POMONA UNIFIED SCHOOL DISTRICT

SCIENCE LABS RENOVATION AT GAREY HIGH SCHOOL
A03-125098 File No. 19-H20

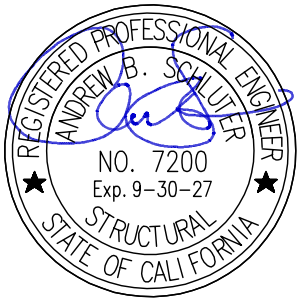
PROJECT MANUAL

PROJECT ADDRESS:
321 W. LEXINGTON AVE.
POMONA, CA 91766

DATE PRINTED: 2025-10-12

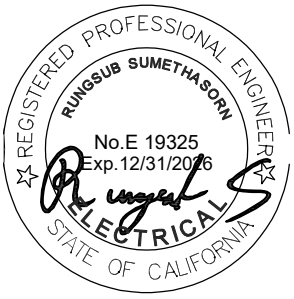
ARCHITECT

STRUCTURAL



MECHANICAL ENGINEER

ELECTRICAL ENGINEER



IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT

APP: 03-125098 INC:

REVIEWED FOR

SS ☑ FLS ☑ ACS ☑

DATE: 10/31/2025

DSA
DIVISION OF THE STATE ARCHITECT
DEPARTMENT OF GENERAL SERVICES

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SECTION 011000
SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Specification and drawing conventions.
6. Misc. Requirements

1.2 PROJECT INFORMATION

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Renovation of (2) of the existing science labs at Garey H.S.

1.4 ACCESS TO SITE

A. Coordinate with the construction manager for access to site. There will be school in session during construction. It is the contractor's responsibility to work around school schedule to minimize the impact to classes, including working extended hours (nights and weekends) at no additional cost to the District.

1.5 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
2. The School will be occupied during construction. Contractor shall not disturb the campus' daily operations. Coordinate with the construction manager for access.
3. Work hour: in accordance with the City's ordinance and/or as specifically instructed by the District.
4. Contractor shall clean up the work and make sure the affected areas are clean at the end of their work shift.

5. Coordinate with the District for staging area and temporary fencing locations. Contractor shall walk the jobsite with the District and submit a drawing indicating the location of temp fence / trash bins, toilet facilities, etc. for review and approval.
6. Use of the District's toilet facilities will NOT be permitted; contractor shall provide their own toilet facilities and maintain (provide weekly cleaning services) them throughout construction.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

A. Division 01 General Requirements: Requirements of Sections in Division 01 apply all Work.
B. In case of conflict in the contract document, contractor shall submit RFI (Request For Information) accordingly prior to proceeding with the work.

1.7 MISC REQUIREMENTS

A. It is the contractor's responsibility to field verify existing room conditions and dimensions and conduct proper layout. Provide layout drawing indicating exact locations of new and existing utility runs. Contractor shall also include a coordinated ceiling layout indicating the locations of all lights, registers, devices, etc. to avoid conflict.
B. Contractor shall provide temporary support / shoring for demolition or new work if needed.
C. Regardless indicated in the contract documents or not, contractor shall provide materials, parts, accessories, and installations as needed for a complete assembly and system in compliant with DSA IRs, Policies, Bulletins, standards and all applicable codes and regulations.
D. Contractor shall patch existing roofing and wall where new penetrations are made. Maintain existing wall / floor / ceiling fire and acoustical rating. Install piping / exhaust fan roof penetrations per the manufacturer's requirement, patch roofing and obtain roofing warranty for the new work and maintain existing roofing warranty.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.
B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles. Substitution Request must be submitted for review and approval during bidding prior to the award of contract. Substitution Request submitted after the contractor is awarded will only be allowed for product discontinued, substitution resulted a credit to the District, and/or Owner requested substitution.

1. Substitution Request Form: Use CSI Form 13.1A.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions 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. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.

g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. 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 date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. 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. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

PART 2 - PRODUCTS
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012600
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications. Should conflict exists, the project General Conditions shall govern.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on District's standard forms.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Construction Manager will 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. Work Change Proposal Requests issued by Construction Manager are not 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.
e. Refer to the project General Conditions for instruction.

B. Contractor-Initiated Work Change Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. 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.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. 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.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Refer to project General Conditions for instruction.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013100
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Requests for Information (RFIs).
2. Project meetings.

B. Related Requirements:

1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

A. RFI: Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use the District's standard form (if any) and include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

1.4 GENERAL COORDINATION PROCEDURES

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 to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

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.

1.5 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor 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.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect and Construction Manager.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor shall always provide suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: District’s standard form.

D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven (or as indicated in the General Condition, whichever is longer) working days for Architect's response for each RFI. RFIs received by Architect or Construction Manager 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 Architect's actions on submittals.
f. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's 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 Section 012600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use CSI Log Form 13.2B.

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect and Construction Manager.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's and Construction Manager's response was received.

F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.6 PROJECT MEETINGS

A. General: Construction Manager will 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 Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within three days of the meeting.

B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. 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. Critical work sequencing and long-lead items.
    c. Designation of key personnel and their duties.
    d. Procedures for processing field decisions and Change Orders.
    e. Procedures for RFIs.
    f. Procedures for testing and inspecting.
    g. Procedures for processing Applications for Payment.
    h. Distribution of the Contract Documents.
    i. Submittal procedures.
    j. Preparation of record documents.
    k. Use of the premises and existing building.
    l. Work restrictions.
    m. Working hours.
    n. Owner's occupancy requirements.
    o. Responsibility for temporary facilities and controls.
    p. Procedures for disruptions and shutdowns.
    q. Construction waste management and recycling.
    r. Parking availability.
    s. Office, work, and storage areas.
    t. Equipment deliveries and priorities.
    u. First aid.
    v. Security.
    w. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013200
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's construction schedule.
2. Daily construction reports.
3. Site condition reports.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Owner.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.
3. Two paper copies.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

C. Daily Construction Reports: Submit at weekly intervals.
D. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion

D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Testing and commissioning.
    i. Punch list and final completion.
    j. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

2.3 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. Approximate count of personnel at Project site.

3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions, including presence of rain or snow.
6. Accidents.
7. Meetings and significant decisions.
8. Unusual events.
9. Stoppages, delays, shortages, and losses.
10. Meter readings and similar recordings.
11. Emergency procedures.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Construction Change Directives received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial completions and occupancies.
18. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, 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.

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
2. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of digital data files (CAD or BIM) of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files (PDF) of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
b. Contractor shall execute a data licensing agreement as required by the architect prior to the release of the digital files.

B. 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. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's 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. Initial Review: Allow a min of 30 days (or as stated in the General Condition, whichever is longer) for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal (or as stated in the General Condition, whichever is longer)

D. Paper Submittals: Not Accepted.
E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software electronic form acceptable to Owner**,** containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of firm or entity that prepared submittal.
    g. Names of subcontractor, manufacturer, and supplier.
    h. Category and type of submittal.
    i. Submittal purpose and description.
    j. Specification Section number and title.
    k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    l. Drawing number and detail references, as appropriate.
    m. Location(s) where product is to be installed, as appropriate.
    n. Related physical samples submitted directly.
    o. Indication of full or partial submittal.
    p. Transmittal number, numbered consecutively.
    q. Submittal and transmittal distribution record.
    r. Other necessary identification.
    s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

    a. Project name.
    b. Number and title of appropriate Specification Section.
    c. Manufacturer name.
    d. Product name.
    e. Insert required information.

F. Options: Identify options requiring selection by Architect.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. 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 with approval notation from Architect's action stamp.

I. 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.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Post electronic submittals as PDF electronic files directly to Architect's FTP site or other online construction administration tool specifically established for Project.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. If acceptable to the construction manager and the architect, submit electronic submittals via email as PDF electronic files.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

3. Action Submittals: Submit electronically
4. Informational Submittals: Submit electronically
5. Certificates and Certifications Submittals: Provide a 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.

    a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

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 published 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.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.

h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

   a. PDF electronic file.

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, unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

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.
3. Submit Shop Drawings in the following format:

   a. PDF electronic file.

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 applicable Specification Section.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. 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.

5. 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 one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. 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 sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

        1) 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: 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. Submit product schedule in the following format:

        a. PDF electronic file.

F. Coordination Drawings Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures.

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

N. Installer Certificates: Submit 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.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit 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.

S. Product Test Reports: Submit written reports indicating that 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.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

U. Schedule of Tests and Inspections: Comply with requirements specified in Section 014000 "Quality Requirements."

V. Preconstruction Test Reports: Submit 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.

W. Compatibility Test Reports: Submit 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.

X. Field Test Reports: Submit written reports 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.

Y. Design Data: Prepare and submit 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.

2.2 DELEGATED-DESIGN (DESIGN BUILD) SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: 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 Architect / District.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. 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 ARCHITECT'S ACTION

A. General: Architect and Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.
B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
F. Review stamp: Architect’s review stamp does not relieve the contractor’s responsibility to fully comply with the contract document.

END OF SECTION 013300

SECTION 014000
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. 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. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Specific test and inspection requirements are not specified in this Section.

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 Architect or Construction Manager.
C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. 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. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: 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 conflicting requirements that are different, but apparently equal, to Architect 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 Architect for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

B. Testing Agency Qualifications: 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.

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections and distribute copies to the Architect, DSA, Project Inspector, and the District. 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.

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. 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.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. 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.

C. 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.

D. 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.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located 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 in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections 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. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

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 329; 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. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

    1. Contractor responsibilities include the following:

        a. Provide test specimens representative of proposed products and construction.
        b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
        c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.

d. When testing is complete, remove test specimens, assemblies, and mockups, do not reuse products on Project.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Demonstrate the proposed range of aesthetic effects and workmanship.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Demolish and remove mockups when directed unless otherwise indicated.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.7 QUALITY CONTROL

A. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

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. 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.

D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -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.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Conducted by a qualified special inspector as required by DSA, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
3. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
4. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: 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 Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

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 or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

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

SECTION 014200
REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "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."

E. "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.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "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.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, contractor shall follow all applicable construction industry standards.

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.

1.3 ABBREVIATIONS AND ACRONYMS

A. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

B. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; http://dodssp.daps.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; http://eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeia; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

C. 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 in the following list.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.

2. DOD - Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; http://dodssp.daps.dla.mil.
3. DSA – Division of the State Architects
4. DSCC - Defense Supply Center Columbus; (See FS).
5. FED-STD - Federal Standard; (See FS).
6. FS - Federal Specification; Available from Department of Defense Single Stock Point; http://dodssp.daps.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.

