)	
PF3xBx40 4000 K	D	38 W	4456	37.55	118.7	525	5,540	 Profile Suspended 60% Up | 40% Dn
PF3xBx35 3500 K	D	38 W	4314	37.55	114.9	508	5,362	
PF3xBx30 3000 K	D	38 W	4171	37.55	111.1	492	5,185	

Photometry Reports: 11692617.10 (38 W)
Integrating Sphere and Photometric results at 4000K by an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011. Results for 3000K and 3500K scaled based on integrating sphere results at 38W (D) and PF1xA. Candlepower Distribution scaled per total lumens of Integrating Sphere results.

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DYNAMIC WHITE CONTROL OPTIONS (PF1xA, PF1xB)

CONTROLS PROTOCOL	CONTROL CURVE	CONTROLS BRAND	DW CODE	CONTROLLER COMPONENTS* (ordered separately)	
DALI	**Linear**	e.g. Lutron, Crestron	WD1		Controller supplied by others
	Inverse Log	e.g. Distech, Helvar	WD2		
nLight	**Linear**	Acuity	WN1	Factory installed nLight converter	
0–10 V	**Linear**	e.g. Leviton, Watt Stopper, Crestron, Pass & Seymour	WC1	Fluxwerx 0–10 V converter per zone	
	Log	e.g. Lutron, Cooper Controls	WC2		

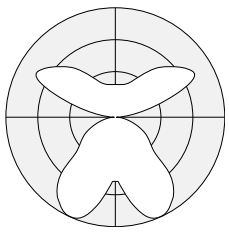
** See Dynamic White Controller data sheet*

DYNAMIC WHITE PERFORMANCE DATA

PF1xAxW2 – 40 Up|60 Dn, 80 CRI

CONFIGURATION			LIGHT & POWER			VISUAL COMFORT	
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	MAX INTENSITY 45–90° (Cd)	MAX LUMINANCE 45–90° (Cd/m²)
6500 K	**A**	**19 W**	2170	18.84	115.2		
	B	**23 W**	2680	23.45	114.3		
	C	**29 W**	3230	29.41	109.8		
	D	**38 W**	4193	39.01	107.5		
5000 K	**A**	**19 W**	2120	17.27	122.7		
	B	**23 W**	2630	21.86	120.3		
	C	**29 W**	3170	27.22	116.5		
	D	**38 W**	4109	36.44	112.8		
4000 K	**A**	**19 W**	2120	17.19	123.3		
	B	**23 W**	2620	21.76	120.4		
	C	**29 W**	3160	27.09	116.6		
	D	**38 W**	4096	36.27	112.9		
3500 K	**A**	**19 W**	2090	17.48	119.6	358	3,741
	B	**23 W**	2580	22.13	116.6	442	4,619
	C	**29 W**	3120	27.55	113.3	535	5,585
	D	**38 W**	4039	36.88	109.5	692	7,230
3000 K	**A**	**19 W**	2030	18.10	112.1		
	B	**23 W**	2520	22.91	110.0		
	C	**29 W**	3030	28.53	106.2		
	D	**38 W**	3933	38.19	103.0		
2700 K	**A**	**19 W**	2020	19.08	105.9	346	3,615
	B	**23 W**	2500	23.75	105.3	429	4,475
	C	**29 W**	3010	29.79	101.0	516	5,388
	D	**38 W**	3902	39.51	98.8	669	6,985

LIGHT DISTRIBUTION



Profile Suspended
42% Up | 58% Dn

Photometry Reports: 11987249.03 – 11987249.08

Integrating Sphere and Photometric results at 38W (D) by an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011.
Results for 19W (A), 23W (B), 29W (C) scaled based on integrating sphere results at 4000K. Candlepower Distribution scaled per total lumens of Integrating Sphere results.

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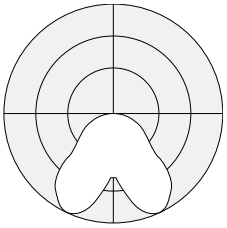
DYNAMIC WHITE PERFORMANCE DATA

PF1xBxW2 – 100 Dn, 80 CRI

CONFIGURATION			LIGHT & POWER			VISUAL COMFORT	
CCT	ENERGY (NOM.)		LIGHT (lm/4ft)	POWER (W/4ft)	EFFICACY (lm/W)	MAX INTENSITY 45-90° (Cd)	MAX LUMINANCE 45-90° (Cd/m²)
6500 K	A	19 W	1920	18.84	101.9		
	B	23 W	2370	23.45	101.1		
	C	29 W	2850	29.41	96.9		
5000 K	A	19 W	1870	17.27	108.3		
	B	23 W	2320	21.86	106.1		
	C	29 W	2800	27.22	102.9		
4000 K	A	19 W	1870	17.19	108.8		
	B	23 W	2310	21.76	106.1		
	C	29 W	2790	27.09	103.0		
3500 K	A	19 W	1850	17.48	105.8	543	5,683
	B	23 W	2280	22.13	103.0	669	7,004
	C	29 W	2750	27.55	99.8	807	8,448
3000 K	A	19 W	1790	18.10	98.9		
	B	23 W	2220	22.91	96.9		
	C	29 W	2670	28.53	93.6		
2700 K	A	19 W	1780	19.08	93.3	522	5,468
	B	23 W	2210	23.75	93.1	648	6,789
	C	29 W	2660	29.79	89.3	780	8,172

LIGHT DISTRIBUTION



Profile Suspended
1% Up | 99% Dn

Photometry Reports: Fluxwerx
Integrating Sphere and Photometric results scaled from PF1xB, PF1xA and PF1xA Dynamic White results from an independent accredited testing laboratory per IES LM-79-2008 and ANSI C78.377-2011. Candlepower Distribution scaled per total lumens of Integrating Sphere results.

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LITHONIA LIGHTING®

Catalog Number	CLX-L48-5000LM-SEF-FDL-MVOLT-GZ10-35K-80CRI-WH
Notes	H
Type	

LED Linear

CLX

24", 36", 48" and 96" Lengths

FEATURES & SPECIFICATIONS

INTENDED USE — The CLX is a linear lighting solution that is available in multiple lengths, lumen packages and distributions. Designed for versatility, the CLX can address virtually any indoor lighting need. The CLX is also offered in standard and high efficacy configurations and capable of being continuous row mounted or installed as a stand-alone fixture. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.

CONSTRUCTION — Channel and cover are formed from code-gauge cold-rolled steel. Housing and lens endcaps are injection molded plastic to provide a more architectural look and feel. The endcaps come standard with a 7/8" knock out for continuous mounting but can be ordered without.

Finish: Paint options include high-gloss, baked white polyester (WH), galvanized (GALV), matte black (MB) and smoke gray (SKGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Offered with acrylic lens and less lens configurations. Provides a choice of optical distributions including, wide, narrow, and aisle.

Models with wide diffuse lens provide up to 12% uplight. Please check the IES file for specific uplight value.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR_ ordering information on page 7.) Electronic LED driver is multi-volt input and 0-10V dimming standard (see Operational Data on page 6 for actual wattage consumption). This fixture is designed to withstand a maximum line surge of 2.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

L70>100,000 hours at 25˚C.

LEDs provide nominal 80 CRI or 90 CRI at 3000 K, 3500 K,4000 K, or 5000 K.

Lumen output up to 2,500 lumens per foot.

INSTALLATION — Fixture may be ceiling or wall mounted (with or without THCLX hanger or angle mounted with CLXANGBRT), pendant or stem mounted with appropriate mounting options.

WARNING — Removing the lens and opening the fixture during installation exposes the LEDs, putting them at risk for damage.

If you plan to surface mount the fixture, we recommend using the THCLX. This eliminates the need to open the fixture.

If you plan to continuous row mount, we recommend using the PLR wiring harness option. This eliminates the need to open the fixture.

Damage to the LEDs caused during installation will not be covered under the warranty.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 104°F (40°C). Optional High Ambient (HA) ranging to 122°F(50°C) available on certain lumen packages (See ambient temperature chart for additional information).
DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN ACT— Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT regulations. Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Flat Diffuse Lens

Round Diffuse Lens

Wide Diffuse Lens

CLX with Reflector

Stock configurations are offered for shorter lead times:

Stock Part Number	UPC
CLX L48 3000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525816
CLX L48 3000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525885
CLX L48 5000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525939
CLX L48 5000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525908
CLX L96 6000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525861
CLX L96 6000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525915
CLX L96 10000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525922
CLX L96 10000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525830
CLX L48 3000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525960
CLX L48 3000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525892
CLX L48 5000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525854
CLX L48 5000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525946
CLX L96 6000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525878
CLX L96 6000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525823
CLX L96 10000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525953
CLX L96 10000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525847

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning when used with Acuity Brands controls products.
All configurations of this luminaire are calibrated and tested to meet the Acuity Brands' specifications for chromatic consistency – including color rendering, color fidelity, and color temperature tolerance around standard CIE chromaticity coordinates.

To learn more about Acuity A+ standards, specifications, and testing visit www.acuitybrands.com/aplus.

design select

Items marked by a shaded background qualify for the Design Select program and ship in 15 days or less. To learn more about Design Select, visit www.acuitybrands.com/designselect.
*See ordering tree for details

CLX LED Linear

Design Select options indicated by this color background.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: CLX L48 5000LM SEF WDL MVOLT GZ10 40K 80CRI WH

CLX	L48	5000LM	SEF		FDL
Series	**Length**	**Nominal lumens**	**Performance package**	**Louver**	**Lens**
CLX LED linear	L24 24"	1500LM 1,500 lumens	SEF Standard efficiency ‡	(Blank) Less louver	L/Lens Less lens
		2000LM 2,000 lumens	HEF Premium efficiency ‡	SBLW Straight blade louver, white ‡	FDL Flat diffuse ‡
		2500LM 2,500 lumens		SBLMB Straight blade louver, matte black ‡	RDL Round diffuse ‡
		3500LM 3,500 lumens		SBLGV Straight blade louver, galvanized ‡	WDL Wide diffuse ‡
		4500LM 4,500 lumens		SBLSKGY Straight blade louver, smoke gray ‡	
		5000LM 5,000 lumens			
	L36 36"	2250LM 2,250 lumens			
		3000LM 3,000 lumens			
		3750LM 3,750 lumens			
		5250LM 5,250 lumens			
		6750LM 6,750 lumens			
		7500LM 7,500 lumens			
	L48 48"	3000LM 3,000 lumens			
		4000LM 4,000 lumens			
		5000LM 5,000 lumens			
		7000LM 7,000 lumens			
		9000LM 9,000 lumens			
		10000LM 10,000 lumens			
	L96 96"	6000LM 6,000 lumens			
		8000LM 8,000 lumens			
		10000LM 10,000 lumens			
		14000LM 14,000 lumens			
		18000LM 18,000 lumens			
		20000LM 20,000 lumens			

	MVOLT		GZ10		35K	80CRI
Distribution	**Voltage**		**Driver ‡**	**Glare Reflector**	**Color temperature**	**Coloring rendering index**
(Blank) General	MVOLT 120-277V ‡	277 277V	GZ1 Generic 0-10V, dims to 1% ‡	(blank) No reflectors	30K 3000 K	80CRI 80 CRI
ND Narrow ‡	120 120V	347 347V ‡	GZ10 Generic 0-10V, dims to 10% ‡	LUGR Reflectors for additional glare reduction ‡	35K 3500 K	90CRI 90 CRI
WD Wide ‡	208 208V ‡	480 480V ‡	EZ1 eldoLED 0-10V, dims to 1% ‡		40K 4000 K	
AD2 Aisle, 24° off center ‡	240 240V ‡				50K 5000 K	