7. MILSPEC - Military Specification and Standards; (See DOD).
8. USAB - United States Access Board; www.access-board.gov.
9. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

D. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. CBHF - State of California; Department of Consumer Affairs; Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR - California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS - California Department of Health Services; (See CDPH).
4. CDPH - California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC - California Public Utilities Commission; www.cpuc.ca.gov.
6. DSA – Division of the State Architects
7. SCAQMD - South Coast Air Quality Management District; www.aqmd.gov.
8. TFS - Texas Forest Service; Forest Resource Development and Sustainable Forestry; http://txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 014523
TESTING AND INSPECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Testing and inspection services to meet requirements of the California Building Code (CBC), Title 24, Parts 1 and 2, as indicated on the Drawings and the DSA approved DSA 103

B. One or more DSA certified inspectors employed by the OWNER in accordance with the requirements of California Building Standards Administrative Code will be assigned to the Work with their duties as specifically defined in Section 4-333(b).

C. Tests of materials are required by a DSA certified testing agency as set forth in Section 4-335 of the California Building Standards Administrative Code.

1.02 RELATED SECTIONS

A. Section 011000:Summary
B. Section 012500:Substitution Procedures
C. Section 013300:Submittal Procedures
D. Section 017700:Closeout Procedures

PART 2 – PRODUCTS (Not applicable)

PART 3 – EXECUTION

3.01 TESTS

A. OWNER will select an independent testing agency to conduct tests, sampling, and testing of materials. Selection of material to be tested shall be by the agency and not by CONTRACTOR.

B. Any material shipped from the source of supply prior to having satisfactorily passed such testing and inspection or prior to the receipt of notice from IOR such testing and inspection is not required shall not be incorporated into the Work.

C. OWNER will select and directly reimburse testing agency the costs for all DSA and/or DSA required tests and inspections, but may be reimbursed by CONTRACTOR for such costs as noted in related sections of the Contract Documents.

D. The independent testing agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work. The agency shall not perform any duties of CONTRACTOR.

3.02 TEST REPORTS

A. Test reports shall include all tests performed, regardless of whether such tests indicate the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations as required shall also be reported. Reports shall indicate the material or materials were sampled and tested in accordance with requirements of CBC, Title 24, Parts 1 and 2, as indicated on the Drawings. Test reports shall indicate specified design strength. They shall also definitely state whether or not material or materials tested comply with the specified requirements.

3.03 VERIFICATION OF TEST REPORTS

A. Each testing agency shall submit to the Division of the State Architect a verified report in duplicate covering tests which are required to be performed by that agency during progress of the Work. Such report shall be furnished each time construction on the Work is suspended, covering tests up to that time, and prior to Final Completion of the Work, covering all tests.

3.04 INSPECTION BY OWNER

A. OWNER and its representatives shall at all times have access, for purpose of inspection, to all parts of the Work and to shops wherein the Work is in preparation, and CONTRACTOR shall at all times maintain proper facilities and provide safe access for such inspection.

B. OWNER shall have the right to reject materials and/or workmanship deemed defective Work, and to require correction. Defective workmanship shall be corrected in a satisfactory manner and defective materials shall be removed from the premises and legally disposed of, all without charge to OWNER. If CONTRACTOR does not correct such defective Work within a reasonable time, fixed by written notice and in accordance with the terms and conditions of the Contract Documents, OWNER may correct such defective Work and proceed in accordance with related Articles of the Contract Documents.

C. CONTRACTOR is responsible for compliance to all applicable local, state, and federal regulations regarding codes, regulations, ordinances, restrictions, and requirements.

3.05 INSPECTOR OF RECORD

A. Inspector of Record is employed by OWNER in accordance with requirements of Title 24 of the California Code of Regulations with their duties specifically defined therein.

B. Inspection of Work shall not relieve CONTRACTOR from any obligation to fulfill all of the terms and conditions of the Contract Documents.

C. CONTRACTOR shall be responsible for scheduling times of inspection, tests, sample taking, and similar activities of the Work.

END OF SECTION

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service: Contractor’s responsibility.

1.3 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire prevention program.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to 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 TEMPORARY FENCING

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 8 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. Also provide green screen.

2.2 TEMPORARY FACILITIES

A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
B. Temporary toilet facilities: Contractor shall provide and maintain temporary toilet facilities throughout the entire duration of the project. Contractor and its subcontractors shall not use the District’s toilet facilities.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

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.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

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: Temporary utility is the sole responsibility of the contractor.

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. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of Owner's existing toilet facilities will not be permitted.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Contractor’s responsibility.

H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

I. Lighting: Provide 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.

2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
B. 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.

C. Parking: Provide temporary parking areas for construction personnel.
D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

E. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
E. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

G. 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. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.

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 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

3.6 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.

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, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

3.7 NOISE

A. Contractor shall cease all construction activities (at no additional cost to the District) should the Construction Manager receives complaints from the District. It is the contractor’s responsibility to make sure that construction activities will not disturb any daily District activities.

END OF SECTION

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. 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 comparable products.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

A. Products: Items obtained 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.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," 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 comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "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, select product compatible with products previously selected, even if previously selected products were also options.

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 and vandalism. 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 determine compliance with the Contract Documents and to determine 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. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

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: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for 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 indicated form properly executed.
3. Refer to other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, 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," Architect will make selection.
5. 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 manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

    a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

    a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable 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 requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

    1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017300
EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
3. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

B. Certified Surveys: Submit two copies signed by land surveyor professional engineer.
C. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.
B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: 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, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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 walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. 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 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 caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.

B. General: Engage a land surveyor professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 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, ducts, and wiring in finished areas unless otherwise 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. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. 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.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building 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 or masonry. Deliver such items to Project site in time for installation.

I. 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.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements"

3.7 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. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.
4. All work shall compliant with federal, state, and local laws and regulations

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: Achieve end-of-Project rates for salvage/recycling of 90 percent by weight of total non-hazardous solid waste generated by the Work. Facilitate recycling and salvage of materials.

1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

1.5 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit 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.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. 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.

G. Qualification Data: For waste management coordinator.

1.6 QUALITY ASSURANCE

A. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Contractor shall provide and implement a waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract. Please note that there will be no staging area available onsite. Contractor shall remove all trash and waste on a daily basis. No overnight trash / waste bins will be allowed onsite.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within 3 days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Donation: Permitted on Project site.

C. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by the construction manager.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inch size.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch size.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 3/4-inch size.
2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

H. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site (on a daily basis) 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 accumulate on-site. All trash / waste shall be removed from the jobsite on a daily basis to avoid conflict with the District's daily operations.
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: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:
1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

1.3 CLOSEOUT SUBMITTALS
1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Construction Manager's signature for receipt of submittals.

5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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 Architect, 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.

1.6 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: 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 to determine acceptance. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization 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 CSI Form 14.1A.

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. Submit list of incomplete items in the following format:

    a. MS Excel electronic file. Architect, through Construction Manager, will return annotated copy.
    b. PDF electronic file. Architect, through Construction Manager, will return annotated copy.
    c. Three Insert number paper copies unless otherwise indicated. Architect, through Construction Manager, will return two copies.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

    1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
    2. 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.
    3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
    4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

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.

    1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform 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 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 designated 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. Power wash paving.
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. 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. Powerwash and remove all Efflorescence from CMU wall.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.
h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
o. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
D. Professional cleaning: Contractor shall also employ a professional cleaning company to perform a final clean for all interior and exterior areas.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

    1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
    2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

        a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

    3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
    4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 017823
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. 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.

C. Title Page: 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 and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

D. 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 Project Manual.

E. 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.

F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type 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. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. 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 Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. 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.

2.2 PRODUCT MAINTENANCE MANUALS

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 Project Manual.

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.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

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.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

   1. Do not use original project record documents as part of operation and maintenance manuals.

F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 017839
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. 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 Requirements:

1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.

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 provide information for preparation of corresponding 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. Record data as soon as possible after obtaining it.
c. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: DWG DXF DGN, Version , Microsoft Windows operating system.
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Architect through Construction Manager for resolution.
6. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect and Construction Manager.
    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. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file paper copy scanned PDF electronic file(s) of marked-up paper copy of Specifications.

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.

B. Format: Submit record Product Data as annotated PDF electronic file paper copy scanned PDF electronic file(s) of marked-up paper copy of Product Data.

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.
B. Format: Submit miscellaneous record submittals as PDF electronic file paper copy scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

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 revisions to project record documents as they occur; do not wait until 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 Architect's and Construction Manager's reference during normal working hours.

END OF SECTION

SECTION 024119
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the demolition and removal of selected portions of existing wall, ceiling and wall and patching of existing surface affected by demolition as needed to match adjacent surface.

B. See Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.

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 removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. 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 removed and reinstalled.

1.3 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity, interruption of utility services, use of elevator and stairs, and locations of temporary partitions and means of egress.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1. Comply with submittal requirements in Division 01 Section "Construction Waste Management and Disposal."

1.4 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

1.5 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect/Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. 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/Engineer and Owner. Owner will remove hazardous materials under a separate contract.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations. Maintain fire-protection facilities in service during selective demolition operations.

1.6 PATCHING

A. Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used) PART

3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect/Engineer.

E. Engage a professional engineer to survey condition of building to determine whether removing

any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction videotapes and templates.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."B. Removed and Salvaged Items:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a 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.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect/Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 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. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally disposed of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 064116
PLASTIC LAMINATE ARCHITECTURAL CABINETS AND EPOXY WORKSURFACES AND SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Solid Epoxy countertops.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

1.2 SUBMITTALS

A. General: Shop drawings and product submittals shall be certified by Woodwork Institute (WI) through the Certified Compliance Program (CCP)

B. Product Data: For each type of product including high-pressure decorative laminate, adhesive for bonding plastic laminate and cabinet hardware and accessories.

C. Epoxy work submittals: Provide certified test reports and recognized evaluation reports showing compliance with specified performance characteristics and physical properties.

D. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

E. Samples:

1. Plastic laminates, for each color, pattern, and surface finish.
2. Thermoset decorative panels, for each color, pattern, and surface finish.

1.3 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: Furnish and Provide WI Certified Compliance Program certificates.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: WI Accredited Millwork Company

B. Installer Qualifications: Licensee of WI's Certified Compliance Program
C. Epoxy worksurface:

1. Manufacturer Qualifications:

a. Products manufacture red in ISO 9001 certified facility.
b. Primary products furnished by single manufacturer with minimum 10 years documented experience in work of this section.

2. Installer Qualifications:

a. Minimum 5 years documented experience in work of this section.

3. Mockup:

a. Construct worksurface mockup, 6’ x full depth
b. Include worksurface and trim
c. Location to be determined in the field.
d. Approved mockup may remain as part of the work.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from Woodwork Institute (WI) certification program indicating that woodwork, including installation, complies with requirements of grades specified.

B. Grade: Premium

C. Certified Wood: Plastic-laminate cabinets shall be made from wood products certified as "FSC Pure" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
D. Type of Construction: Frameless.

E. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
F. Chemical Resistant Laminate:

1. Manufacturers (Basis of Design): Wilsonart Chemsurf Chemical-Resistant Laminate

a. Post-Forming Type: Wilsonart Type 390
b. Sheet thickness: 0.034" nominal
c. Color, Pattern, and Finish: Selected from manufacturer's full range of available selections

2. Install per manufacturer's instructions

2.2 SOLID EPOXY COUNTERTOPS AND SINKS

A. Basis of Design: Epoxy Resin solid worksurface by DURCON

B. Solid Epoxy Resin Materials:

1. Sheets cast from modified epoxy resin and non-asbestos inert fillers; compounded mixture cured and thermoset specifically from formulation to provide exceptional physical and chemical resistance required in heavy duty laboratory environments.
2. Sheets monolithic throughout without surface coating application.
3. Certified to NSF / ANSI 51
4. Certified by GREENGUARD under Indoor Air Quality and Greenguard Gold Certification programs.
5. Physical properties: minimum acceptable physical performance in accordance with SEFA 3 testing procedures:

a. Densite / specific gravity: Tested to ASTM D792; minimum test rating of 133.6 lb / ft3
b. Rockwell hardness: Tested to ASTM D785; minimum M Scale rating of 109.
c. Fire resistance: tested to ASTM D635; classified as self-extinguishing.
d. Surface burning characteristics: Tested to ASTM E84; flame spread index 5 and smoke developed index of 185
e. Coefficient of linear thermal expansion: Tested to ASTM D696; rating of 1.2 x 10-5 in/inoF
f. Heat deflection: Tested to ASTM D648; maximum 293 degree F
g. Flexural strength: Tested to ASTM D790; minimum rating 12.6 KPSI
h. Flexural modulus: Tested to ASTM D790; 3240 KPSI or 22.4 Gpa
i. Water absorption, 24 hours: Tested to ASTM D570; maximum 0.03% by weight.
j. Compression strength: Tested to ASTM D695; minimum 32.7 kpsi or 226 Mpa.
k. Chemical resistance; minimum acceptable chemical resistance performance in accordance with SEFA 3

C. Edges: ClassicTop with ¼" Machined Radius with 1" standard overhang. Provide 1/8"x1/8" drip groove

D. Joints: Follow manufacturer's design guide. Provide adhesive "Smooth-on" as required at joints.
E. Sinks: sizes as indicated on the drawings. cupsinks shall be TS04 by DURCON
F. Sink Cutouts:

1. Drop in sinks: Provide a beveled rabbet cut through the worksurface so that the lip of the rabbet cut supports the protruding sink rim. The sink rim is inset into the top below the bevel.
2. Undermount sinks: Provide an eased edge cutout in the worksurface 1" smaller than the inside dimensions of the sink unit. Provide a ½" worksurface lip overhang the sink on all sides.
3. Cupsinks: Provide standard flush mount. Provide a rabbet cut in the worksurface.

G. Curb / Spach: 6" high. 1" thick. Transitions shall be mitered. Coordinate with manufacturer when ordering. Provide classic 1/8" machined bevel.
H. Thickness: 1" for typical worksurface. Check each sheet at factory for required thickness
I. Fumehood worksurface

1. Thickness: 1.25", coordinate with fume hood manufacturer for exact requirements.
2. Coordinate locations and requirements for vent and cupsink cutouts.
3. Provide a ¼" machined radius along the front edge.

J. Corner treatment: exposed corners shall be eased slightly for safety.
K. Allowable tolerances:

1. Square: plus or minus 1/64" for each 12" of length
2. Location of cutouts and drilled openings: Plus or minus 1/16" of design dimension
3. Size of cutouts and drilled openings: Plus 1/16" or design dimension
4. Code (CBC and ADA) compliant dimensions: plus or minus 0"

L. Warpage:

1. Inspect tops for warpage prior to fabrication by placing on true flat surface.
2. Maximum allowable warpage (per manufacturer's requirements): 1/16" in 36" span or 3/16" in 96" span.

M. Colors to be selected from manufacturer's full range of selection.

2.3 CABINET MATERIALS

A. Provide materials that comply with requirements of referenced quality standard for each type of grade specified.
1. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

a. Thickness: ¾”
b. Use at cabinets.

2. Thermoset Decorative Overlay: Medium-density fiberboard with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1

a. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges.
b. Color and pattern: Match adjacent.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware per ANSI/BHMA standards (latest edition) Grade1. Comply with CBC 1126B.4 for all pull hardware.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 165 degrees of opening. Automatic closing shall engage only in the last 10 degrees of swing.

1. Basis of Design: Series 3000 by Grass America, Inc. or approved equal.
2. Quantity: 2 min. per door leaf or as recommended by the manufacturer base on the size of cabinets, whichever is more stringent.
3. Finish: Bright Nickel, BHMA 619 brass/bronze or 646 steel.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter. BHMA A156.9, B02011.

D. Catches: Magnetic catches, BHMA A156.9, B03141

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081

F. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

G. Drawer Slides: BHMA A156.9.
1. Provide positive stop, side-mounted, full extension, zinc-plated steel drawers slides with steel ball bearings.
2. Basis of Design: No. 3640A Accuride, Inc. 200 pound capacity minimum, up to 42” wide.

H. Door and Drawer Silencers: BHMA A156.16, L03011. Rubber, approximately ¼” diameter, color compatible with adjacent finish.

I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

J. Cabinet locks: Provide locks on each cabinet doors and drawers.
1. 100DR or 200DW by Olympus Lock, Inc.

K. Selection of cabinet hardware is subjected to changes by the District. Contractor shall provide different hardware as selected by the District at no additional cost.

2.5 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
B. Installation materials: Manufacturer's joint adhesive, panel adhesive, and sealants as required to suite project conditions. Do not use adhesives that contain urea formaldehyde. All fasteners shall have an up-to-date ICC ER report.
C. Adhesives: Use adhesives that meet 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. Adhesive for Bonding Plastic Laminate: As recommended by laminate manufacturer (Low VOC content.

2.6 ACCESSORIES

A. Sink stopper: USS2

B. Sink outlet: S03-R

2.7 FABRICATION

A. Complete fabrication, including assembly 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.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, 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.
C. Comply with manufacturer's written instructions and design guidelines

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Clean surfaces just prior to installation
C. Prepare surfaces / substrates using methods recommended by the manufacturers.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Contractor shall remove existing finish and install backing as required. Patch wall to match existing adjacent.
C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or screws for exposed fastening, countersunk and filled flush with woodwork.
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, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

G. Epoxy Worksurface installation:
1. Do not begin worksurface installation until cabinets have been installed.
2. Install in accordance with manufacturer’s instructions and approved shop drawings
3. Install tops plumb and level
4. Scribe to adjacent surfaces in accordance with manufacturer’s recommendations
5. Fasten tops to supporting construction with adhesive appropriate for use with adjoining construction and as recommended by manufacturer.
6. Form field joints using manufacturer’s recommended adhesive. Form joints to be inconspicuous and nonporous.
7. Install fume hood base work surfaces using fasteners and adhesive appropriate for use with adjoining construction and as recommended by manufacture

H. Protection

1. Protect installed products until Project Completion.
2. Touch up, repair, or replace damaged product.

END OF SECTION 064116

SECTION 07 01 51
MAINTENANCE OF MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the Conditions of the Contract and Division 01 Specification Sections apply to this Section.
B. Scope of Work:

1. Patch Obsolete Roof Openings
2. Install insulation and cover board to match existing roof field height
3. Install HPR Torch Base at affected area extending 6” into field of existing roof field surface
4. Install StressPly IV Plus Mineral at affected area extending 9” into field of existing roof field surface
5. Spud back gravel on existing surfacing extending 9” surrounding new patch area
6. Apply three-course of GarMesh reinforcement and Cool-Sil mastic at perimeter of new patch area
7. Apply Cool-Sil HB White at patch area and extending 9” into existing roof field
8. Flash Exhaust Vent Curb:
9. Install HPR Torch base extending 6” into field of existing roof field surface. Flashing ply to run up and over top edge of new curb
10. Install StressPly IV Plus Mineral extending 6” into field of existing roof field surface. Flashing ply to run up and over top edge of new curb and be backnailed vertically 8” OC
11. The entire sheet of flashing membrane must be solidly adhered to the substrate.
12. Apply Cool-Sil HB White at new patch area and extending 9” into existing roof field

1.02 SUMMARY

A. Section includes products and procedures for properly maintaining existing roofing assets in accordance with maintenance agreements and warranty provisions in effect. Maintenance activities include but are not limited to the following:

B. Scheduled inspections of installed roofing.
C. Documentation of existing conditions.
D. Sampling and testing by a qualified testing agency.
E. Planning and scheduling maintenance procedures.
F. Performing maintenance procedures in accordance with the provisions of warranties in effect, including but not limited to:
G. Patch Obsolete Roof Opening
H. Flash Exhaust Vent Curb
I. Reporting maintenance activities completed under the terms of the Contract.
J. Related Sections:
K. Division 07 Section Common Work Results for Thermal and Moisture Protection.
L. Division 07 Section Sheet Metal Flashing and Trim.

1.03 REFERENCES

A. The following resource documents will be provided by the Owner for the Contractor's use in maintaining the roofing system:

B. Record Drawings
C. Record Specifications
D. Operation and maintenance manuals
E. Manufacturer's warranty
F. Installer warranty.
G. Construction progress documentation
H. Roofing maintenance records
I. Existing maintenance agreements
J. Insurance records

1.04 SUBMITTALS FOR REVIEW

A. Product Data: Provide manufacturer's technical product data for each type of roofing product specified. Include data substantiating that materials comply with specified requirements.
B. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.

1.05 SUBMITTALS FOR INFORMATION

A. Manufacturer's Installation Instructions: Submit installation instructions and recommendations indicating special precautions required for installing the membrane.
B. Manufacturer's Certificate: Certify that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.
C. Manufacturer's Certificate: Submit a certified copy of the roofing manufacturer's ISO 9001 compliance certificate.
D. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147.
E. Written certification from the roofing system manufacturer certifying the applicator is currently authorized for the installation of the specified roof system.
F. Qualification data for firms and individuals identified in Quality Assurance Article below.

1.06 CONTRACT CLOSEOUT SUBMITTALS

A. General: Comply with Requirements of Division 01 Section - Closeout Submittals.
B. Special Project Warranty: Provide specified warranty for the project, executed by the authorized agent of the manufacturer.
C. Roofing Maintenance Instructions. Provide a manual of manufacturer's recommendations for maintenance of installed roofing systems.
D. Insurance Certification: Assist owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.
E. Demonstration and Training Schedule: Provide a schedule of proposed dates and times for instruction of Owner's personnel in the maintenance requirements for completed roofing work. Refer to Part 3 for additional requirements.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with not less than [12] years documented experience [and have ISO 9001 certification].

B. Installer Qualifications: Company specializing in modified bituminous roofing installation with not less than [5] years experience and authorized by roofing system manufacturer as qualified to install manufacturer's roofing materials.

C. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress. Maintain proper supervision of workmen.
D. Maintain a copy of the contract documents in the possession of the Supervisor/Foreman and

on the roof at all times.

E. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system manufacturer.
F. Upon request of the architect or owner, submit manufacturer's written approval of secondary components in list form, signed by an authorized agent of the manufacturer.
G. Source Quality Control: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site with seals and labels intact, in manufacturer's original containers, dry and undamaged.
B. Store and handle roofing sheets in a dry, well-ventilated, weather-tight place to prevent moisture exposure. Store rolls of felt and other sheet materials on pallets or other raised surface. Stand all roll materials on end. Cover roll goods with a canvas tarpaulin or other breathable material (not polyethylene).
C. Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.
D. Secure all material and equipment on the job site. If any material or equipment is stored on the roof, assure that the integrity of the deck is not compromised at any time. Damage to the deck caused by the Contractor's actions will be the sole responsibility of the Contractor, and the deck will be repaired or replaced at his expense.

1.09 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Roofing Conference: Convene a pre-roofing conference approximately two (2) weeks before scheduled commencement of modified bituminous roofing system installation and associated work.
B. Require attendance of installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any), Architect, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of the work, including (where applicable) Owner's insurers, testing agencies and governing authorities. Objectives of conference include:
C. Review foreseeable methods and procedures related to roofing work, including set up and mobilization areas for stored material and work area.
D. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work performed by others.
E. Review structural loading limitations of deck and inspect deck for loss of flatness and for

required attachment.

F. Review roofing system requirements (drawings, specifications and other contract documents).
G. Review required submittals both completed and yet to be completed.
H. Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
I. Review required inspection, testing, certifying and material usage accounting procedures.
J. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not mandatory requirement).
K. Record discussion of conference including decisions and agreements (or disagreements) reached and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.
L. Review notification procedures for weather or non-working days.
M. The Owner's Representative will designate one of the conference participants to record the proceedings and promptly distribute them to the participants for record.
N. The intent of the conference is to resolve issues affecting the installation and performance of roofing work. Do not proceed with roofing work until such issues are resolved the satisfaction of the Owner and Engineer of record. This shall not be construed as interference with the progress of work on the part of the Owner or Engineer of record.

1.10 MANUFACTURER'S INSPECTIONS

A. When the project is in progress, the roofing system manufacturer will provide the following:
B. Report progress and quality of the work as observed.
C. Provide daily job site inspections.
D. Report to the Owner in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.
E. Confirm after completion that manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.11 PROJECT CONDITIONS

A. Proceed with roofing work only when existing and forecasted weather conditions will permit a unit of work to be installed in accordance with manufacturer's recommendations and warranty requirements.
B. Do not apply roofing insulation or membrane to damp deck surface.
C. Do not expose materials subject to water or solar damage in quantities greater than can be weatherproofed during same day.
D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank one (1) inch cap nails, or screws and plates at a rate of one (1) fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and four (4) ft o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install four (4) additional fasteners at the upper edge of the membrane when strapping the plies.

1.12 SEQUENCING AND SCHEDULING

A. Sequence installation of roofing with related units of work specified in other Sections to ensure that roof assemblies, including roof accessories, flashing, trim and joint sealers, are protected against damage from effects of weather, corrosion and adjacent construction activity.
B. Complete all roofing field assembly work each day. Phased construction will not be accepted.

1.13 WARRANTY

A. Upon completion of installation, and acceptance by the Owner and Architect, the Manufacturer will supply to the Owner the appropriate warranty.

B. Installer will submit a two (2) year warranty to the membrane manufacturer with a copy directly to Owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. When a particular trade name or performance standard is specified it shall be indicative of a standard required.
B. Provide maintenance products as manufactured by the Garland Company for Pomona USD district Standard.

The Garland Company
3800 East 91st Street
Cleveland, Ohio 44105
Telephone: 714-745-5317
Website: www.garlandco.com

C. No substitutions will be permitted that will compromise the terms of the Owner's warranty and maintenance agreements.

2.02 TEMPORARY ROOFING MATERIALS

A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).
B. Base Sheet: ASTM D4601, HPR Glasbase type II asphalt-coated, glass-fiber sheet.
C. Glass-Fiber Felts: ASTM D2178, HPR Glasfelt type IV, asphalt-impregnated, glass-fiber felt.
D. Asphalt Primer: Garla Prime WB.
E. Flashing Adhesive: Flashing Bond.
F. Sealant: Green Lock Structural Adhesive.
G. Sheet metal for gutters and down spouts: Garland 22 ga Kynar 30 year warranty

2.03 MAINTENANCE MATERIALS

A. Base flashing ply:
B. Base Flashing Ply: One (1) layer HPR Torch base sheet of torch applied base sheet covered by an additional layer of torch-applied modified membrane.

C. Modified Membrane: STRESSPLY IV MINERAL PLUS; 180 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing membrane reinforced with a fiberglass and polyester composite scrim. This membrane is designed for torch applications and has a burn-off backer that indicates when the material is hot enough to be installed.

2.04 BITUMINOUS MATERIALS

A. Asphalt Primer: Garla Prime WB V.O.C. compliant, ASTM D41.

B. Flashing adhesive: Flashing Bond

2.05 SHEET MATERIALS

A. Reinforcing Fabric:

B. Fiberglass mesh: Garmesh.
C. Polyester fabric. Grip Polyester soft.
D. Base Flashing Ply: HPR Torch Base SBS Torch Grade Base Sheet with woven fiberglass scrim reinforcement with the following minimum performance requirements according to ASTM D5147. Properties: (Finished Membrane):

E. Tensile Strength (ASTM D-5147)
F. 2 in/min. @ 73.4 ± 3.6°F MD 210 lbf/in CMD 210 lbf/in
G. 50 mm/min. @ 23 ± 3°C MD 36.7 kN/m CMD 36.7 kN/m
H. Tear Strength (ASTM D5147)
I. 2 in/min. @ 73.4 ± 3.6°F MD 250 lbf CMD 250 lbf
J. 50 mm/min. @ 23 ± 3°C MD 1112N CMD 1112N
K. Elongation at Maximum Tensile (ASTM D5147)
L. 2 in/min. @ 73.4 ± 3.6°F MD 4.0% CMD 4.0%
M. 50 mm/min. @ 23 ± 3°C MD 4.0% CMD 4.0%
N. Modified Flashing Ply:
O. STRESSPLY IV PLUS MINERAL

P. Modified Membrane Properties (Finished Membranes): STRESSPLY IV PLUS MINERAL; ASTM D6162, Type III Grade G

Q. Tensile Strength (ASTM D5147)
R. 2 in/min. @ 73.4 ± 3.6°F MD 310 lbf/in CMD 310 lbf/in
S. 50 mm/min. @ 23 ± 3°C MD 54.2 kN/m CMD 54.2 kN/m
T. Tear Strength (ASTM D5147)
U. 2 in/min. @ 73.4 ± 3.6°F MD 510 lbf CMD 510 lbf
V. 50 mm/min. @ 23 ± 3°C MD 2269 N CMD 2269 N
W. Elongation at Maximum Tensile (ASTM D5147)
X. 2 in/min. @ 73.4 ± 3.6°F MD 6.0% CMD 6.0%
Y. 50 mm/min. @ 23 ± 3°C MD 6.0% CMD 6.0%
Z. Low Temperature Flexibility (ASTM D5147): Passes -40°F (-40°C)

2.06 SURFACING

A. Cool Sil HB White Roof Coating:

B. Tensile 2300-2600 psi
C. Reflectance SRI 112
D. Mineral Surfaced Membranes - Roofing Granules shall meet requirements of ASTM D451 and/or be recommended by the membrane manufacturer. Loose granules for bleed out shall match size and color of granulated membrane sheet.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrate surfaces and conditions under which roofing maintenance will be performed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to Roofing System Manufacturer and Maintenance Contractor.

3.02 DOCUMENTING EXISTING CONDITIONS

A. Document existing conditions with high-resolution photographic equipment and provide supplemental written reports for the Owner's records.

3.03 SAMPLING AND TESTING

A. Prepare samples, such as core cuts, and deliver to a qualified testing agency for evaluation.
B. Samples shall be of adequate size to perform testing procedures. Confer with the Owner's testing agency to assure adequate sampling.
C. Place samples in containers approved by the Roofing System Manufacturer and ship in a manner that preserves their condition.

3.04 MAINTENANCE MEETING

A. Prior to executing maintenance procedures, meet with the Owner and/or Owner's Facility Manager to review maintenance records, field reports, photographs, and certified test reports, and detailed proposals describing the extent of maintenance procedures and repairs required.
B. Do not proceed with maintenance procedures and repairs without the approval of the Owner and/or Owner's Facility Manager

3.05 MAINTENANCE REQUIREMENTS, GENERAL

A. Cooperate with manufacturer, inspection and test agencies engaged or required to perform services in connection with the Owner's roofing maintenance programs.
B. Insurance/Code Compliance: Comply with governing regulations and the Owner's insurance requirements.
C. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Replace or restore surfaces damaged during maintenance.
D. Apply roofing materials as specified herein unless recommended otherwise by manufacturer's instructions. Keep roofing materials dry before and during application.

3.06 ROOFING MAINTENANCE PROCEDURES

A. Patch Obsolete Roof Opening:

1. Install insulation and cover board to height of existing roof field
2. Install HPR Torch Base at affected area extending 6” into field of existing roof field surface
3. Install StressPly IV Plus Mineral at affected area extending 9” into field of existing roof field surface.
4. Spud back gravel on existing surfacing extending 9” surrounding new patch area
5. Apply three-course of GarMesh reinforcement and Cool-Sil mastic at perimeter of new patch area
6. Apply Cool-Sil HB White at patch area and extending 9” into existing roof field

B. Flash Exhaust Vent Curb:

1. Install flashing ply extending 6” into field of existing roof field surface. Flashing ply to run up and over top edge of new curb

2. Install finished cap sheet ply extending 6” into field of existing roof field surface. Flashing ply to run up and over top edge of new curb and be backnailed vertically 8” OC
3. The entire sheet of flashing membrane must be solidly adhered to the substrate.
4. Counter flashing, cap flashings, expansion joints, and similar work to be coordinated with roofing work are specified in other sections.
5. Roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices to be coordinated with the roofing system are in other sections.
6. Apply Cool-Sil HB White at new patch area and extending 9” into existing roof field

3.07 SURFACING

A. Cool Sil Roof Coating: installed at a rate of one (3) gallon per square per coat. This shall be a one coat pass. Broadcast Title 24 compliant white minerals at 50 lbs per square.

3.08 CLEANING

A. Remove bitumen adhesive drippings from all walls, windows, floors, ladders and finished surfaces.
B. In areas where finished surfaces are soiled by work of this Section, comply with the cleaning instructions of the manufacturer of surfaces.
C. Repair or replace defaced or disfigured finishes caused by work of this section.

3.09 CONSTRUCTION WASTE MANAGEMENT

A. Remove and properly dispose of waste products generated during maintenance procedures. Comply with requirements of authorities having jurisdiction

3.10 FINAL INSPECTION

A. Upon completion of roofing maintenance work, meet with Installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.
B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.
C. At the manufacturer's discretion a thermographic scan of the roof during final inspection may be performed to determine the presence of damp or wet materials installed. The thermographic scan shall be provided at a price negotiated between the Contractor and the Owner and paid for by the Owner by means of a change order.
D. If core cuts verify the presence of damp or wet materials, the Contractor shall be required to replace the damaged areas at his own expense.
E. Repair or replace (as required) deteriorated or defective work discovered at time of inspection to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
F. The Contractor shall notify the Owner upon completion of corrections.
G. Following the final inspection, acceptance will be made in writing by the material manufacturer.

3.11 FINAL DOCUMENTATION AND REPORTING

A. Submit final documentation of procedures and recommendations to the Owner for record.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Other sealants as needed.

1.2 GENERAL

A. Regardless indicated on the contract drawings or not, it is the contractor's responsibility to provide joint sealants and/or caulking at locations required by the project inspector, architect and various industry standards.

B. All joint assemblies (sealants) provided for this project shall be water resistant.
C. Contractor shall provide sealant for all application of the project from one manufacturer.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product that will be used in the project. It is the contractor's responsibility to review the contractor document carefully and submit a schedule of sealants (also list the locations being used) that will be used on the project. It is also the contractor's responsibility to verify the compatibility of each product with different materials.
B. Samples: For each kind and color of joint sealant required.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

B. Preinstallation Conference: Conduct conference at Project site.

C. All products shall comply with all California codes, laws and regulations.

1.6 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish 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: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system 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. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Stain-Test-Response Characteristics: Sealant shall be be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Weatherproofing: Provide weatherproofing sealant as needed at damp or wet locations.

F. Sealant Primer: Provide primer as required per manufacturer’s requirements.

2.2 SILICONE JOINT SEALANTS

A. Mildew-Resistant Silicone Joint Sealant : ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. BASF Building Systems.
    b. Dow Corning Corporation.
    c. GE Advanced Materials - Silicones.
    d. May National Associates, Inc.
    e. Pecora Corporation.
    f. Polymeric Systems, Inc.
    g. Schnee-Morehead, Inc.
    h. Sika Corporation; Construction Products Division.
    i. Tremco Incorporated.

2. Type: Single component (S) or multicomponent (M).
3. Grade: Pourable (P) or nonsag (NS).
4. Class: 100/50.
5. Uses Related to Exposure: Traffic (T) or Nontraffic (NT).

2.3 URETHANE JOINT SEALANTS

A. Urethane Joint Sealant : ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. BASF Building Systems.
    b. Bostik, Inc.
    c. Lymtal, International, Inc.
    d. May National Associates, Inc.
    e. Pacific Polymers International, Inc.
    f. Pecora Corporation.
    g. Polymeric Systems, Inc.
    h. Schnee-Morehead, Inc.
    i. Sika Corporation; Construction Products Division.
    j. Tremco Incorporated.

2. Type: Single component (S).
3. Grade: nonsag (NS).
4. Class: 100/50.
5. Uses Related to Exposure: Nontraffic (NT).

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant : Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following 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. BASF Building Systems.
b. Bostik, Inc.
c. May National Associates, Inc.
d. Pecora Corporation.
e. Schnee-Morehead, Inc.
f. Tremco Incorporated.

2.5 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.6 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.
C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate 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 by joint-sealant manufacturer or as indicated by 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 or primer 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.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Comply with manufacturer’s installation procedures.

C. Install sealant backings of kind 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.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. 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.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs 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 profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

G. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.

H. 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.

3.3 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Tile control and expansion joints.
   c. Joints between different materials listed above.
   d. Other joints as indicated.

2. Joint Sealant: Silicone or Urethane
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Construction joints in cast-in-place concrete.
   b. Joints between plant-precast architectural concrete units.
   c. Control and expansion joints in unit masonry.
   d. Joints in dimension stone cladding.
   e. Joints in exterior insulation and finish systems.
   f. Joints between metal panels.
   g. Joints between different materials listed above.
   h. Perimeter joints between materials listed above and frames of doors windows and louvers.
   i. Control and expansion joints in ceilings and other overhead surfaces.
   j. Other joints as indicated.

2. Joint Sealant: Silicone or Urethane
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Control and expansion joints on exposed interior surfaces of exterior walls.

b. Perimeter joints of exterior openings where indicated.
c. Tile control and expansion joints.
d. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
e. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
f. Other joints as indicated.

2. Joint Sealant: Latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated.

2. Joint Sealant: Silicone.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.2 REFERENCES

1. Comply with the latest SDI (Steel Door Institute), ANSI and ASTM standards.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and framing anchor details.
C. Samples for Initial Selection: For units with factory-applied color finishes.
D. Samples for Verification: For each type of exposed finish required.
E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 WARRANTY AND QUALITY CONTROL

A. Provide 5 year extended warranty for all doors and frames
B. Doors and frames shall be shop primed a maximum of 30 days prior to field installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Steelcraft

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 HOLLOW-METAL DOORS AND FRAMES

A. Extra Heavy-Duty Doors and Frames: SDI A250.8, Level 3.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Faces: Metallic-coated steel sheet, minimum thickness of 16GA with minimum A60 coating.
    d. Edge Construction: Model 2, Seamless.
    e. Core: Steel Stiffened
    f. Finish: Factory primed and field painted

3. Frames:

    a. Materials: Metallic-coated steel sheet, minimum thickness of 16ga with minimum A60 coating.
    b. Construction: Fully continuously welded.

4. Finish: Factory primed and field painted.

2.4 FRAME ANCHORS

A. General: Comply with SDI requirements.
B. 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. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. 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.

C. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, 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.

2.5 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
G. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

2.6 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 metal thickness. 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. Hollow-Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.

C. 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. Sidelight and Transom Bar 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.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. 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 one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

    b. Compression Type: Not less than two anchors in each frame.
    c. 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.

6. Door Silencers: Provide Silencers at both exterior and interior frames.
    a. Except on weather-stripped frames, drill stops to receive door silencers.
        1) Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
        2) Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with 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 glazing and installation types indicated.

2.7 STEEL FINISHES

A. Factory Finish: Factory primed and field painted.

2.8 ACCESSORIES

A. Louvers: Provide sightproof louvers for new doors, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame. Factory primed and field painted
B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

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-rated openings, install frames according to 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 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 plumb, square, 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 will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. 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.
7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
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.

B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

    a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch. Coordinate with door hardware manufacturer for doors to receive door shoes / sweeps
    d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

3.2 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 Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 092216
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Show Drawings:
1. Provide floor and ceiling plans to show the area of work.
2. Provide applicable details.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
B. 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.
C. Division of the State Architects (DSA) requirements: Provide products and installations in compliance with DSA requirements.

2.2 FRAMING SYSTEMS

A. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.

1. Minimum Base-Metal Thickness: 16GA min or as indicated on Drawings, whichever is thicker.
2. Depth: As indicated on Drawings**.**

B. Slip-Type Head Joints: Where indicated, provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:

1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
        2) MBA Building Supplies; Slotted Deflecto Track.
        3) Steel Network Inc. The VertiTrack VTD Series.
        4) Telling Industries; Vertical Slip Track.

C. Firestop Tracks: Manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
    b. Metal-Lite, Inc.; The System.
    c. Steel Network Inc. The VertiTrack VTD Series.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.033 inch.

E. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.033 inch.
2. Depth: 7/8 inch.

G. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: hat shaped.

2.3 AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
C. Install bracing at terminations in assemblies.
D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
C. Install studs so flanges within framing system point in same direction.
D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:

1. Screw to framing members.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Furring Members:

1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 09 24 00

PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Supply and Installation of LaHabra FastWall® 100 Stucco Assemblies

1.2 REFERENCES

A. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar

B. ASTM C578 - Specification for Preformed, Cellular Polystyrene Thermal Insulation

C. ASTM C847 - Standard Specification for Metal Lath

D. ASTM C897 - Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plaster

E. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster

F. ASTM C933 - Standard Specification for Welded Wire Lath

G. ASTM C1032 - Standard Specification for Woven Wire Plaster Base

H. ASTM C1063 - Standard Specification for Installation of Lathing and Furring for Portland Cement Based Plaster

I. ASTM C1177 - Specification for Glass Mat Gypsum for Use as Sheathing

J. ASTM C1278 - Specification for Fiber-Reinforced Gypsum Panel

K. ASTM C1396 - Standard Specification for Gypsum Board

L. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials

M. ASTM E119 - Method for Fire Tests of Building Construction and Materials

N. ASTM E330 - Test Method for Structural Performance of Windows, Curtain Walls, and Doors by Uniform Static air Pressure Difference

O. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

P. ICC Acceptance Criteria 219 - Acceptance Criteria for Exterior Insulation And Finish Systems

Q. ICC Acceptance Criteria 11 - Acceptance Criteria for Cementitious Exterior Wall Coatings

1.1 ASSEMBLY DESCRIPTION

A. LaHabra FastWall 100 Krak-Shield™ Stucco Assembly: A code complying water resistive barrier, metal lath, Fastwall Stucco Base (Fastwall Stucco Base Concentrate or Fastwall Stucco Base Sanded), Parex USA reinforcing mesh embedded in Parex USA Stucco Level Coat, and an acrylic or elastomeric based finish coat.

1.2 SUBMITTALS

A. General: Submit Samples, Evaluation Reports and manufacturers product datasheets in accordance with Division 1 General Requirements Submittal Section.

B. Samples: Submit samples for approval. Samples shall be of materials specified and of suitable size as required to accurately represent each color and texture used on project. Prepare each sample using same tools and techniques for actual project application. Maintain and make available, at job site, approved samples.

C. Manufacturer's Warranty: Submit sample copies of Manufacturer's Warranty indicating Single Source Responsibility for Water Stucco Base coat, finish coat and optional Primer, level coat and reinforcing mesh as specified.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have marketed stucco assemblies in United States for at least five years and shall have completed projects of same general scope and complexity.

2. Applicator: Shall be experienced and competent in installation of stucco materials, and shall provide evidence of a minimum of 5 years experience in work similar to that required by this section.