					WH
Options					**Finish**
PS1050	Emergency battery pack, 10W, CA Title 20 Noncompliant ‡	PLR__	Plug-in wiring, see page 14 for ordering information	nLight® Wired:	WH White
E10WLCP	Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS ‡	PLR1G	Plug-in wiring, single circuit, Ground	N100 nLight® without lumen management	GALVW Galvanized with white lens end caps
BGTD	Generator transfer device, not available with PS1050 ‡	PLR1LVG	Plug-in wiring, single circuit, low-voltage dimming, Ground ‡	N100EMG nLight® without lumen management For use with generator supply EM power ‡	GALVB Galvanized with black lens end caps
OCS	5', 18/3 Reloc selectable One Pass cable (fixture will bear dry location label) ‡	RRL__	RELOC®-ready luminaire. See page 14 for ordering information	NES7 nLight® nES 7 PIR integral occupancy sensor ‡	MB Matte black
HA	High ambient, for use in ambient temperatures up to 50°C ‡	SPD	Surge protection device, provides up to 6kV protection ‡	NESPDT7 nLight® nES PDT 7 dual technology integral occupancy control ‡	SKGYW Smoke gray with white lens end caps
EPNKO	Decorative endplate, no knock out ‡	BAA	Buy America(n) Act Compliant	NES7ADCX nLight® nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡	SKGYB Smoke gray with black lens end caps
OUTCTR	Wiring leads pulled through back center of fixture ‡	nLight® Wireless:		NESPDT7ADCX nLight® nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡	
OUTEND	Wiring leads pulled through end of fixture ‡	NLTAIR2 RES7	nLight AIR Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell ‡	Individual controls: ‡	
Cord Sets: ‡		NLTAIR2 RES7EM	nLight AIR Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency operation, via power interrupt detection ‡	MSD7 PIR integral occupancy sensor	
CS1W	6' Staight blade plug, 120V ‡	NLTAIR2 RES7PDT	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell ‡	MSDPDT7 PDT 7 dual technology integral occupancy control	
CS3W	NEMA twist-lock plug, 120V ‡	NLTAIR2 RES7PDTEM	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell and UL924 Emergency operation, via power interrupt detection ‡	MSD7ADC PIR integral occupancy sensor with automatic dimming control photocell	
CS7W	Staight blade plug, 277V ‡	NLTAIR2 RIO	No sensor control ‡	MSDPDT7ADC PDT integral occupancy sensor with automatic dimming control photocell	
CS11W	NEMA twist-lock plug, 277V ‡	NLTAIR2 RIOEM	No sensor, Control Input function only and UL924 Emergency operation, via power interrupt detection ‡		
CS25W	NEMA twist-lock plug, 347V ‡				
CS97W	NEMA twist-lock plug, 480V ‡				
CS93W	600V SEOOW white cord, no plug (no voltage required)				
CS6WG16ST0WD5D	6' white cord, 16/5, no plug, includes low voltage dimming wires (no voltage required) ‡				

See Accessories and footnotes on next page

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Accessories: *Order as separate catalog number.*

Mounting:

ZACVH M100	Adjustable 10' aircraft cable with Y hanger (1 pair)
ZAC120	One adjustable aircraft cable with canopy 120", white
ZACFP120	One adjustable aircraft cable with feed (3 conductor) and canopy, 120", white
ZACFPD120	One adjustable aircraft cable with feed (5 conductor) and canopy 120", white
ZAC240	One adjustable aircraft cable with canopy 240", white
ZACFP240	One adjustable aircraft cable with feed (3 conductor) and canopy, 240", white
ZACFPD240	One adjustable aircraft cable with feed (5 conductor) and canopy 240", white

SQ_	Swivel stem hanger (specify length in 2" increments up to 48") Ships White
THCLX ___	Tong hanger (Must specify color) (one pair) ‡
CLXANGBKT ____	Angle bracket, (Must specify color) (one pair) ‡
HC36 M12	Hanger chain, 36" (1 pair)

Wireguards:

WGCLX24 ___	24" wireguard qty 1, (Must specify color) ‡
WGCLX36 ___	36" wireguard qty 1, (Must specify color) ‡
WGCLX48 ___	48" wireguard qty 1, (Must specify color) ‡
WGCLX48 ___ J2	48" wireguard qty 2, (Must specify color) ‡
WGCLX48 ___ J25	48" wireguard qty 25, (Must specify color) ‡
WGCLX48 ___ J50	48" wireguard qty 50, (Must specify color) ‡

‡ Option Value Ordering Restrictions

Option value	Restriction
347V, 480V	Voltage selected utilizes a step-down transformer. Not available with L24 when ordered with N100. Not available with PS1050, E10WLCP or BGTD option.
BGTD	Not available with MVOLT, 208V or 240V. Not available with HA. Available with L48 or L96 only. 20 Not available with PS1050 or E10WLCP options. Not available with 208 or 240V. Not available Individual controls, NLight Wired, or NLight Wireless options.
CS1W, CS3W, CS7W, CS11W, CS25W, CS963W, CS97W	Not available with BGTD option. Must specify voltage. Not available with PLR options.
CS6WG16ST0WD5D	Not available with Individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
Driver	When continuous row mounting, fixtures must all have the same driver selection.
E10WLCP	Not available with OUTCR, Not available with HA. Not available with 347V or 480V. Not available with BGTD option. Requires SPD option. Not available with L24 or L36. Not available with L48 in combination with N100.
EPNKO	Not available OUTEND.
EZ1	Not available with HA option. Not available with 5000LM, 7500LM.
FDL, RDL, WDL	Only available with general distribution. Not available with CLXRN accessories.
GZ1, GZ10	Not available with Individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
HA	Not available with L24, L26, Not available with BGTD option. Not available with EZ1. Only available with L48 3000/4000/5000LM and L96 6000/8000/10000LM.
HEF	not available with L48 3000LM and L96 6000LM
LUGR	Not available with L36 length. Only available with WH finish. Not compatible with THCLX Hanger or wireguard accessories. LUGR option required for some DLC premium qualifications - Please check the DLC Qualified Products List to determine if LUGR option is necessary to meet requirement. If mounting in continuous rows, ensure all models ordered with LUGR option if required on any configuration to ensure rows match in form factor. LUGR reflectors ship in standard fixture carton and are not sold as separate accessory - this option MUST be specified as part of the CLX model number.
MSD7, MSDPDT7, MSD7ADC, MSDPDT7ADC	Not available with any other control option. Requires EZ1. Sensor housing will be the same color as lens end caps.
N100, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from separate N100 enabled fixture.
ND, WD, AD2	Not available with CLXRN accessories. Available L/LENS only.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Not available with any other control option. Requires EZ1. Requires N100 or N100EMG option, N100EMG with NES7 requires RFA. Sensor housing will be the same color as lens end caps.
NLTAIR2 RES7(EM), NLTAIR2 RES7PDT(EM), NLTAIR2 RIO(EM)	Not available with L96 14000LM, 18000LM, 20000LM. Sensor housing will be the same color as lens end caps. For EM, see UL924 Sequence of Operation chart below.
OCS	Must specify voltage.
OUTCR	Not available with L24, Not available with PLR options.
OUTEND	Not available with PLR options.
PLR1LVG	Not available with Individual controls, NLight Wired, or NLight Wireless options. Refer to page 14 for more PLR details.
PS1050	Not available with 347V or 480V. Not available with BGTD option. Requires SPD option. Not available with L24 or L36. Not available with L48 in combination with N100. Not available with HA.
SBLW, SBLMB, SBLGV, SBLSKGY	When ordered with L24 only available with 1500LM or 2000LM in combination with GZ10 driver. Not for use with THCLX, CLXANGBKT or WGCLX accessories. Not available with RDL lens options.
SEF	Not available with EZ1 when ordered with L24 with 5000LM or L36 with 7500LM.
SPD	Required with PS1050, E10WLCP, BGTD, XAD, or XAD924.
THCLX ___, CLXANGBKT ____	Not available with louver or wireguards. THCLX___ not available with LUGR.
Wireguards	Not for use with LUGR option. For L96 fixtures, use qty 2 48" wireguards.

UL924 Sequence of Operation

The below information applies to all nLight AIR devices with an EM option.

- EM devices will remain at their high-end trim and ignore wireless lighting control commands, unless a normal-power-sensed (NPS) broadcast is received at least every 8 seconds.
- Using the CLAIRITY+ mobile app, EM devices must be associated with a group that includes a normal power sensing device to receive NPS broadcasts.
- Only non-emergency rPP20, rLSXR, rSBOR, rSDGR, and nLight AIR luminaires with version 3.4 or later firmware can provide normal power sensing for EM devices. See specification sheets for control devices and luminaires for more information on options that support normal power sensing.

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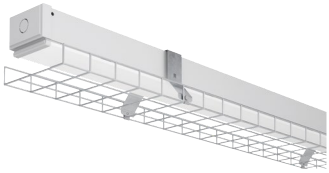
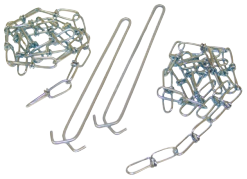
OPTIONS AND ACCESSORIES



Wireguard
Ships separately from fixture:
96" fixture requires two WGCLX48.
Order as:
WGCLX24___
WGCLX36___
WGCLX48___

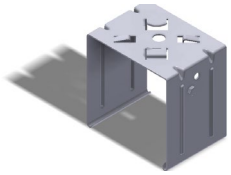
LUGR glare reflector
NOT available as accessory - must be specified as part of the fixture nomenclature. See ordering notes on page 3.

Aircraft Cable with Canopy
Available in 120" or 240"
Order as:
ZAC120
ZAC240



HANGER CHAIN
36" chain with Y hanger. ships as a pair
Order as:
HC36

ZACVH HANGER
10' Aircraft cable with Y hanger.
Order as:
ZACVH



Tong hanger
Ships as a pair
Order As:
THCLX___

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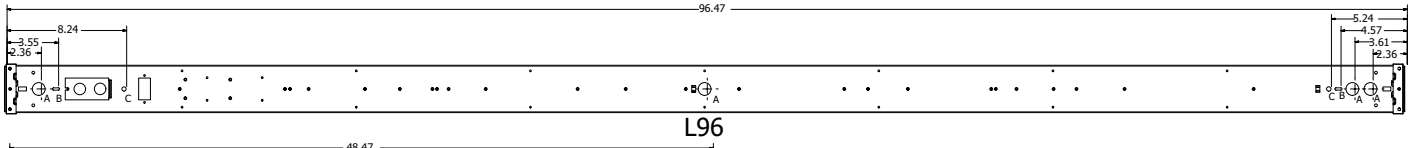
DIMENSIONS

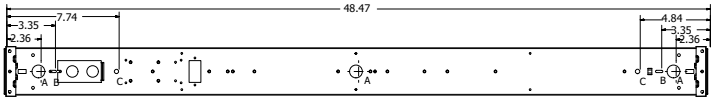
All dimensions are in inches (centimeters) unless otherwise indicated.
Dimensions may vary with options or accessories.

INTEGRATED SENSOR ADDS 2.0 INCHES TO STANDALONE FIXTURE LENGTH
HOUSING END CAP ADDS 0.236 INCHES TO FIXTURE LENGTH PER SIDE. DIMENSIONS BELOW INCLUDE ENDCAPS.

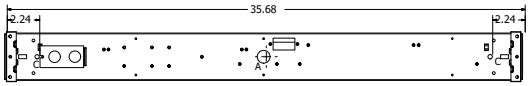
A - 7/8" KNOCK OUT
B - 0.5" by 0.16" SLOT
C - 0.3" DIA HOLE



L96



L48



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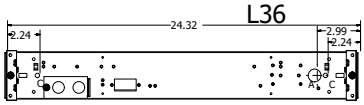
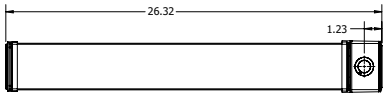


L24

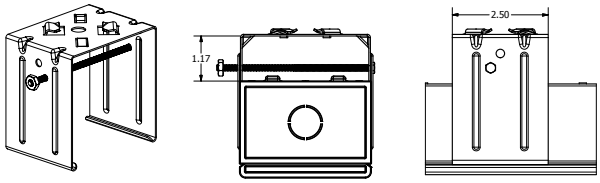


L24 WITH SENSOR

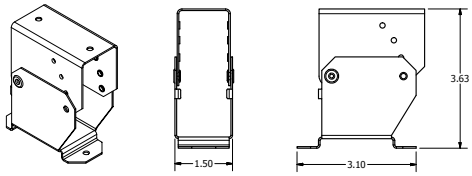
PALLET DIMENSIONS

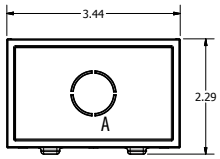
Length	Approx Weight	Fixtures per pallet	Pallet Dims (L X W X H)
L24	4 lb	100	54x46x37
L36	5 lb	80	54x46x37
L48	7.5 lb	64	54x46x37
L96	14 lb	64	98x46x37

THCLX - SHIPS TWO PER ORDER,
UTILIZES A #8 HEX HEAD SCREW AND NUT
FIXTURE SITS 1.3 INCHES FROM STRUCTURE WHEN MOUNTED

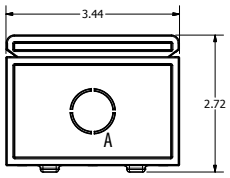


CLXANGBKT - SHIPS TWO PER ORDER
HOLES TO MOUNTING STRUCTURE ARE 0.175" DIA, 2.5" APART
FIXTURE SITS APPROXIMATELY 3.5" FROM STRUCTURE
WHEN MOUNTED HORIZONTAL TO STRUCTURE

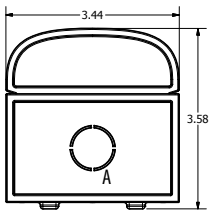




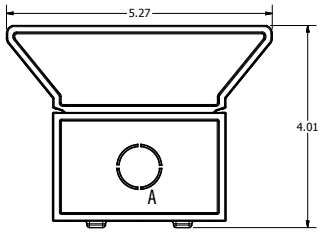
L/LENS



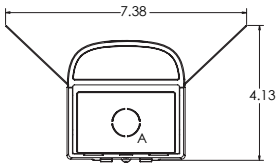
FDL



RDL



WDL



LUGR Reflector Option
- applies to all lens types

PHOTOMETRICS

See www.lithonia.com.