B. LaHabra FastWall 100 Stucco Functional Criteria:

1. General: Stucco application shall be to vertical substrates or to substrates sloped for positive drainage. Substrates sloped for drainage shall have additional protection from weather exposure that might be harmful to coating performance.
2. Testing to meet International Code Council Acceptance Criteria AC11
3. Performance Requirements

Fastwall	**Method**	**ICC AC 11 Criteria**	**Results**
Accelerated Weathering	ASTM G153	2000 Hours	No deleterious effect
Freeze-Thaw Resistance	ICC AC 11	10 cycles	Pass
Transverse Wind Load Resistance	ASTM E330	Meet Design Loads	Refer to ICC-ES ESR-2564
Fire Resistance	ASTM E119	One hour fire	Refer to ICC-ES ESR-2564
Drainage	ICC AC 11	90%	Refer to ICC-ES ESR-2564
Acrylic Finish	**Method**	**ICC or ASTM Criteria**	**Results**
Accelerated Weathering	ASTM G153 (ASTM G 23) ASTM G154	No deleterious effects at 2000 hours when viewed under 5x magnification	2000 Hours: no deleterious effect
Freeze/Thaw Resistance	ASTM E2485	No deleterious effects at 10 cycles when viewed under 5x magnification	60 cycles: no deleterious effect
Fungus Resistance	MIL STD 810B	No Requirement	28 days: no growth
Mildew Resistance	ASTM D3273	No growth supported during 28 day exposure period	Pass
Moisture Resistance	ASTM D2247	No deleterious effects at 14 day exposure	Pass
Salt Fog Resistance	ASTM B117	No deleterious effects at 300 hours	500 hours: no deterioration

C. Substrate Conditions:

1. Substrate materials and construction shall conform to the building code having jurisdiction.
2. Substrates shall be sound, dry and free of dust, dirt, laitance, efflorescence and other harmful contaminants.
3. Substrate Dimensional Tolerances: Flat with ¼ in (6.4 mm) within any 4 ft (1.22 m) radius.
4. Maximum deflection of substrate system under positive or negative design loads shall not exceed L/360 of span.

D. Expansion and Control Joints: Continuous expansion and control joints shall be installed at locations in accordance with ASTM C1063 and ASTM C926.

1. Substrate movement, and expansion and contraction of LaHabra FastWall 100 Stucco and adjacent materials shall be taken into account in design of expansion joints, with proper consideration given to sealant properties, installation conditions, temperature range, coefficients of expansion of materials, joint width to depth ratios, and other material factors. Minimum width of expansion joints shall be as specified by the designer or shown on the project drawings.
2. In accordance with ASTM C1063, expansion or control joints shall be installed in walls not more than 144 ft² (13.4 m²) in area, and not more than 100 ft² (9.3 m²) in area for all non-vertical applications. The distance between joints shall not exceed 18 ft (5.5 m) in either direction or a length-to-width ratio of 2-½ to 1.
3. For direct appliaction to concrete or masonry, stucco joints are requried only at control/expansion joints in the underlaying concrete or masonry.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver LaHabra FastWall 100 Stucco Assembly products in original packaging with manufacturer's identification.

B. Storage: Store LaHabra FastWall 100 Stucco Assembly products in a dry location, out of direct sunlight, off the ground, and protected from moisture.

1.5 SITE / ENVIRONMENTAL CONDITIONS

A. Substrate Temperature: Do not apply LaHabra products to substrates whose temperature are below 40°F (4.4°C) or contain frost or ice.

B. Inclement Weather: Do not apply LaHabra products during inclement weather, unless appropriate protection is employed.

C. Sunlight Exposure: Avoid, when possible, installation of the LaHabra products in direct sunlight. Application of LaHabra Finishes in direct sunlight in hot weather may adversely affect aesthetics.

D. Do not apply stucco base coats or finishes if ambient temperature falls below 40ºF (4ºC) within 24 hours of application. Protect stucco from uneven and excessive evaporation during dry weather and strong blasts of dry air.

E. Prior to installation, the wall shall be inspected for surface contamination, or other conditions that may adversely affect the performance of the LaHabra Fastwall 100 Stucco Assembly, and shall be free of residual moisture.

1.6 COORDINATION AND SCHEDULING:

A. Coordination: Coordinate LaHabra Fastwall 100 Stucco Assembly installation with other construction operations.

1.7 WARRANTY

A. Warranty: Upon request, at completion of installation, provide Standard Limited LaHabra Fastwall 100 Stucco Assembly Warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Parex USA, Inc., 4125 E. La Palma Ave., Suite 250, Anaheim, CA 92807

B. Components: Obtain components manufactured by Parex USA of LaHabra Fastwall 100 Stucco Assembly from authorized distributors. No substitutions or additions of other materials are permitted without prior written permission from Parex USA for this project.

2.2 MATERIALS

A. LaHabra Fastwall 100 Stucco Assembly Materials:

1. LaHabra Fastwall 100 Stucco Base (⅜ in – ½ in)

a. LaHabra Fastwall Stucco Base Sanded: Proprietary mixture of portland cement, and proprietary ingredients mixed with clean, cool, potable water in the field.

B. LaHabra Acryic Bonder & Admix: 100% acrylic admix emulsion for portland cement based products, to enhance curing, adhesion, freeze-thaw resistance and workability.

C. Leveling and Reinforcing Coat (Required for LaHabra Fastwall 100 Krak-Shield Stucco Assembly):

1. Parex USA Stucco Level Coat™: Copolymer based, factory blend of cement and proprietary ingredients requiring addition of water.

2. Parex USA 355 Standard Mesh: Weight 4.5 oz/yd^2 (153 g/m^2) reinforcing mesh.

D. LaHabra Perma-Primer: 100% acrylic based coating to prepare surfaces for LaHabra finishes.

E. LaHabra Finish:

1. Perma-Elastic Elastomeric Finish: Factory blended, 100 % acrylic polymer based elastomeric textured finish, integrally colored.

a. Finish texture and color to match existing adjacent.

2.3 RELATED MATERIALS AND ACCESSORIES

A. General: LaHabra Fastwall 100 Stucco Assembly and its related materials shall conform to the requirements of ICC-ES Evaluation Report No. 2564 and shall conform to this specification.

B. Substrate Materials:

1. Gypsum Sheathing: Minimum ½ in (13 mm) thick, core-treated, weather-resistant, exterior gypsum sheathing complying with ASTM C79 or ASTM C1177.
2. Other Approved by Parex USA in writing prior to the project

C. Water Resistive Barriers:

1. For non-wood based sheathing shall be either:
   a. 1 layer asphalt-saturated felt complying with ASTM D 226 Type I.
   b. Lath with appropriate paper backing
   c. Other recognized equivalent
2. For wood based sheathing shall be either:
   a. 2 layers of Grade D asphalt saturated Kraft building paper, or 1 layer of the Kraft building paper plus paper backed lath
   b. Grade D paper with a water resistance equal to or greater than 60 minutes, with an intervening nonwater-absorbing layer or drainage space.
   c. Other recognized equivalent

D. Lath and Accessories: Conform to ASTM C847, ASTM C933, ASTM C1032, ASTM C1063 and Appendix

1. Accessories: Manufacturer's standard steel products with minimum G60 galvanizing unless otherwise indicated as rigid polyvinyl chloride (PVC plastic) or zinc alloy
2. Metal Plaster Bases: Minimum 17 gauge self-furred stucco netting, minimum 3.4 lb/yd^2 (1.8 kg/m^2) expanded metal diamond lath, or welded wire lath in accordance with applicable codes and standards.
3. Provide J molds with weep holes by Fry Reglet.

E. Expanded Polystyrene Features over LaHabra Fastwall 100 Stucco

1. Adhesive and Base Coat
   a. LaHabra Polybond: Modified portland cement adhesive and basecoat for exterior foam shapes, such as pop-outs, plant-ons, cornices and reveals mixed with water.
2. Reinforcing Mesh
   a. Parex USA Standard Mesh: Weight 4.5 oz/yd^2 (153 g/m^2) reinforcing mesh.

F. Seals, Sealants and Bond Breakers: Sealants shall conform to ASTM C920, Grade NS, Class 25, Use NT. Backer rod shall be closed-cell polyethylene foam.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify project site conditions under provisions of Section 01 00 00.

B. Compliance: Comply with manufacturer's instructions for installation of LaHabra Fastwall 100 Stucco Assembly products.

C. Substrate Examination: Examine prior to LaHabra Fastwall Stucco Base installation as follows:

1. Substrate shall be of a type approved by Parex USA.
2. Substrate shall be examined for soundness, and other harmful conditions.
3. Substrate shall be free of dust, dirt, laitance, efflorescence, and other harmful contaminants.
4. Substrate construction in accordance with substrate material manufacturer's specifications and applicable building codes.

D. Advise Contractor of discrepancies preventing installation of the LaHabra Fastwall 100 Stucco Assembly. Do not proceed with the LaHabra Fastwall 100 Stucco Assembly work until unsatisfactory conditions are corrected.

E. Ensure that flashing has been installed per Specification Section 07 60 00 - Flashing and Sheet Metal.

3.2 PREPARATION

A. Water Resistive Barrier:

1. The Water Resistive Barrier shall be placed over all substrates except concrete or unpainted masonry. Painted (coated) CMU is to use a bond breaker such as asphalt paper and lath if the paint or coating cannot be removed.
2. Installed according to manufacturers instructions.

B. Wire Fabric Lath and Metal Lath: Install according to ICC Evaluation Report ESR 2564, ASTM C1063 and Appendix and the Building Code.

C. Concrete (Cast-in-Place): Provide a surface that is slightly scarified, water absorbent, straight and true to line and plane. Remove form ties and trim projecting concrete so it is even with the plane of the wall. Remove form release agents.

3.3 MIXING

A. Mix LaHabra proprietary products in accordance with manufacturer's instructions, including the applicable LaHabra Fastwall 100 Stucco Assembly Product Data Sheets.

B. Admix - LaHabra Acrylic Bonder & Admix

Mix up to 1 gal (3.8 L) per 1 bag of LaHabra Fastwall Stucco Concentrate. Mix up to 1 qt (1 L) per bag of LaHabra Fastwall Sanded. Add after dry components and the majority of the water has been mixed. Mix no longer than required to provide a uniform mixture. DO NOT OVER-MIX. Overmixing entrains excessive amounts of air which weaken the material. Do not re-temper mixes over 20 minutes old.

3.4 APPLICATION

A. General: LaHabra Fastwall 100 Stucco Assembly and its related materials shall conform to the requirements of ICC-ES Evaluation Report No. 2564 and shall conform to this specification.

B. Bonding Agent - LaHabra Acrylic Bonder & Admix

1. Apply at an approximate rate of 250 ft^2 per gallon using a low-pressure sprayer, brush or roller. (application in direct sunlight may cause the product to dry too quickly)

C. LaHabra Fastwall Stucco Base:

1. Either LaHabra Fastwall Stucco mixtures shall be applied in one or two coats to a minimum thickness of ⅜ in (9.5 mm) by hand troweling or machine spraying the mixture to the wire lath in accordance with LaHabra Fastwall Stucco Product Data Sheets. The maximum thickness applied in one pass is ½ in (12.7 mm).
2. Rod surface to true plane and float to densify.
3. Trowel to smooth and uniform surface to receive acrylic polymer finish coat.