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POWER SENTRY EMERGENCY BATTERY PACKS

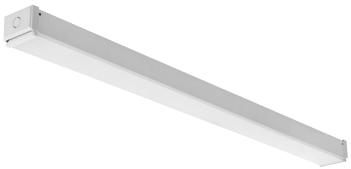
		SEF Emergency Lumens	HEF Emergency Lumens
PS1050	Factory installable	1400	1500
E10WLCP	Factory installable	1400	1500
PS1555LCP	Field installable, remote mount only	2000	2100

Note: For emergency lumen output of specific model, please consult factory. One board will be illuminated during emergency operation.

Emergency Battery Pack Options - Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2H A	7W	120	840	Storm Shelter / 2 Hour Runtime
ILB CP10 A	10W	90	1200	
ILBLP CP10 HE SD A	10W	90	1200	Title 20, Self Diagnostic
ILB CP10 HE AELR A	10W	90	1200	Title 20; Enabled with Self Testing, Automated Reporting (STAR)
ILBLP CP15 HE SD A	15W	90	1800	Title 20, Self Diagnostic
ILB CP20 HE A	20W	90	2400	Title 20
ILB CP20 HE SD A	20W	90	2400	Title 20, Self Diagnostic

All the above are UL Listed products that are certified for field install external/remote to the fixture.
*Minimum delivered lumen output to assist in product selection for increased fixture mounting height.
The CP10 delivered emergency illumination outperforms legacy 1400 lumen fluorescent emergency ballast.
Please contact us at productsupportemergency@acuitybrands.com for any Emergency Battery related questions.



SELF-TESTING AUTOMATED REPORTING

+

Field Installed Emergency LED Driver

ILB CP10 HE AELR A

Compliance Just Got Easier!

Emergency Lighting with Self Testing Automated Reporting (STAR), enables self-testing and automated reporting to aid in life safety code compliance. Emergency lighting equipment enabled with STAR, automatically conducts the required monthly and annual tests, logs results within the units, and wirelessly communicates test data on demand to the CLARITY+ mobile app. **Leave the ladders, disruptions and written records behind with emergency lighting solutions with STAR!**

DOWNLOAD CLAIRTY™+

Available on the App Store

ANDROID APP ON Google play

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CLX CHARACTERISTICS

Nominal Lumen Package	Length	Wattage								Length	Width	Depth	Comparable Light Source
		Standard Efficiency				High Efficiency							
		120V	277V	347V	480V	120V	277V	347V	480V	Dimensions are shown in inches			
2500LM	24"	18.4	18.4	24.0	24.0	17.4	17.4	23.1	23.1	24	3.5	3.75	1-lamp 32W T8, 1-lamp 54W T5HO, 50W HID
5000LM	24"	41.5	41.5	47.4	47.4	38.1	38.1	44.1	44.1	24	3.5	3.75	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
3750LM	36"	26.5	26.5	32.1	32.1	25.1	25.1	30.7	30.7	36	3.5	3.75	1-lamp 32W T8, 1-lamp 54W T5HO, 50W HID
7500LM	36"	62.6	62.6	68.6	68.6	54.0	54.0	59.7	59.7	36	3.5	3.75	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
5000LM	48"	31.8	31.8	37.2	37.2	30.3	30.3	35.8	35.8	48	3.5	3.75	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
10000LM	48"	70.7	70.7	76.2	76.2	65.3	65.3	70.8	70.8	48	3.5	3.75	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
10000LM	96"	63.7	63.7	69.0	69.0	60.6	60.6	66.1	66.1	96	3.5	3.75	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
20000LM	96"	141.3	141.3	146.8	146.8	130.5	130.5	136.1	136.1	96	3.5	3.75	6-lamp 32W T8, 4-lamp 54W T5HO, 200W HID

Note: For wattage by configuration, please reference the CLX Operational Data Document.

Lumen Package	UGR Values of CLX L24 @ 80CRI and 3500K UGR (70% 50% 20% reflectance using a 4H x 8H room size)													
	FDL		RDL		WDL		FDL LUGR		RDL LUGR		WDL LUGR		L/LENS	
	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise
1500LM SEF	21.2	23.8	19.4	25.2	17.4	21.1	16.8	14	17.8	16.6	18.1	17.9	24.9	25.1
2000LM SEF	22.3	24.9	20.5	26.3	18.6	22.3	17.9	15.1	18.8	17.6	19.2	18.9	26.1	26.2
2500LM SEF	23.1	25.7	21.3	27.1	19.4	23.1	18.6	15.8	19.6	18.4	19.9	19.7	26.9	27
3500LM SEF	24.1	26.7	22.3	28.1	20.4	24.1	19.7	16.9	20.7	19.5	21	20.8	27.9	28.1
4500LM SEF	25.4	28	23.6	29.4	21.7	25.4	20.7	17.9	21.7	20.5	22	21.8	29.2	29.3
5000LM SEF	25.6	28.2	23.3	29.1	21.4	25.1	21	18.3	21.5	20.3	21.8	21.5	29.4	29.5
1500LM HEF	21.1	23.7	19.3	25.1	21.8	25.5	16.5	13.7	17.6	16.3	17.8	17.6	24.9	25
2000LM HEF	22.2	24.8	20.4	26.2	17.4	21.1	17.6	14.8	18.6	17.4	18.8	18.6	26	26.2
2500LM HEF	23	25.7	21.3	27	18.5	22.2	18.4	15.6	19.4	18.2	19.7	19.4	26.8	27
3500LM HEF	24.1	26.7	22.3	28.1	19.3	23	19.8	17	20.9	19.7	21.1	20.9	27.9	28
4500LM HEF	25.3	27.9	23.5	29.3	20.4	24.1	20.8	18	21.8	20.6	22.1	21.8	29.1	29.3
5000LM HEF	25.5	28.1	23.7	29.5	21.6	25.3	21.1	18.3	22.1	20.9	22.3	22.1	29.3	29.5

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values. To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application

Lumen Package	UGR Values of CLX L36 @ 80CRI and 3500K UGR (70% 50% 20% reflectance using a 4H x 8H room size)							
	FDL		RDL		WDL		L/LENS	
	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise
2250LM SEF	21.4	24.1	19.7	25.6	17.7	21.6	25.2	25.4
3000LM SEF	22.3	25	20.6	26.5	18.6	22.5	26.2	26.3
3750LM SEF	23.2	25.9	21.4	27.3	19.5	23.4	27	27.2
5250LM SEF	24.2	26.9	22.5	28.4	20.5	24.4	28	28.2
6750LM SEF	25.1	27.8	23.3	29.2	21.4	25.3	28.9	29
7500LM SEF	25.4	28.1	23.6	29.5	21.7	25.6	29.2	29.4
2250LM HEF	25	27.7	20.5	26.4	18.6	22.5	25.2	25.3
3000LM HEF	25.3	28	21.4	27.3	19.4	23.3	26.1	26.2
3750LM HEF	21.4	24.1	22.4	28.3	20.5	24.4	27	27.1
5250LM HEF	22.3	25	23.2	29.2	21.3	25.2	28	28.1
6750LM HEF	23.1	25.8	23.6	29.5	21.6	25.5	28.8	29
7500LM HEF	24.2	26.8	19.6	25.5	17.7	21.6	29.1	29.3

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values.
To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application

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Lumen Package	UGR Values of CLX L48 @ 80CRI and 3500K UGR (70% 50% 20% reflectance using a 4H x 8H room size)													
	FDL		RDL		WDL		FDL LUGR		RDL LUGR		WDL LUGR		L/LENS	
	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise
3000LM SEF	21.8	24.5	19.7	25.3	18.6	23.4	19.2	16.5	20.2	19	20.6	20.3	24.8	25.6
4000LM SEF	22.8	25.5	20.7	26.3	19.6	24.4	20.3	17.5	21.2	20	21.6	21.4	25.8	26.6
5000LM SEF	23.6	26.3	21.4	27	20.4	25.2	21	18.2	21.9	20.7	22.3	22.1	26.6	27.3
7000LM SEF	24.8	27.6	22.7	28.3	21.6	26.5	22.3	19.6	23.3	22.1	23.7	23.4	27.8	28.6
9000LM SEF	25.6	28.4	23.5	29.1	22.5	27.3	23.2	20.4	24.1	22.9	24.5	24.3	28.6	29.4
10000LM SEF	26	28.7	23.8	29.5	22.8	27.6	23.6	20.8	24.5	23.3	24.9	24.7	29	29.8
3000LM HEF	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4000LM HEF	22.8	25.6	20.7	26.3	22.8	25.6	20.3	17.5	21.3	20.1	21.7	21.4	29.5	30.3
5000LM HEF	23.6	26.3	21.4	27	23.6	26.3	21	18.2	21.9	20.7	22.3	22.1	30.2	31
7000LM HEF	24.8	27.6	22.7	28.3	24.8	27.6	22.4	19.6	23.4	22.2	23.8	23.5	27.8	28.6
9000LM HEF	25.7	28.4	23.6	29.2	25.7	28.4	23.2	20.4	24.2	23	24.6	24.3	28.7	29.5
10000LM HEF	26	28.7	23.9	29.5	26	28.7	23.6	20.9	24.6	23.4	25	24.7	29	29.8

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values. To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application

Lumen Package	UGR Values of CLX L96 @ 80CRI and 3500K UGR (70% 50% 20% reflectance using a 4H x 8H room size)													
	FDL		RDL		WDL		FDL LUGR		RDL LUGR		WDL LUGR		L/LENS	
	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise
6000LM SEF	21.8	24.6	19.7	25.4	17.9	22.4	19.3	16.5	20.2	19	20.6	20.4	24.8	25.6
8000LM SEF	22.8	25.5	20.7	26.4	18.8	23.4	20.3	17.6	21.2	20.1	21.6	21.4	25.8	26.6
10000LM SEF	23.6	26.3	21.4	27.2	19.6	24.2	21	18.3	21.9	20.8	22.3	22.1	26.5	27.3
14000LM SEF	24.8	27.6	22.7	28.5	20.9	25.5	22.4	19.6	23.3	22.1	23.7	23.5	27.8	28.6
18000LM SEF	25.7	28.4	23.5	29.3	21.7	26.3	23.2	20.5	24.1	23	24.5	24.3	28.6	29.4
20000LM SEF	26	28.7	23.9	29.6	22	26.6	23.6	20.9	24.5	23.4	24.9	24.7	29	29.7
6000LM HEF	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8000LM HEF	22.8	25.6	20.7	26.5	18.9	23.5	20.4	17.6	21.3	20.1	21.7	21.5	25.8	26.6
10000LM HEF	23.6	26.3	21.4	27.2	19.6	24.2	21	18.3	21.9	20.8	22.3	22.1	27	27.8
14000LM HEF	24.9	27.6	22.7	28.5	20.9	25.5	22.4	19.7	23.4	22.2	23.8	23.5	27.8	28.6
18000LM HEF	25.7	28.4	23.6	29.3	21.7	26.3	23.2	20.5	24.2	23	24.6	24.3	28.7	29.5
20000LM HEF	26	28.8	23.9	29.6	22.1	26.6	23.7	20.9	24.6	23.4	25	24.8	29	29.8

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values. To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application

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RRL - RELOC®-Ready Luminaire

- RRL connectors can be used with Quick-Flex®, System 820 and OnePass® systems.
- Load side of connector factory installed to luminaire.
- 4-pole mating connector with push-in terminations allows for simple installation.
- Touch-safe design on both halves meets UL/CSA requirement.
- Wiping contact design allows safe disconnect under load.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: RRLA

Series		Wiring instructions	
RRL	RELOC®-ready luminaire	A	Hot conductor wired to position #1 (phase A)
		B	Hot conductor wired to position #2 (phase B)
		C	Hot conductor wired to position #3 (phase C) [1]

Compatible RELOC® Cables for Industrial Luminaires (ordered and shipped separately)

OCS

OCU

OD

DC

PT

Notes

1 C, ABE, and C12S options are not used with Quick-Flex QFC, QSFC, QPT, and QD.

PLUG-IN WIRING INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. PLR22 (2-circuit) and crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Not for use with dedicated emergency circuits.

Note: Specifications subject to change without notice.

Wiring

PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits (PLR2A / PLR2B Only)				Dimming		Ground	
PLR22	(blank)	Not required for PLR22	(blank)	Not required for PLR22			(blank)	No Dimming	G	Ground (required)
PLR	1	Black	(blank)	Not required for PLR1			(blank)	No Dimming	G	Ground (required)
	2	Black and red	**Circuits to which driver is connected**		**Battery charging circuit (must be unswitched)**		LV	Low-voltage Dimming	G	Ground (required)
			(blank)	Not required for PLR22	(blank)	No battery charging circuit				
			A	Black wire	ELA	Battery pack wired to black wire				
			B	Red wire	ELB	Battery pack wired to red wire				

Typical Applications

Notes:

When specifying PLR1, you will not specify A or B as there is only a single hot wire which would be black in color.

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit PLR22
- Multiple circuit with night-lights located along row as desired

COMMERCIAL INDOOR: One Lithonia Way, Conyers, GA 30012 Phone: 800-705-SERV (7378) techsupport-commercialindoor@acuitybrands.com www.lithonia.com

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LITHONIA LIGHTING®

Catalog Number	CLX-L48-5000LM-SEF-FDL-MVOLT-GZ10-35K-80CRI-WH
Notes	H-EM
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — The CLX is a linear lighting solution that is available in multiple lengths, lumen packages and distributions. Designed for versatility, the CLX can address virtually any indoor lighting need. The CLX is also offered in standard and high efficacy configurations and capable of being continuous row mounted or installed as a stand-alone fixture. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.

CONSTRUCTION — Channel and cover are formed from code-gauge cold-rolled steel. Housing and lens endcaps are injection molded plastic to provide a more architectural look and feel. The endcaps come standard with a 7/8" knock out for continuous mounting but can be ordered without.

Finish: Paint options include high-gloss, baked white polyester (WH), galvanized (GALV), matte black (MB) and smoke gray (SKGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Offered with acrylic lens and less lens configurations. Provides a choice of optical distributions including, wide, narrow, and aisle.

Models with wide diffuse lens provide up to 12% uplight. Please check the IES file for specific uplight value.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR_ ordering information on page 7.) Electronic LED driver is multi-volt input and 0-10V dimming standard (see Operational Data on page 6 for actual wattage consumption). This fixture is designed to withstand a maximum line surge of 2.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

L70>100,000 hours at 25˚C.

LEDs provide nominal 80 CRI or 90 CRI at 3000 K, 3500 K,4000 K, or 5000 K.

Lumen output up to 2,500 lumens per foot.

INSTALLATION — Fixture may be ceiling or wall mounted (with or without THCLX hanger or angle mounted with CLXANGBRT), pendant or stem mounted with appropriate mounting options.

WARNING — Removing the lens and opening the fixture during installation exposes the LEDs, putting them at risk for damage.

If you plan to surface mount the fixture, we recommend using the THCLX. This eliminates the need to open the fixture.

If you plan to continuous row mount, we recommend using the PLR wiring harness option. This eliminates the need to open the fixture.

Damage to the LEDs caused during installation will not be covered under the warranty.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 104°F (40°C). Optional High Ambient (HA) ranging to 122°F(50°C) available on certain lumen packages (See ambient temperature chart for additional information).
DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN ACT— Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT regulations. Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

LED Linear

CLX

24", 36", 48" and 96" Lengths

Flat Diffuse Lens

Round Diffuse Lens

Wide Diffuse Lens

CLX with Reflector

Stock configurations are offered for shorter lead times:

Stock Part Number	UPC
CLX L48 3000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525816
CLX L48 3000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525885
CLX L48 5000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525939
CLX L48 5000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525908
CLX L96 6000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525861
CLX L96 6000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525915
CLX L96 10000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525922
CLX L96 10000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525830
CLX L48 3000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525960
CLX L48 3000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525892
CLX L48 5000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525854
CLX L48 5000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525946
CLX L96 6000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525878
CLX L96 6000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525823
CLX L96 10000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525953
CLX L96 10000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525847

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning when used with Acuity Brands controls products.
All configurations of this luminaire are calibrated and tested to meet the Acuity Brands' specifications for chromatic consistency – including color rendering, color fidelity, and color temperature tolerance around standard CIE chromaticity coordinates.

To learn more about Acuity A+ standards, specifications, and testing visit www.acuitybrands.com/aplus.

design select

Items marked by a shaded background qualify for the Design Select program and ship in 15 days or less. To learn more about Design Select, visit www.acuitybrands.com/designselect.
*See ordering tree for details

Design Select options indicated by this color background.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: CLX L48 5000LM SEF WDL MVOLT GZ10 40K 80CRI WH

CLX	L48	5000LM	SEF		FDL
Series	**Length**	**Nominal lumens**	**Performance package**	**Louver**	**Lens**
CLX LED linear	L24 24"	1500LM 1,500 lumens	SEF Standard efficiency ‡	(Blank) Less louver	L/Lens Less lens
		2000LM 2,000 lumens	HEF Premium efficiency ‡	SBLW Straight blade louver, white ‡	FDL Flat diffuse ‡
		2500LM 2,500 lumens		SBLMB Straight blade louver, matte black ‡	RDL Round diffuse ‡
		3500LM 3,500 lumens		SBLGV Straight blade louver, galvanized ‡	WDL Wide diffuse ‡
		4500LM 4,500 lumens		SBLSKGY Straight blade louver, smoke gray ‡	
		5000LM 5,000 lumens			
	L36 36"	2250LM 2,250 lumens			
		3000LM 3,000 lumens			
		3750LM 3,750 lumens			
		5250LM 5,250 lumens			
		6750LM 6,750 lumens			
		7500LM 7,500 lumens			
	L48 48"	3000LM 3,000 lumens			
		4000LM 4,000 lumens			
		5000LM 5,000 lumens			
		7000LM 7,000 lumens			
		9000LM 9,000 lumens			
		10000LM 10,000 lumens			
	L96 96"	6000LM 6,000 lumens			
		8000LM 8,000 lumens			
		10000LM 10,000 lumens			
		14000LM 14,000 lumens			
		18000LM 18,000 lumens			
		20000LM 20,000 lumens			

	MVOLT		GZ10		35K	80CRI
Distribution	**Voltage**		**Driver ‡**	**Glare Reflector**	**Color temperature**	**Coloring rendering index**
(Blank) General	MVOLT 120-277V ‡	277 277V	GZ1 Generic 0-10V, dims to 1% ‡	(blank) No reflectors	30K 3000 K	80CRI 80 CRI
ND Narrow ‡	120 120V	347 347V ‡	GZ10 Generic 0-10V, dims to 10% ‡	LUGR Reflectors for additional glare reduction ‡	35K 3500 K	90CRI 90 CRI
WD Wide ‡	208 208V ‡	480 480V ‡	EZ1 eldoLED 0-10V, dims to 1% ‡		40K 4000 K	
AD2 Aisle, 24° off center ‡	240 240V ‡				50K 5000 K	

						WH
Options						**Finish**
PS1050	Emergency battery pack, 10W, CA Title 20 Noncompliant ‡	PLR__	Plug-in wiring, see page 14 for ordering information	nLight® Wired:		WH White
E10WLCP	Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS ‡	PLR1G	Plug-in wiring, single circuit, Ground	N100	nLight® without lumen management	GALVW Galvanized with white lens end caps
BGTD	Generator transfer device, not available with PS1050 ‡	PLR1LVG	Plug-in wiring, single circuit, low-voltage dimming, Ground ‡	N100EMG	nLight® without lumen management For use with generator supply EM power ‡	GALVB Galvanized with black lens end caps
OCS	5', 18/3 Reloc selectable One Pass cable (fixture will bear dry location label) ‡	RRL__	RELOC®-ready luminaire. See page 14 for ordering information	NES7	nLight® nES 7 PIR integral occupancy sensor ‡	MB Matte black
HA	High ambient, for use in ambient temperatures up to 50°C ‡	SPD	Surge protection device, provides up to 6kV protection ‡	NESPDT7	nLight® nES PDT 7 dual technology integral occupancy control ‡	SKGYW Smoke gray with white lens end caps
EPNKO	Decorative endplate, no knock out ‡	BAA	Buy America(n) Act Compliant	NES7ADCX	nLight® nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡	SKGYB Smoke gray with black lens end caps
OUTCTR	Wiring leads pulled through back center of fixture ‡	nLight® Wireless:		NESPDT7ADCX	nLight® nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡	
OUTEND	Wiring leads pulled through end of fixture ‡	NLTAIR2 RES7	nLight AIR Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell ‡	Individual controls: ‡		
Cord Sets: ‡		NLTAIR2 RES7EM	nLight AIR Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency operation, via power interrupt detection ‡	MSD7	PIR integral occupancy sensor	
CS1W	6' Staight blade plug, 120V ‡	NLTAIR2 RES7PDT	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell ‡	MSDPDT7	PDT 7 dual technology integral occupancy control	
CS3W	NEMA twist-lock plug, 120V ‡	NLTAIR2 RES7PDTEM	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell and UL924 Emergency operation, via power interrupt detection ‡	MSD7ADC	PIR integral occupancy sensor with automatic dimming control photocell	
CS7W	Staight blade plug, 277V ‡	NLTAIR2 RIO	No sensor control ‡	MSDPDT7ADC	PDT integral occupancy sensor with automatic dimming control photocell	
CS11W	NEMA twist-lock plug, 277V ‡	NLTAIR2 RIOEM	No sensor, Control Input function only and UL924 Emergency operation, via power interrupt detection ‡			
CS25W	NEMA twist-lock plug, 347V ‡					
CS97W	NEMA twist-lock plug, 480V ‡					
CS93W	600V SEOOW white cord, no plug (no voltage required)					
CS6WG16ST0WD5D	6' white cord, 16/5, no plug, includes low voltage dimming wires (no voltage required) ‡					

See Accessories and footnotes on next page

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Accessories: *Order as separate catalog number.*

Mounting:

ZACVH M100	Adjustable 10' aircraft cable with Y hanger (1 pair)
ZAC120	One adjustable aircraft cable with canopy 120", white
ZACFP120	One adjustable aircraft cable with feed (3 conductor) and canopy, 120", white
ZACFPD120	One adjustable aircraft cable with feed (5 conductor) and canopy 120", white
ZAC240	One adjustable aircraft cable with canopy 240", white
ZACFP240	One adjustable aircraft cable with feed (3 conductor) and canopy, 240", white
ZACFPD240	One adjustable aircraft cable with feed (5 conductor) and canopy 240", white

SQ_	Swivel stem hanger (specify length in 2" increments up to 48") Ships White
THCLX __	Tong hanger (Must specify color) (one pair) ‡
CLXANGBKT ____	Angle bracket, (Must specify color) (one pair) ‡
HC36 M12	Hanger chain, 36" (1 pair)

Wireguards:

WGCLX24 __	24" wireguard qty 1, (Must specify color) ‡
WGCLX36 __	36" wireguard qty 1, (Must specify color) ‡
WGCLX48 __	48" wireguard qty 1, (Must specify color) ‡
WGCLX48 __ J2	48" wireguard qty 2, (Must specify color) ‡
WGCLX48 __ J25	48" wireguard qty 25, (Must specify color) ‡
WGCLX48 __ J50	48" wireguard qty 50, (Must specify color) ‡

‡ Option Value Ordering Restrictions

Option value	Restriction
347V, 480V	Voltage selected utilizes a step-down transformer. Not available with L24 when ordered with N100. Not available with PS1050, E10WLCP or BGTD option.
BGTD	Not available with MVOLT, 208V or 240V. Not available with HA. Available with L48 or L96 only. 20 Not available with PS1050 or E10WLCP options. Not available with 208 or 240V. Not available Individual controls, NLight Wired, or NLight Wireless options.
CS1W, CS3W, CS7W, CS11W, CS25W, CS963W, CS97W	Not available with BGTD option. Must specify voltage. Not available with PLR options.
CS6WG16ST0WD5D	Not available with Individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
Driver	When continuous row mounting, fixtures must all have the same driver selection.
E10WLCP	Not available with OUTCR, Not available with HA. Not available with 347V or 480V. Not available with BGTD option. Requires SPD option. Not available with L24 or L36. Not available with L48 in combination with N100.
EPNKO	Not available OUTEND.
EZ1	Not available with HA option. Not available with 5000LM, 7500LM.
FDL, RDL, WDL	Only available with general distribution. Not available with CLXRN accessories.
GZ1, GZ10	Not available with Individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
HA	Not available with L24, L26, Not available with BGTD option. Not available with EZ1. Only available with L48 3000/4000/5000LM and L96 6000/8000/10000LM.
HEF	not available with L48 3000LM and L96 6000LM
LUGR	Not available with L36 length. Only available with WH finish. Not compatible with THCLX Hanger or wireguard accessories. LUGR option required for some DLC premium qualifications - Please check the DLC Qualified Products List to determine if LUGR option is necessary to meet requirement. If mounting in continuous rows, ensure all models ordered with LUGR option if required on any configuration to ensure rows match in form factor. LUGR reflectors ship in standard fixture carton and are not sold as separate accessory - this option MUST be specified as part of the CLX model number.
MSD7, MSDPDT7, MSD7ADC, MSDPDT7ADC	Not available with any other control option. Requires EZ1. Sensor housing will be the same color as lens end caps.
N100, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from separate N100 enabled fixture.
ND, WD, AD2	Not available with CLXRN accessories. Available L/LENS only.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Not available with any other control option. Requires EZ1. Requires N100 or N100EMG option, N100EMG with NES7 requires RFA. Sensor housing will be the same color as lens end caps.
NLTAIR2 RES7(EM), NLTAIR2 RES7PDT(EM), NLTAIR2 RIO(EM)	Not available with L96 14000LM, 18000LM, 20000LM. Sensor housing will be the same color as lens end caps. For EM, see UL924 Sequence of Operation chart below.
OCS	Must specify voltage.
OUTCR	Not available with L24, Not available with PLR options.
OUTEND	Not available with PLR options.
PLR1LVG	Not available with Individual controls, NLight Wired, or NLight Wireless options. Refer to page 14 for more PLR details.
PS1050	Not available with 347V or 480V. Not available with BGTD option. Requires SPD option. Not available with L24 or L36. Not available with L48 in combination with N100. Not available with HA.
SBLW, SBLMB, SBLGV, SBLSKGY	When ordered with L24 only available with 1500LM or 2000LM in combination with GZ10 driver. Not for use with THCLX, CLXANGBKT or WGCLX accessories. Not available with RDL lens options.
SEF	Not available with EZ1 when ordered with L24 with 5000LM or L36 with 7500LM.
SPD	Required with PS1050, E10WLCP, BGTD, XAD, or XAD924.
THCLX ___, CLXANGBKT ____	Not available with louver or wireguards. THCLX___ not available with LUGR.
Wireguards	Not for use with LUGR option. For L96 fixtures, use qty 2 48" wireguards.

UL924 Sequence of Operation

The below information applies to all nLight AIR devices with an EM option.

- EM devices will remain at their high-end trim and ignore wireless lighting control commands, unless a normal-power-sensed (NPS) broadcast is received at least every 8 seconds.
- Using the CLAIRITY+ mobile app, EM devices must be associated with a group that includes a normal power sensing device to receive NPS broadcasts.
- Only non-emergency rPP20, rLSXR, rSBOR, rSDGR, and nLight AIR luminaires with version 3.4 or later firmware can provide normal power sensing for EM devices. See specification sheets for control devices and luminaires for more information on options that support normal power sensing.

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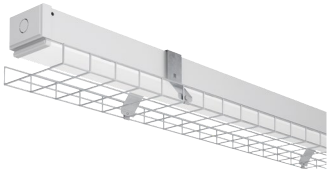
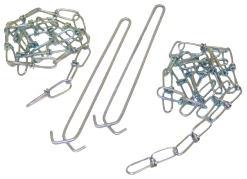
OPTIONS AND ACCESSORIES



Wireguard
Ships separately from fixture:
96" fixture requires two WGCLX48.
Order as:
WGCLX24___
WGCLX36___
WGCLX48___

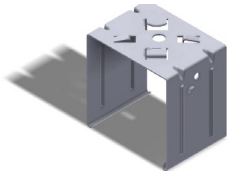
LUGR glare reflector
NOT available as accessory - must be specified as part of the fixture nomenclature. See ordering notes on page 3.

Aircraft Cable with Canopy
Available in 120" or 240"
Order as:
ZAC120
ZAC240



HANGER CHAIN
36" chain with Y hanger. ships as a pair
Order as:
HC36

ZACVH HANGER
10' Aircraft cable with Y hanger.
Order as:
ZACVH



Tong hanger
Ships as a pair
Order As:
THCLX___

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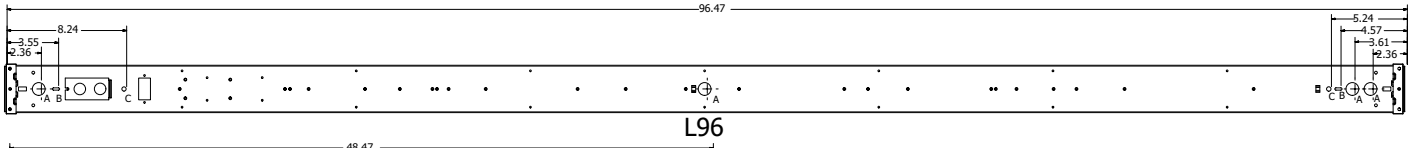
DIMENSIONS

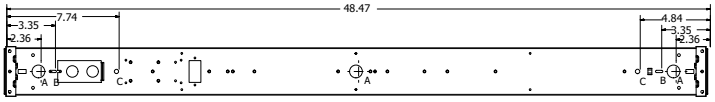
All dimensions are in inches (centimeters) unless otherwise indicated.
Dimensions may vary with options or accessories.

INTEGRATED SENSOR ADDS 2.0 INCHES TO STANDALONE FIXTURE LENGTH
HOUSING END CAP ADDS 0.236 INCHES TO FIXTURE LENGTH PER SIDE. DIMENSIONS BELOW INCLUDE ENDCAPS.

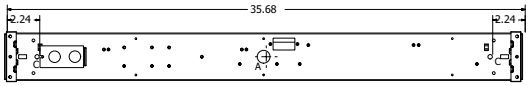
A - 7/8" KNOCK OUT
B - 0.5" by 0.16" SLOT
C - 0.3" DIA HOLE



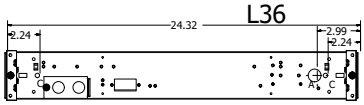
L96



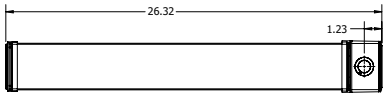
L48



L36



L24

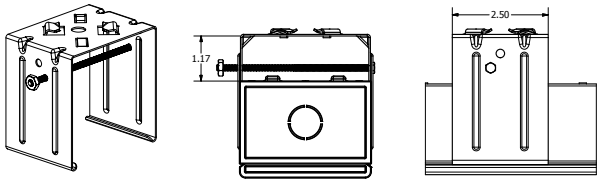


L24 WITH SENSOR

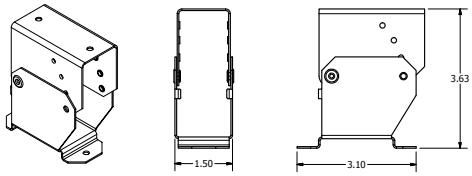
PALLET DIMENSIONS

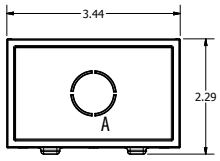
Length	Approx Weight	Fixtures per pallet	Pallet Dims (L X W X H)
L24	4 lb	100	54x46x37
L36	5 lb	80	54x46x37
L48	7.5 lb	64	54x46x37
L96	14 lb	64	98x46x37

THCLX - SHIPS TWO PER ORDER,
UTILIZES A #8 HEX HEAD SCREW AND NUT
FIXTURE SITS 1.3 INCHES FROM STRUCTURE WHEN MOUNTED

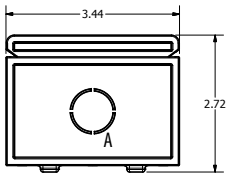


CLXANGBKT - SHIPS TWO PER ORDER
HOLES TO MOUNTING STRUCTURE ARE 0.175" DIA, 2.5" APART
FIXTURE SITS APPROXIMATELY 3.5" FROM STRUCTURE
WHEN MOUNTED HORIZONTAL TO STRUCTURE

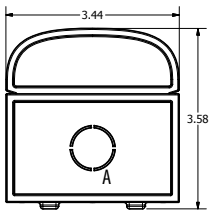




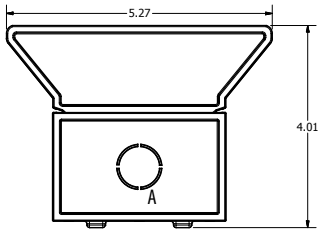
L/LENS



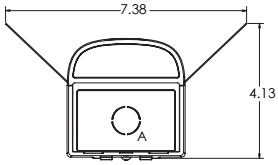
FDL



RDL



WDL



LUGR Reflector Option
- applies to all lens types

PHOTOMETRICS

See www.lithonia.com.

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POWER SENTRY EMERGENCY BATTERY PACKS

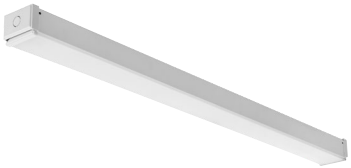
		SEF Emergency Lumens	HEF Emergency Lumens
PS1050	Factory installable	1400	1500
E10WLCP	Factory installable	1400	1500
PS1555LCP	Field installable, remote mount only	2000	2100

Note: For emergency lumen output of specific model, please consult factory. One board will be illuminated during emergency operation.

Emergency Battery Pack Options - Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2H A	7W	120	840	Storm Shelter / 2 Hour Runtime
ILB CP10 A	10W	90	1200	
ILBLP CP10 HE SD A	10W	90	1200	Title 20, Self Diagnostic
ILB CP10 HE AELR A	10W	90	1200	Title 20; Enabled with Self Testing, Automated Reporting (STAR)
ILBLP CP15 HE SD A	15W	90	1800	Title 20, Self Diagnostic
ILB CP20 HE A	20W	90	2400	Title 20
ILB CP20 HE SD A	20W	90	2400	Title 20, Self Diagnostic

All the above are UL Listed products that are certified for field install external/remote to the fixture.
*Minimum delivered lumen output to assist in product selection for increased fixture mounting height.
The CP10 delivered emergency illumination outperforms legacy 1400 lumen fluorescent emergency ballast.
Please contact us at productsupportemergency@acuitybrands.com for any Emergency Battery related questions.



SELF-TESTING AUTOMATED REPORTING

+

Field Installed Emergency LED Driver

ILB CP10 HE AELR A

Compliance Just Got Easier!