D. Leveling and Reinforcing Coat (LaHabra Fastwall 100 Krak-Shield Stucco Assembly):

1. After Moist Curing, allow LaHabra Fastwall Stucco Base to air dry a minimum of 24 hours before applying the leveling and reinforcing coat.
2. Using a stainless steel trowel, apply the LaHabra Stucco Level Coat over the LaHabra Fastwall Stucco Base at a thickness of $^{1}/_{16}$ – $^{3}/_{32}$ in. (1.6 – 2.4 mm).
3. Fully embed the Parex USA Standard Mesh into the wet Stucco Level Coat including diagonal strips at corners of openings and trowel smooth. If Standard Mesh is used, seams are overlapped 2½ in (63 mm).
4. The LaHabra acrylic primer and finishes can be applied as soon as the LaHabra Stucco Level Coat has cured, typically within 24 hours.

E. Expanded Polystyrene Featured over LaHabra Fastwall Stucco Base:

1. Install back-wrap mesh at EPS terminations.
2. Apply LaHabra adhesive to backs of insulation boards with a notched trowel. Allow to dry a minimum of 12 hours.
3. Apply LaHabra Base coat to the entire foam shape and pull the backwrap mesh around the foam shapes and fully embed it into the base coat.
4. Immediately embed the reinforcing mesh in the wet LaHabra Base coat.

F. LaHabra Primer and Finish:

1. Remove surface contaminants such as dust or dirt without damaging the substrate.
2. Ambient and surface temperature must be 40°F (4°C) or higher during application and drying time. Supplemental heat and protection from precipitation must be provided as needed.
3. Use only on surfaces that are sound, clean, dry, unpainted, and free from any residue that might affect the ability of the finish to bond to the surface.
4. LaHabra FastWall 100 Krak-Shield Stucco Assembly
    a. Before the application of the finish, the base coat must have cured a minimum of 24 hours or longer as required by weather conditions. Examine the cured base coat for any irregularities.
    b. Correct these irregularities to produce a flat surface.
5. Protect LaHabra Finish Coats from inclement weather until completely dry.

G. Curing:

1. LaHabra Fastwall Stucco Base: Keep stucco moist for at least 48 hours (longer in dry weather) by lightly fogging walls. Start light fogging after initial set of 1–2 hours.
2. Air dry acrylic based and elastomeric finish coats only, do not wet cure.

3.5 CLEAN-UP

A. Removal: Remove and legally dispose of LaHabra Fastwall 100 Stucco component debris material from job site.

3.6 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind them.

B. Provide protection of installed stucco from dust, dirt, precipitation, and freezing during installation.

C. Provide protection of installed finish from dust, dirt, precipitation, freezing, and continuous high humidity until fully dry.

D. Clean exposed surfaces using materials and methods recommended by the manufacturer of the material or product being cleaned. Remove and replace work that cannot be cleaned to the satisfaction of the Designer/Owner.

END OF SECTION

SECTION 09 29 00
GYPSUM BOARD

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Type X mold- and moisture-resistant gypsum board.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
   2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   3. ASTM C630 Standard Specification for Water-Resistant Gypsum Backing Board.
   4. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board.
   5. ASTM C1396 Standard Specification for Gypsum Board.
   6. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
   7. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Gypsum Association (GA):
   1. GA-214 Recommended Levels of Gypsum Board Finish.
   2. GA-216 Application and Finishing of Gypsum Panel Products.
   3. GA-801 Handling and Storage of Gypsum Panel Products: A Guide for Distributors, Retailers, and Contractors.

1.03 SUBMITTALS

A. Product Data: Manufacturer’s specifications and installation instructions for each product specified.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Provide products that comply with the following limits for surface burning characteristics when tested per ASTM E84:
   1. Flame spread: 15.
   2. Smoke developed: 0.

1.05 DELIVERY, STORAGE & HANDLING

A. Comply with manufacturer’s instructions, GA-216 and GA-801. Stack product flat on a level surface. As individual sheets are removed for installation, raise products carefully on edge and carry in a vertical position. Take care to avoid impact, undue flexing and damage to edges, ends and corners.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Georgia-Pacific Gypsum LLC

1. Fire-Rated Mold- and Moisture-Resistant Gypsum Board: ToughRock Fireguard Mold-Guard.

2.02 MATERIALS

A. 5/8 Inch Type X Fire-Rated Mold- and Moisture-Resistant Gypsum Board:
   1. Thickness: 5/8 inch.
   2. Width: 4 feet.
   3. Length: 8 feet.
   4. Weight: 2.23 pounds per square foot.
   5. Edges: Tapered.
   6. Surfacing: 100% recycled paper coverings on face, back and long edges; green color on face.
   7. Flexural Strength, Parallel (ASTM C473): Not less than 46 lbf.
   8. Flexural Strength, Perpendicular (ASTM C473): Not less than 147 lbf.
   9. R-Value (ASTM C518): Not less than 0.56.
   10. Nail Pull Resistance (ASTM C473): Not less than 87 lbf.
   11. Humidified Deflection (ASTM C473): Not more than 5/8 inch.
   12. Hardness, Core, Edges, and Ends (ASTM C473, ASTM C1396): Not less than 15.
   13. Water Absorption (ASTM C630, ASTM C1396): Less than 5 percent of weight.
   14. Mold Resistance (ASTM D3273): 10, in a test as manufactured.
   15. Acceptable Products:
      a. 5/8 Inch ToughRock Fireguard Mold-Guard, Georgia-Pacific Gypsum.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: In accordance with GA-216 or ASTM C840, and the manufacturer's recommendations.

   1. Manufacturer's Recommendations:
      a. Current "Submittal Sheet", Georgia-Pacific Gypsum.

3.02 FINISHING

A. Comply with GA-214 and GA-216, and the manufacturer's recommendations.

3.03 PROTECTION

A. Protect gypsum board installations from damage and deterioration until the date of Substantial Completion.

END OF SECTION

SECTION 095113
ACOUSTICAL CEILING PANELS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

1. Provide new acoustical ceiling panels at existing T bar ceiling grid.

1.03 SUBMITTALS

A. 6"x6" (min.) samples of each tile type, pattern, and color required.
B. Product data.
C. Warranty Documents

1.04 DELIVERY, STORAGE AND HANDLING OF MATERIALS

A. All materials shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements.
B. Storage:
    1. Panels: Storage time of materials at the job site should be as short as possible, and environmental conditions should be as near as possible to those specified for occupancy (see no. 1.05 below). Excess humidity during storage can cause expansion of material and possible warp, sag, or poor fit after installation. Chemical changes in the mat and/or coatings can be aggravated by excess humidity and cause discoloration during storage, even in unopened cartons. Cartons should be removed from pallets and stringers to prevent distortion of material. Long-term (6- 12 months) storage under uncontrolled environmental conditions should be avoided.
C. Handling: Handle in such manner to ensure against racking, distortion, or physical damage of any kind.
D. Damaged or deteriorated materials should be removed from the premises. Immediately before installation, to stabilize tile and panels, store them at a location where temperature and humidity conditions duplicate those ambient during installation and anticipated for occupancy.

1.05 ENVIRONMENTAL CONDITIONS

A. Installation of acoustical panels shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete, or terrazzo work has dissipated.
B. Do not use ceiling panels in extreme or continuous high humidity, or areas exposed directly to weather or water. Ceiling panels are sized and designed for use within the standard occupancy range of temperature and humidity, 65-85 °F (18-29 °C), no more than 70% RH (relative humidity). Humidity can greatly affect product dimensional stability and sag resistance. Sag can become noticeable during periods of high humidity lasting only a few hours. CLIMAPLUS

ceilings if used with DONN® Brand Suspension Systems, can withstand temperatures from 60-104 °F (32-40 °C) and relative humidity up to 95%-100% RH. See USG Interiors Inc. for specific warranty information.

C. Allow time for dimensional changes in ceiling panels stored at temperature/humidity conditions well outside of those recommended for service. With increases in temperature/humidity, these products expand (up to 1/64 in./ft. (4.3 mm/m) at 85 °F (29 °C)/90% RH) and may not fit into a fixed grid. Conversely, with decreases, these products will be undersize, but expand to normal when standard ambient conditions return.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility: To obtain combined warranty for the Donn Brand suspension system and the acoustical panel, color match or ceiling panel and suspension system compatibility, all acoustical panel and suspension system components shall be produced and supplied by one manufacturer. Materials supplied by more than one manufacturer are not acceptable.

B. Subcontractor qualifications: Installer shall have successful experience in the installation of suspended ceiling systems on projects with requirements similar to requirements specified.

C. Source quality control:
    1. Test reports: Manufacturer will provide test certification for minimum requirements as tested in accordance with applicable industry standards and/or to meet performance standards specified by various agencies.
    2. Changes from system: System performance following any substitution of materials or change in assembly design must be certified by the manufacturer.
    3. All ceiling panel cartons must contain UL label for acoustical compliance.

1.07 PROJECT CONDITIONS

A. Environmental requirements for interior installation: Building shall be enclosed with windows and exterior doors in place and glazed, and roof watertight before installation of ceiling system and related ceiling components.

B. Coordination with other work:
    1. General: Coordinate with other work supported by or penetrating through the ceiling, including mechanical and electrical work and partition systems.
    2. Mechanical work: Ductwork above ceiling shall be complete, and permanent heating and cooling systems operating to climate conditions prior to installation of ceiling components.
    3. Electrical work: Installation of conduit above ceiling shall be complete before installation of ceiling components.

C. Protection:
    1. Personnel: Follow good safety and industrial hygiene practices during handling and installing of all products and systems, with personnel to take necessary precautions and wear appropriate personal protective equipment as needed. Read material safety data sheets and related literature for important information on products before installation.

Contractor to be solely responsible for all personal safety issues during and subsequent to installation; architect, specifier, owner, and manufacturer will rely on contractor's performance in such regard.

2. Protect completed work above ceiling system from damage during installation of ceiling components.

1.08 ALTERNATE CONSTRUCTION WASTE DISPOSAL

Recycle:

1. Separate clean dry ceiling tile pieces from contaminants for landfilling or reuse.
2. Working with the local manufacturer representative and the local waste hauler provide packaged and secure products for pick up.
3. Allowed panels and Conditions: Check with manufacturer for acceptance.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Suspended Acoustical Ceiling System:
    1. Acoustical Ceiling Panel
        a. Armstrong School Zone Fine Fissured AirAssure Square Lay-in panel
        b. Size: 24"x48"
        c. Extra Material: Provide a min. of 10% of ceiling tiles to the District at project closeout as extra materials.
    2. Metal Suspension System: Existing

PART 3 - EXECUTION

3.01 General

A. Comply with Standard for Ceiling Suspension System Installations: Comply with ASTM C636.
B. Comply with Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
C. Comply with manufacturer's installation requirements.
D. Comply with California Building Code requirements.
E. Comply with Division of the State Architects requirements.
F. Comply with CISCA Ceilings Systems Handbook.
G. Comply with NFPA 70 – 2008 National Electrical Code (NEC) Section 410-36.