Emergency Lighting with Self Testing Automated Reporting (STAR), enables self-testing and automated reporting to aid in life safety code compliance. Emergency lighting equipment enabled with STAR, automatically conducts the required monthly and annual tests, logs results within the units, and wirelessly communicates test data on demand to the CLARITY+ mobile app. **Leave the ladders, disruptions and written records behind with emergency lighting solutions with STAR!**

DOWNLOAD CLAIRTY™+

Available on the App Store

ANDROID APP ON Google play

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CLX CHARACTERISTICS

Nominal Lumen Package	Length	Wattage								Length	Width	Depth	Comparable Light Source
		Standard Efficiency				High Efficiency							
		120V	277V	347V	480V	120V	277V	347V	480V	Dimensions are shown in inches			
2500LM	24"	18.4	18.4	24.0	24.0	17.4	17.4	23.1	23.1	24	3.5	3.75	1-lamp 32W T8, 1-lamp 54W T5HO, 50W HID
5000LM	24"	41.5	41.5	47.4	47.4	38.1	38.1	44.1	44.1	24	3.5	3.75	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
3750LM	36"	26.5	26.5	32.1	32.1	25.1	25.1	30.7	30.7	36	3.5	3.75	1-lamp 32W T8, 1-lamp 54W T5HO, 50W HID
7500LM	36"	62.6	62.6	68.6	68.6	54.0	54.0	59.7	59.7	36	3.5	3.75	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
5000LM	48"	31.8	31.8	37.2	37.2	30.3	30.3	35.8	35.8	48	3.5	3.75	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
10000LM	48"	70.7	70.7	76.2	76.2	65.3	65.3	70.8	70.8	48	3.5	3.75	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
10000LM	96"	63.7	63.7	69.0	69.0	60.6	60.6	66.1	66.1	96	3.5	3.75	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
20000LM	96"	141.3	141.3	146.8	146.8	130.5	130.5	136.1	136.1	96	3.5	3.75	6-lamp 32W T8, 4-lamp 54W T5HO, 200W HID

Note: For wattage by configuration, please reference the CLX Operational Data Document.

Lumen Package	UGR Values of CLX L24 @ 80CRI and 3500K UGR (70% 50% 20% reflectance using a 4H x 8H room size)													
	FDL		RDL		WDL		FDL LUGR		RDL LUGR		WDL LUGR		L/LENS	
	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise
1500LM SEF	21.2	23.8	19.4	25.2	17.4	21.1	16.8	14	17.8	16.6	18.1	17.9	24.9	25.1
2000LM SEF	22.3	24.9	20.5	26.3	18.6	22.3	17.9	15.1	18.8	17.6	19.2	18.9	26.1	26.2
2500LM SEF	23.1	25.7	21.3	27.1	19.4	23.1	18.6	15.8	19.6	18.4	19.9	19.7	26.9	27
3500LM SEF	24.1	26.7	22.3	28.1	20.4	24.1	19.7	16.9	20.7	19.5	21	20.8	27.9	28.1
4500LM SEF	25.4	28	23.6	29.4	21.7	25.4	20.7	17.9	21.7	20.5	22	21.8	29.2	29.3
5000LM SEF	25.6	28.2	23.3	29.1	21.4	25.1	21	18.3	21.5	20.3	21.8	21.5	29.4	29.5
1500LM HEF	21.1	23.7	19.3	25.1	21.8	25.5	16.5	13.7	17.6	16.3	17.8	17.6	24.9	25
2000LM HEF	22.2	24.8	20.4	26.2	17.4	21.1	17.6	14.8	18.6	17.4	18.8	18.6	26	26.2
2500LM HEF	23	25.7	21.3	27	18.5	22.2	18.4	15.6	19.4	18.2	19.7	19.4	26.8	27
3500LM HEF	24.1	26.7	22.3	28.1	19.3	23	19.8	17	20.9	19.7	21.1	20.9	27.9	28
4500LM HEF	25.3	27.9	23.5	29.3	20.4	24.1	20.8	18	21.8	20.6	22.1	21.8	29.1	29.3
5000LM HEF	25.5	28.1	23.7	29.5	21.6	25.3	21.1	18.3	22.1	20.9	22.3	22.1	29.3	29.5

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values. To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application

Lumen Package	UGR Values of CLX L36 @ 80CRI and 3500K UGR (70% 50% 20% reflectance using a 4H x 8H room size)							
	FDL		RDL		WDL		L/LENS	
	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise
2250LM SEF	21.4	24.1	19.7	25.6	17.7	21.6	25.2	25.4
3000LM SEF	22.3	25	20.6	26.5	18.6	22.5	26.2	26.3
3750LM SEF	23.2	25.9	21.4	27.3	19.5	23.4	27	27.2
5250LM SEF	24.2	26.9	22.5	28.4	20.5	24.4	28	28.2
6750LM SEF	25.1	27.8	23.3	29.2	21.4	25.3	28.9	29
7500LM SEF	25.4	28.1	23.6	29.5	21.7	25.6	29.2	29.4
2250LM HEF	25	27.7	20.5	26.4	18.6	22.5	25.2	25.3
3000LM HEF	25.3	28	21.4	27.3	19.4	23.3	26.1	26.2
3750LM HEF	21.4	24.1	22.4	28.3	20.5	24.4	27	27.1
5250LM HEF	22.3	25	23.2	29.2	21.3	25.2	28	28.1
6750LM HEF	23.1	25.8	23.6	29.5	21.6	25.5	28.8	29
7500LM HEF	24.2	26.8	19.6	25.5	17.7	21.6	29.1	29.3

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values.
To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application

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Lumen Package	UGR Values of CLX L48 @ 80CRI and 3500K UGR (70% 50% 20% reflectance using a 4H x 8H room size)													
	FDL		RDL		WDL		FDL LUGR		RDL LUGR		WDL LUGR		L/LENS	
	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise
3000LM SEF	21.8	24.5	19.7	25.3	18.6	23.4	19.2	16.5	20.2	19	20.6	20.3	24.8	25.6
4000LM SEF	22.8	25.5	20.7	26.3	19.6	24.4	20.3	17.5	21.2	20	21.6	21.4	25.8	26.6
5000LM SEF	23.6	26.3	21.4	27	20.4	25.2	21	18.2	21.9	20.7	22.3	22.1	26.6	27.3
7000LM SEF	24.8	27.6	22.7	28.3	21.6	26.5	22.3	19.6	23.3	22.1	23.7	23.4	27.8	28.6
9000LM SEF	25.6	28.4	23.5	29.1	22.5	27.3	23.2	20.4	24.1	22.9	24.5	24.3	28.6	29.4
10000LM SEF	26	28.7	23.8	29.5	22.8	27.6	23.6	20.8	24.5	23.3	24.9	24.7	29	29.8
3000LM HEF	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4000LM HEF	22.8	25.6	20.7	26.3	22.8	25.6	20.3	17.5	21.3	20.1	21.7	21.4	29.5	30.3
5000LM HEF	23.6	26.3	21.4	27	23.6	26.3	21	18.2	21.9	20.7	22.3	22.1	30.2	31
7000LM HEF	24.8	27.6	22.7	28.3	24.8	27.6	22.4	19.6	23.4	22.2	23.8	23.5	27.8	28.6
9000LM HEF	25.7	28.4	23.6	29.2	25.7	28.4	23.2	20.4	24.2	23	24.6	24.3	28.7	29.5
10000LM HEF	26	28.7	23.9	29.5	26	28.7	23.6	20.9	24.6	23.4	25	24.7	29	29.8

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values. To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application

Lumen Package	UGR Values of CLX L96 @ 80CRI and 3500K UGR (70% 50% 20% reflectance using a 4H x 8H room size)													
	FDL		RDL		WDL		FDL LUGR		RDL LUGR		WDL LUGR		L/LENS	
	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise
6000LM SEF	21.8	24.6	19.7	25.4	17.9	22.4	19.3	16.5	20.2	19	20.6	20.4	24.8	25.6
8000LM SEF	22.8	25.5	20.7	26.4	18.8	23.4	20.3	17.6	21.2	20.1	21.6	21.4	25.8	26.6
10000LM SEF	23.6	26.3	21.4	27.2	19.6	24.2	21	18.3	21.9	20.8	22.3	22.1	26.5	27.3
14000LM SEF	24.8	27.6	22.7	28.5	20.9	25.5	22.4	19.6	23.3	22.1	23.7	23.5	27.8	28.6
18000LM SEF	25.7	28.4	23.5	29.3	21.7	26.3	23.2	20.5	24.1	23	24.5	24.3	28.6	29.4
20000LM SEF	26	28.7	23.9	29.6	22	26.6	23.6	20.9	24.5	23.4	24.9	24.7	29	29.7
6000LM HEF	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8000LM HEF	22.8	25.6	20.7	26.5	18.9	23.5	20.4	17.6	21.3	20.1	21.7	21.5	25.8	26.6
10000LM HEF	23.6	26.3	21.4	27.2	19.6	24.2	21	18.3	21.9	20.8	22.3	22.1	27	27.8
14000LM HEF	24.9	27.6	22.7	28.5	20.9	25.5	22.4	19.7	23.4	22.2	23.8	23.5	27.8	28.6
18000LM HEF	25.7	28.4	23.6	29.3	21.7	26.3	23.2	20.5	24.2	23	24.6	24.3	28.7	29.5
20000LM HEF	26	28.8	23.9	29.6	22.1	26.6	23.7	20.9	24.6	23.4	25	24.8	29	29.8

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values. To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application

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RRL - RELOC®-Ready Luminaire

- RRL connectors can be used with Quick-Flex®, System 820 and OnePass® systems.
- Load side of connector factory installed to luminaire.
- 4-pole mating connector with push-in terminations allows for simple installation.
- Touch-safe design on both halves meets UL/CSA requirement.
- Wiping contact design allows safe disconnect under load.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example**: RRLA

Series		Wiring instructions	
RRL	RELOC®-ready luminaire	A	Hot conductor wired to position #1 (phase A)
		B	Hot conductor wired to position #2 (phase B)
		C	Hot conductor wired to position #3 (phase C) [1]

Compatible RELOC® Cables for Industrial Luminaires (ordered and shipped separately)

OCS

OCU

OD

DC

PT

Notes

1 C, ABE, and C12S options are not used with Quick-Flex QFC, QSFC, QPT, and QD.

PLUG-IN WIRING INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. PLR22 (2-circuit) and crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Not for use with dedicated emergency circuits.

Note: Specifications subject to change without notice.

Wiring

PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits (PLR2A / PLR2B Only)				Dimming		Ground	
PLR22	(blank)	Not required for PLR22	(blank)	Not required for PLR22			(blank)	No Dimming	G	Ground (required)
PLR	1	Black	(blank)	Not required for PLR1			(blank)	No Dimming	G	Ground (required)
	2	Black and red	**Circuits to which driver is connected**		**Battery charging circuit (must be unswitched)**		LV	Low-voltage Dimming	G	Ground (required)
			(blank)	Not required for PLR22	(blank)	No battery charging circuit				
			A	Black wire	ELA	Battery pack wired to black wire				
			B	Red wire	ELB	Battery pack wired to red wire				

Typical Applications

Notes:

When specifying PLR1, you will not specify A or B as there is only a single hot wire which would be black in color.

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit PLR22
- Multiple circuit with night-lights located along row as desired

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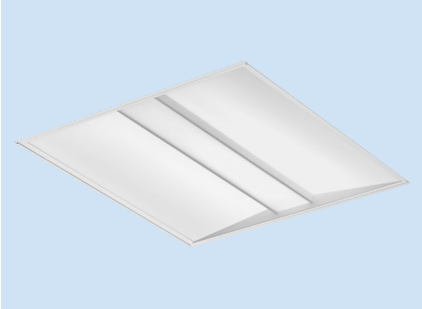
LIGHTING TYPE K

MARK ARCHITECTURAL LIGHTING

SPECIFICATIONS

TYPE: K

PROJECT: SANTA ANA ZOO EDUCATION HUB



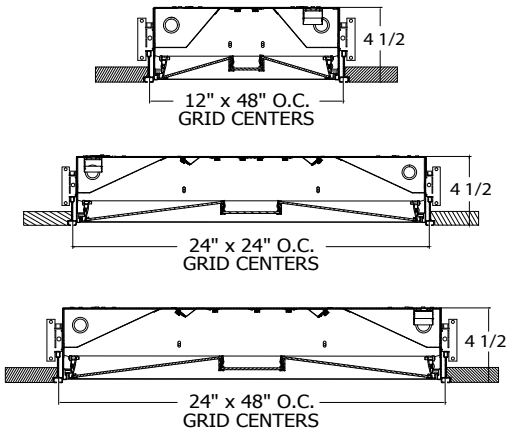
WHISPER

LUMINOUS CENTER

HIGHLIGHTS

- Clean, simple design with sloping side panels with primary luminous center element
- 2000 to 8000 lumen packages available
- From 103 to 124 lumens per watt (LPW), depending on size, lens, lumen combination
- 1X4, 2X2, and 2X4 sizes available
- Three center shielding options
- UGR data on page 3

DIMENSIONS

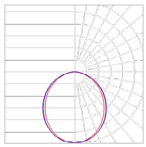


FIXTURE PERFORMANCE

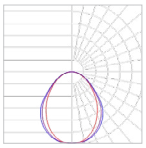
Size	Nominal Lumens	Delivered Lumens	Input Watts	LPW
1x4 LCTR	2000LM	2026	18	110
	2500LM	2550	23	109
	3000LM	3072	30	103
	3300LM	3339	29	116
	3500LM	3552	33	109
	4000LM	3985	37	107
	4500LM	4563	44	104
	4800LM	4845	47	104
	5000LM	5040	43	117
	5500LM	5541	49	114
	6000LM	6039	53	115
	6500LM	6544	56	117
	7000LM	7038	61	116
	7200LM	7232	65	110
2x2 LCTR	2000LM	2042	18	112
	2500LM	2545	22	117
	3000LM	3048	27	112
	3300LM	3332	31	107
	3500LM	3543	32	111
	4000LM	4044	39	103
	4500LM	4542	39	116
	4800LM	4858	42	115
	5000LM	5045	48	105
2x4 LCTR	2000LM	2022	17	122
	2500LM	2556	21	123
	3000LM	3047	26	116
	3500LM	3540	29	122
	4000LM	3894	33	117
	4500LM	4554	40	115
	4800LM	4829	43	113
	5000LM	5058	41	124
	5500LM	5548	46	121
	6000LM	6026	51	119
	6500LM	6542	54	121
	7000LM	7021	60	117
	7200LM	7238	62	117
	7500LM	7560	65	116
	8000LM	7885	68	115

*Based on LCTR 35K 80CRI with SWC center shielding

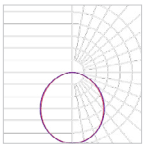
DISTRIBUTION



Soft White Acrylic (SWC)



Micro-Prismatic Conical De-Glaring Lens (YBC)



Hexagonal De-Glare Center (GHC)

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Design Select options indicated by this color background.

Ordering

Example: WHSPR LCTR 2X2 90CRI 30K 3300LM MIN1 MVOLT YBC NLIGHT

WHSPR	LCTR	2X2	80CRI	35K	3300LM

Series

WHSPR	Whisper LED

Decorative Element

LCTR	Luminous Center

Size

2X2	2' x 2'
2X4	2' x 4'
1x4	1' x 4'

1. Not available with sensor option.

LED Color Rendering

80CRI	>80 CRI
90CRI	>90 CRI

LED Color Temp

27K	2700K
30K	3000K
35K	3500K
40K	4000K
50K	5000K

LED Output[1]

2000LM	2000 Lumens	**5000LM**	5000 Lumens
2500LM	2500 Lumens	**5500LM**[2]	5500 Lumens
3000LM	3000 Lumens	**6000LM**[2]	6000 Lumens
3300LM[4]	3300 Lumens	**6500LM**[2]	6500 Lumens
3500LM	3500 Lumens	**7000LM**[2]	7000 Lumens
4000LM	4000 Lumens	**7200LM**[2]	7200 Lumens
4500LM	4500 Lumens	**7500LM**[3]	75000 Lumens
4800LM	4800 Lumens	**8000LM**[3]	8000 Lumens

1. Nominal values. Consult Fixture Performance table for actual delivered lumens.
2. Not available with 2X2
3. Not available with 1X4 or 2X2
4. Not available with 2X4

MIN10	MVOLT	SWC			

Minimum Dimming Level

NODIM[1]	Non Dimming
MIN1	Constant Current, Dimming to 1%
MIN10[2]	Constant Current, Dimming to 10%
DARK	Constant Current, Dimming to 0.1%

1. If NODIM is selected, do not select a value from the Control Input category.
2. Only available with ZT

Voltage

MVOLT	120-277 Volt
120	120 Volt
277	277 Volt
347	347 Volt

Center Shielding

SWC	Soft White Acrylic
YBC	Microprismatic Conical De-Glaring Lens
GHC[1]	Hexagonal De-Glare Lens

1. Not Declare listed.

Finish

(blank)	Standard White paint
AMF	Anti-Microbial White
RALTBD[1]	RAL Paint Finishes

1. RALTBD is for pricing only. Replace with applicable RAL number & finish when placing order.

Emergency Options

(blank)	No Emergency Required
E10WLCP[1,4]	10 Watt Battery Pack, Constant Power with Self Diagnostics, T20 Compliant
EMG[2]	Emergency nLight Device for Use with EM PowerCircuit
BGTD[3]	Generator Transfer Device

1. Not available with 6000LM, 6500LM, 7000LM, 7200LM, 7500LM, or 8000LM. Test switch located on internal reflector behind diffuser. Glow of test switch visible from below.
2. Requires NLTAIR2 or NLIGHT. nLight EMG option requires a connection to an existing nLight network. Power is provided from a separate nLight device.
3. Not available with MVOLT or 347. Must select 120 or 277 option, not available with E10WLCP or NLTAIR2 options.
4. Not available with 347.

Trim

(blank)	No Trim
AR[1]	Air Return

1. Not available woth 1X4, NLIGHT, DMX, CP, or AMF

ZT			

Control Input

(blank)	Use with NODIM Option
ZT	0-10V
NLIGHT[1]	nLight Wired
NLTAIR2[1,4]	nLight Air (wireless) Enabled
DALI[2]	DALI
DMX[2,5]	DMX
ECOD[3]	Lutron Ecosystem Driver

1. Only available with MIN1 or DARK
2. Only available with DARK.
3. Only available with MIN1
4. If sensor required, must select API or APD.
5. Not available with 6500LM, 7000LM, 7200LM, 7500LM, or 8000LM.
For additional ordering assistance consult 'Intelligent Luminaire Technology Guide'.

Primary Sensors[1,2,3]

(blank)	No Sensor
PIR[4]	Occupancy Sensor- Passive Infrared
PDT[4]	Occupancy Sensor- Dual Technology (Passive Infrared & Microphonics)
API	PIR Occupancy Sensor & Photocell
APD	PDT Occupancy Sensor & Photocell

1. Not available with NODIM or MIN10.
2. Not available with ECOD, DMX, or DALI.
3. If paired with ZT, sensor will be integral but not nLight enabled. All sensors are factory-installed onboard sensors.
4. Requires NLIGHT.
For additional ordering assistance consult 'Intelligent Luminaire Technology Guide'.

Pre-Wire Whips

(blank)	No Pre-Wire
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
PWS1846 PWSLV[1,2]	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge, purple and gray
PWS1856LV[1,2]	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage purple and grey wires

1. Not available with NODIM, NLIGHT, or NLTAIR2.
2. Not available with PIR , PDT, API, or APD sensors.

Options

(blank)	No Options
CP[1]	Chicago Plenum
GLR[2]	Fast-Blow Fuse
GMF[2]	Slow-Blow Fuse
LATC	Earthquake Clips
BAA	Buy America(n) Act Compliant

1. Not available with NLIGHT.
2. Specific 120 or 277 voltage required.

design select

Items marked by a shaded background qualify for the Design Select program and ship in 15 days or less. To learn more about Design Select, visit www.acuitybrands.com/designselect.
*See ordering tree for details

Maximum order quantity for Design Select lead times is 250 luminaires.

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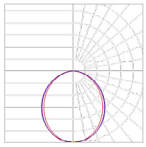
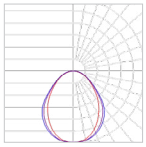
PHOTOMETRICS



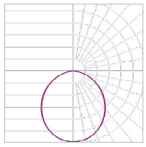
SWC
Test Report: ISF 232732P75
IES LM79-08
Catalog #: WHSPR LCTR 2x4 35K 80CRI 8000LM SWC
Lumens: 7884.9
Wattage: 68.3
Efficacy: 116

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	2,304.90	29.20%
0-40	3,707.20	47.00%
0-60	6,342.60	80.40%
60-90	1,542.30	19.60%
70-100	633.2	8.00%
90-120	0	0%
0-90	7,884.90	100%
90-180	0	0%
0-180	7,884.90	100%



YBC
Test Report: ISF 232733P75
IES LM79-08
Catalog #: WHSPR LCTR 2x4 35K 80CRI 8000LM YBC
Lumens: 7570.8
Wattage: 68.3
Efficacy: 111

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	2,566.10	33.90%
0-40	4,035.20	53.30%
0-60	6,347.40	83.80%
60-90	1,223.30	16.20%
70-100	526	6.90%
90-120	0	0%
0-90	7,570.80	100%
90-180	0	0%
0-180	7,570.80	100%



GHC
Test Report: ISF 232731P75
IES LM79-08
Catalog #: WHSPR LCTR 2x4 35K 80CRI 8000LM GHC
Lumens: 7647.3
Wattage: 68.3
Efficacy: 112

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	2,176.50	28.50%
0-40	3,531.30	46.20%
0-60	6,120.10	80.00%
60-90	1,527.20	20.00%
70-100	627.2	8.20%
90-120	0	0%
0-90	7,647.30	100%
90-180	0	0%
0-180	7,647.30	100%

EXPECTED LIFE: L80@ 60,000 hours; 25°C ambient temperature

UGR CHART

		UGR (70% 50% 20% reflectance using a 4H x 8H room size)					
		Crosswise			Endwise		
SIZE	LUMEN PACKAGE	SWC	YBC	GHC	SWC	YBC	GHC
1x4	2000LM	18.1	17.3	18.2	16.9	16.3	17.1
	2500LM	18.9	18.1	19.0	17.7	17.1	17.9
	3000LM	19.6	18.8	19.6	18.4	17.7	18.5
	3300LM	19.9	19.1	19.9	18.7	18.0	18.8
	3500LM	20.1	19.3	20.1	18.9	18.2	19.0
	4000LM	20.5	19.7	20.5	19.3	18.6	19.4
	4500LM	21.0	20.2	21.0	19.8	19.1	19.9
	4800LM	21.2	20.4	21.2	20.0	19.3	20.1
	5000LM	21.3	20.5	21.4	20.1	19.4	20.2
	5500LM	21.6	20.8	21.7	20.4	19.8	20.6
	6000LM	21.9	21.1	22.0	20.7	20.1	20.9
	6500LM	22.2	21.4	22.3	21.0	20.3	21.1
	7000LM	22.5	21.7	22.5	21.3	20.6	21.4
	7200LM	22.6	21.8	22.6	21.4	20.7	21.5
2x2	2000LM	17.9	16.6	17.9	17.8	16.6	17.9
	2500LM	18.7	17.4	18.6	18.6	17.4	18.7
	3000LM	19.3	18.0	19.3	19.2	18.0	19.3
	3300LM	19.6	18.3	19.6	19.5	18.3	19.6
	3500LM	19.8	18.5	19.8	19.7	18.5	19.9
	4000LM	20.3	19.0	20.2	20.2	19.0	20.3
	4500LM	20.7	19.4	20.6	20.6	19.4	20.7
	4800LM	20.9	19.6	20.9	20.8	19.6	21.0
	5000LM	21.1	19.7	21.0	21.0	19.8	21.1
2x4	2000LM	15.8	14.4	15.6	15.0	13.7	15.2
	2500LM	16.6	15.2	16.4	15.8	14.5	16.0
	3000LM	17.2	15.8	17.0	16.4	15.1	16.6
	3500LM	17.7	16.3	17.6	16.9	15.6	17.1
	4000LM	18.0	16.7	17.9	17.3	15.9	17.4
	4500LM	18.6	17.2	18.4	17.8	16.5	18.0
	4800LM	18.8	17.4	18.6	18.0	16.7	18.2
	5000LM	19.0	17.6	18.8	18.2	16.9	18.3
	5500LM	19.3	17.9	19.1	18.5	17.2	18.7
	6000LM	19.6	18.2	19.4	18.8	17.5	19.0
	6500LM	19.8	18.5	19.7	19.1	17.7	19.2
	7000LM	20.1	18.7	19.9	19.3	18.0	19.5
	7200LM	20.2	18.8	20.0	19.4	18.1	19.6
	7500LM	20.3	19.0	20.2	19.6	18.3	19.7
	8000LM	20.5	19.1	20.3	19.7	18.4	19.9

*UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR" and/ or "Point-UGR" values. To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application.
For more information on UGR see UGR FAQ

CCT/CRI SCALING CHART

CCT	CRI	MULTIPLIER	
27K	80CRI	0.94	
30K	80CRI	0.97	
35K	80CRI	1.00	
40K	80CRI	1.02	
50K	80CRI	1.04	R9
27K	90CRI	0.79	57.35
30K	90CRI	0.81	52.70
35K	90CRI	0.83	56.18
40K	90CRI	0.84	58.38
50K	90CRI	0.89	55.60

Lumen scaling charts can be used to approximate the lumen values at different Kelvin temperatures, color rendering indices, optics, or shielding.
Example: Calculating the lumen change from 80CRI 35K to 80CRI 40K = Lumen output for WHSPR 2X4 35K 80CRI 8000LM SWC (8032) x 1.02 multiplier = 8193 lumens

SHIELDING SCALING CHART

Shielding	Multiplier
SWC	1.000
YBC	0.999
GHC	0.989

** Based upon Soft White Acrylic (SWC) shielding*

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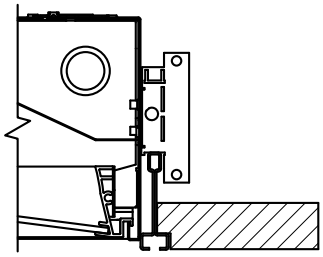
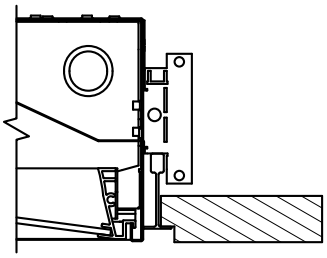
MOUNTING

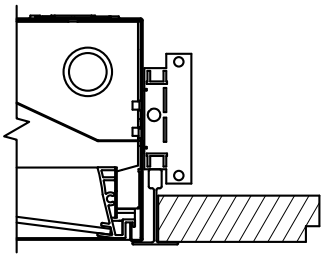
Recessed, lay-in formed steel trim. Universal trim accommodates 9/16" slot grid or 15/16" inverted tee, or 9/16" inverted tee.



UNIV
(9/16" Slot Grid)



UNIV
(9/16" Grid)

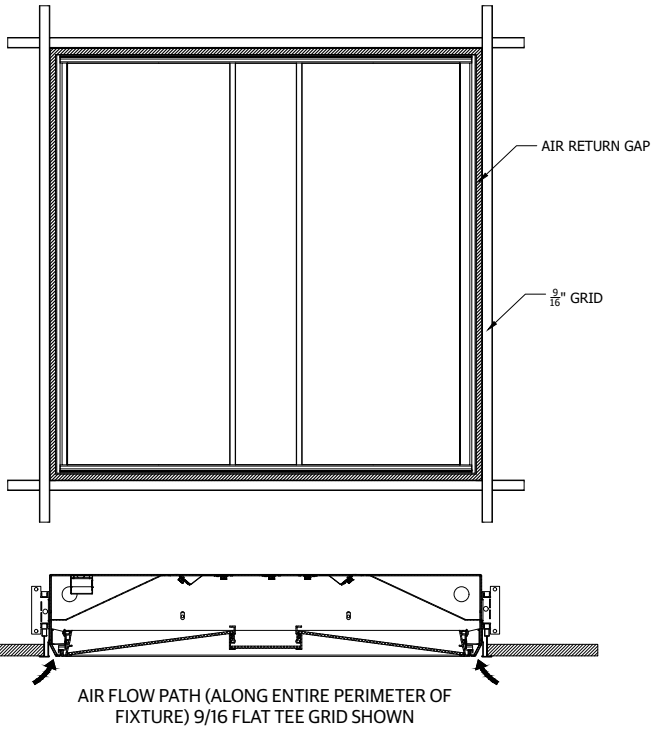


UNIV
(15/16" Grid)

For recessed mounting in hard ceiling applications, use one of the following drywall grid adapters (ordered separately).

Fixture	Drywall Grid Adapter (DGA)
WHSPR LCTR 2X2	DGA22
WHSPR LCTR 2X4	DGA24
WHSPR LCTR 1X4	DGA14WHS

AIR RETURN



AIR FLOW PATH (ALONG ENTIRE PERIMETER OF FIXTURE) 9/16 FLAT TEE GRID SHOWN

Use total area of the air returns shown below in conjunction with the pressure differential between the plenum and room space to calculate your flow rate.

WHSPR LCTR 2X2	
Grid Type	Air Return Area (in^2)
Flat 9/16	29.5
Flat 15/16	12.2
Slotted 9/16	29.5

WHSPR LCTR 2X4	
Grid Type	Air Return Area (in^2)
Flat 9/16	44.9
Flat 15/16	18.5
Slotted 9/16	44.9

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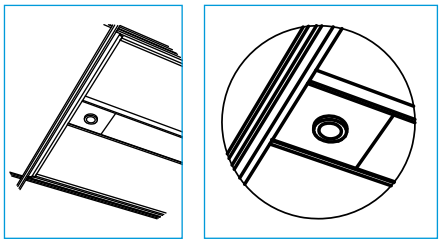
INTEGRATED SENSORS



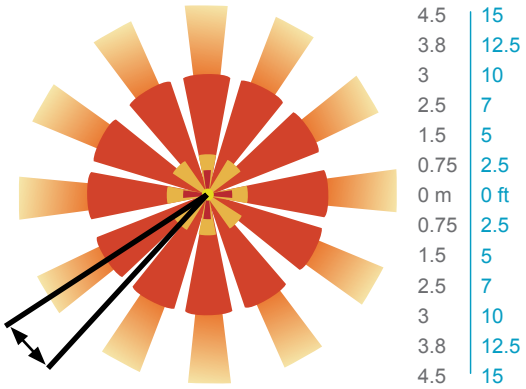
Pictured with Occupancy Sensor and Photocell

COVERAGE PATTERN

MICRO 360° Lens

- At the 7.5 ft (2.29 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.
- Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.
- Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.

7.5 ft Mounting Height



Lens rotates 15° to enable adjustment

EMERGENCY OPTION

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.25 x P x LPW
P = 10 watts for PS1055LCP
LPW - Lumens per watt rating of the luminaire. This information is available on page 1 of this spec sheet or appropriate IES file.

UL924 Sequence of Operation

The below information applies to all nLight AIR devices with an EM option.

- EM devices will remain at their high-end trim and ignore wireless lighting control commands, unless a normal-power-sensed (NPS) broadcast is received at least every 8 seconds.
- Using the CL**AIR**ITY+mobile app, EM devices must be associated with a group that includes a normal power sensing device to receive NPS broadcasts.
- Only non-emergency rPP20, rLSXR, rSBOR. rSDGR, and nLight AIR luminaires with version 3.4 or later firmware can provide normal power sensing for EM devices. See specification sheets for control devices and luminaires for more information on options that support normal power sensing.

CONTROL ACCESSORIES

nLight® Wired Control Accessories
Order as separate catalog number

Wall Switches	Model Number
On/Off single pole	nPODMA (color)
On/Off two pole	nPODMA 2P (color)
On/Off single pole, dimming	nPODMA DX (color)
On/Off two pole, dimming	nPODMA 2P DX (color)
On/Off, two level	nPODMA 2L (color)
Graphic touchscreen	nPOD TOUCH (color)

For more information see nPOD and nPOD TOUCH spec sheets

nLight AIR® Control Accessories
Order as separate catalog number

Wall Switches	Model Number
On/Off single pole	rPODBA (color)
On/Off two pole	rPODBA 2P (color)
On/Off single pole, dimming	rPODBA DX (color)
On/Off two pole, dimming	rPODBA 2P DX (color)
On/Off, 4 scene control	rPODBA 4S (color)

For more information see rPOD spec sheets

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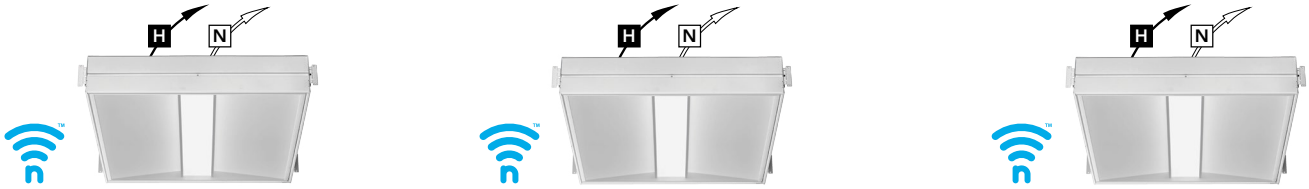
NLIGHT AIR WIRELESS



Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With our CL***AIR***ITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the intended outcome

rPODB 2P DX WH G2

Mobile Device

For more information, please consult our technical guides for nLight or nLight Air.

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INTELLIGENT LUMINAIRE TECHNOLOGY GUIDE

Choose nomenclature from these columns

Driver Configuration (MVOLT)

Minimum Dimming Level		Control Input	Dimming Range	Notes
NODIM	+	(blank)	–	No 0-10V leads from driver
MIN10	+	ZT	100% to 10%	Linear Dimming, supplied with leads for 0-10V control
MIN1	+	ZT	100% to 1%	Linear Dimming, supplied with leads for 0-10V control
MIN1	+	NLIGHT	100% to 1%	Linear Dimming, NIO EZ PH, included with luminaire
MIN1	+	NLTAIR2	100% to 1%	Linear Dimming, internal RIO EZDL 90D G2 included with luminaire
MIN1	+	ECOD	100% to 1%	Lutron Hi-lume 1% EcoSystem (LDE1)
DARK	+	ZT	100% to 0.1%	Logarithmic Dimming, supplied with leads for 0-10V control
DARK	+	NLIGHT	100% to 0.1%	Logarithmic Dimming, NIO EZ PH included with luminaire
DARK	+	NLTAIR2	100% to 0.1%	Logarithmic Dimming, RIO EZDL 90D G2 included with luminaire
DARK	+	DALI	100% to 0.1%	Logarithmic Dimming, DALI controls by others
DARK	+	DMX	100% to 0.1%	Compatible with DMX / RDM (Remote Device Management), DMX controls by others

Choose nomenclature from these columns

Control/Sensor Configurations

Control Input		Sensor		Emergency	Integral Component Description
ZT	+	API		(blank)	Sensor Switch MSD 7 EZ ADC
ZT	+	APD		(blank)	Sensor Switch MSD PDT 7 EZ ADC
NLIGHT	+	PIR		(blank)	nLight NES 7
NLIGHT	+	PIR	+	EMG	nLight NES 7 with NIO EZ PH ER
NLIGHT	+	PDT		(blank)	nLight NES PDT 7
NLIGHT	+	PDT	+	EMG	nLight NES PDT 7 with NIO EZ PH ER
NLIGHT	+	API		(blank)	nLight NES 7 ADCX
NLIGHT	+	API	+	EMG	nLight NES 7 ADCX with NIO EZ PH ER
NLIGHT	+	APD		(blank)	nLight NES PDT 7 ADCX
NLIGHT	+	APD	+	EMG	nLight NES PDT 7 ADCX with NIO EZ PH ER
NLIGHT	+	(blank)		(blank)	nLight NIO EZ PH
NLIGHT	+	(blank)	+	EMG	nLight NIO EZ PH ER
NLTAIR2	+	API		(blank)	nLight RES7 G2
NLTAIR2	+	API	+	EMG	nLight RES7 EM 90D G2
NLTAIR2	+	APD		(blank)	nLight RES7 PDT G2
NLTAIR2	+	APD	+	EMG	nLight RES7 PDT EM 90D G2
NLTAIR2	+	(blank)		(blank)	nLightRIO EZDL 90D G2
NLTAIR2	+	(blank)	+	EMG	nLight RIO EZDL EM 90D G2

For more information, please consult our technical guides for nLight or nLight Air.

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