3.02 Inspection

A. Examine areas to receive ceiling panels for conditions that will adversely affect installation. Provide written report of discrepancies.
B. Do not start work until unsatisfactory conditions are corrected.

C. Work to be concealed: Verify work above ceiling is complete and installed in manner that will not affect layout and installation of ceiling panels.
D. Beginning of installation shall signify acceptance of conditions in areas to receive ceiling panels.

3.03 Preparation

A. Field dimensions: Installer must verify actual field dimensions prior to installation.
B. Renovation work: Installing contractor shall verify that existing ceiling structure is adequate to support additional Compasso ceiling suspension requirement.
C. Coordination: Coordinate and schedule installation of ceiling system with work of other trades affected by this installation, with particular attention given to mechanical and electrical work required to be installed and operating before ceiling work can begin.

3.04 Installation

A. Standard reference: Install ceiling panels and suspension system, including necessary hangers, grillage, splines, and other supporting hardware, in accordance with ASTM C636, CISCA Ceiling Systems Handbook, (UL Design) and any applicable code requirement.
B. Manufacturer's Reference: Install ceiling panels in exposed grid systems, supported on all edges, in accordance with manufacturer’s warranty.
C. Drawing and DSA Reference: Install ceiling panels and suspension trim system according to procedure provided by manufacturer and DSA and in accordance with approved shop drawings.
D. Hanger Wires:
    1. Spacing: Space hanger wires on main tees not more than 48 inches o.c. a maximum of 48 inches o.c., attaching hangers directly to the structure above, or as required to support loads.
    2. Limitations: Do not support wires from mechanical and/or electrical equipment, piping or other equipment occurring above ceiling.
E. Accessories: Install accessories as applicable to meet project requirements.
F. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.
G. Install acoustical tiles in coordination with suspension system.
    1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
    2. Remove and replace any damaged tiles.
H. Lighting Fixtures:
    1. All light fixtures shall be mechanically attached to the suspension system in accordance with DSA IR 25-2 requirements
    2. Support of rigid lay-in (Type G) or can light fixtures:
        a. Each fixture less than 10 lbs. shall have a single wire (wire may be slack) attached from the fixture to structure.
        b. Each fixture that weighs between 10 and 56 lbs. shall have two wires (wires may be slack) attached at diagonal corners of the fixture to structure.

c. Each fixture greater than 56 lbs. shall be directly supported to structure by approved hangers.
d. Pendant light fixtures shall be directly supported from structure with 9-gauge wire (or approved alternative).

I. Air Terminals:
1. Air terminals less than 20 lbs. shall be positively attached to the suspension system
2. Air terminals that weigh between 20 and 56 lbs. shall be mechanically attached to the suspension system. Two slack wires shall be attached from the housing to structure.
3. Air terminals in excess of 56 lbs. shall be directly supported to structure by approved hangers

3.05 Field Quality Control

A. Deflection on installed system: Maximum deflection shall not exceed 1/360 of the span.

3.06 Cleaning

A. Suspension System: Remove panel material and perform any necessary cleaning maintenance with non-solvent based commercial cleaner
B. Immediately remove any corrosive substances or chemicals that would attack painted finishes (i.e. wallpaper adhesives)
C. Painting: painting of existing suspension member shall be with a high-quality solvent base enamel paint and applied as recommended by paint manufacturer. Provide a minimum of (1) coat of primer and (2) coats of finish coats.
D. Removal of debris: Remove all debris resulting from work of this section.

END OF SECTION

SECTION 096519
RESILIENT TILE FLOORING

PART 1 – GENERAL

1. SUBMITTALS
    a. Product Specification
    b. Specification for Adhesive
    c. Floor Layouts
    d. Samples
    e. Schedule
    f. Qualifications for Installer
2. CLOSEOUT SUBMITTALS
    a. Maintenance Instructions
    b. Warranty
3. QUALITY ASSURANCE
    a. Environmental:
        i. FloorScore® Certified
        ii. Environmental Product Declarations
        iii. Health Product Declaration
    b. Installer Qualifications: Installer who has been trained in the installation of resilient sheet flooring.
    c. Mockups: Install 100 sf of product at designated location for architect review and approval.
4. MATERIAL STORAGE AND HANDLING
    a. Store tiles on a flat surface and squarely on top of one another.
    b. Store away from vents and direct sunlight.
    c. When palletizing, first place a 5/8” or thicker plywood on the pallet. Stack 2 rows high side by side with no airspace between. Then quarter turn for 2 rows side by side. Do not exceed 12 boxes high. If you are stacking pallets, use a 1” thick plywood in between pallets.
    d. Store in protected dry conditions between 65 and 85 degrees.
5. SITE CONDITIONS
    a. The permanent HVAC system must be on for 7 days prior to, during and after installation between 65 and 85 degrees Fahrenheit or 18 to 29 degrees Celsius.
    b. Material and adhesive must be acclimated to the installation area for a minimum of 48 hours prior to installation.

PART 2 – PRODUCTS

6. TESTING REQUIREMENTS
    a. Slip Resistance ASTM D2047: ADA Compliant
    b. Static Load Limit ASTM F970: 1500 psi
    c. Residual Indentation F1914: passes, 8%

d. Flexibility ASTM F137: Passes
e. Resistance to Heat ASTM F1514: Passes
f. Resistance to Light ASTM F1515: Passes
g. Resistance to Chemicals ASTM F925: Passes
h. Radiant Flux ASTM E648: / 0.45 W/sq. cm., Class I
i. Smoke Density ASTM E662: Passes, <450

7. RESILIENT TILE
   a. Manufacturer: Patcraft
   b. Product: Numix, I768V
   c. Class ASTM F1700: ASTM F1700 Class I- monolithic solid vinyl tile Type A (smooth)
   d. Wear-layer Thickness: 0
   e. Overall Thickness: 0.125 inches (3.17 mm)
   f. Nominal Dimensions:36 in x 36 in
   g. Finish: Color, finish and pairing to be selected by the District from manufacturer's full range.
   h. Installation: Glue Down
8. BASE
   a. Provide 4" Cove Base 215PC at walls / cabinets, etc.
   b. Color to be selected from manufacturer's full range of colors, including InStock, QuickShip, and Made to Order colors.
9. INSTALLATION MATERIALS
   a. Provide all materials / accessories as needed to provide a complete installation as required by the manufacturer.
   b. High Moisture Management Solutions (10 Year Warranty)
      i. Concrete with %RH <99%, MVER </=10, pH < 11
         1. Apply USG Advanced skim coat as necessary for patch/skim coat.
         2. Install flooring with Shaw 4151* adhesive.
      ii. Concrete with %RH >/= 99%, MVER </=12, pH </= 12
         1. Apply Shaw Surface Prep EXT followed by Shaw Moisture Shield.
         2. Apply USG Advanced skim coat as necessary for patch/skim coat.
         3. Install flooring with Shaw 4151* adhesive.
      iii. Concrete with %RH >/= 99%, MVER </= 17, pH> 12
         1. Apply Surface Prep
         2. Apply Shaw Moisture Shield.
         3. Apply MRP
         4. Apply USG Advanced Skim Coat as necessary for patch/skim coat.
         5. Install flooring with Shaw 4151* adhesive
      iv. Concrete with %RH >/= 99%, MVER >17, pH> 12
         1. Apply Shaw Surface Prep EXT followed by Shaw MoistureTek.
         2. Apply USG Advanced skim coat as necessary for patch/skim coat.
         3. Install flooring with Shaw 4151* adhesive.
   c. Adhesives:
      i. Lokworx Resilient 95% RH 8 lbs pH 10

ii. Lokworx+ Resilient
iii. S150 spray 95% RH NA pH 11
iv. Shaw 4151 for high moisture 99% RH 10 lbs. pH 12
v. Shaw 200 for low demand areas 85% RH 5 lbs pH 5-9

d. Weld Rod
   i. Heat
   ii. Chemical
e. Primer: Shaw 9050
f. Leveling and Patching Compounds: Use only Portland-based patching and leveling compounds. Do not install resilient flooring over gypsum-based patching and/or leveling compounds.
g. Shaw MRP: Barrier Primer over concrete, Old Cut Back Adhesive, Chemically Abated Floors or other solid surfaces
h. FinishWorx Transition Strips (Micro Transition, Metal TrimMaster)
i. FinishWorx Wall Base Accessories
j. FinishWorx Cove Base Accessories:
   i. Angle Profile
   ii. Detail Profile
   iii. Quarter Round Profile
k. Floor Polish

PART 3 – EXECUTION

10. EXAMINATION
    a. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content, pH, smoothness and level.
    b. Proceed with installation after any unsatisfactory conditions have been corrected.
11. PREPARATION OF SUBSTRATE
    a. All substrates to receive resilient flooring shall be dry, clean, smooth and structurally sound. They shall be free of dust, solvent, paint, wax, oil, grease, residual adhesive, adhesive removers, curing, sealing, hardening, or parting compounds, alkaline salts, excessive carbonation or laitance, mold, mildew and other foreign materials that might prevent adhesive bond.
    b. RADIANT HEAT
       i. Substrates must not exceed 85°F surface temperature.
       ii. Seven days prior to installing resilient products, activate the radiant system at maximum temperature to reduce residual moisture in the concrete.
       iii. 24 hours prior to installation, lower the temperature to 70°F and maintain that temperature for 48 hours after installation.
       iv. Ensure the floor does not exceed 85°F. An in-floor temperature sensor is recommended.
    c. WOOD SUBSTRATES
       i. Double-layered APA rated plywood subfloors should be a minimum 1” total thickness, with at least 18” well ventilated air space beneath. Insulate and protect

crawl spaces with a vapor barrier.

ii. Do not install over sleeper construction subfloors or wood subfloors applied directly over concrete.

iii. Underlayment panels can only correct minor deficiencies in the sub-floor while providing a smooth, sound surface on which to adhere the resilient flooring.

iv. Any failures in the performance of the underlayment panel rests with the panel manufacturer and not with Shaw Industries, Inc.

v. It is recommended that your chosen APA underlayment grade panels be designed for installation under resilient flooring and carry a written warranty covering replacement of the entire flooring system.

vi. Always follow the underlayment manufacturer's installation instructions.

d. STRIP – PLANK WOOD FLOORING

i. Due to expansion and contraction of individual boards during seasonal changes add 1/4" or thicker APA rated underlayment panels be installed over these types of subfloors.

e. CONCRETE

i. New or existing concrete subfloors must meet the guidelines of the latest edition of ACI 302 and ASTM F 710.

ii. On or below-grade slabs must have an effective vapor retarder directly under the slab.

iii. Wet curing 7 days is the preferred method for curing new concrete.

iv. Remove curing compounds 28 days after placement, so concrete can begin drying.

v. Concrete floors shall be flat within 3/16" in 10 ft. F-Number System: Overall values of FF 36/FL 20 may be appropriate for resilient floor coverings.

vi. Internal relative humidity may not exceed 90% RH.

f. LIGHTWEIGHT CONCRETE

i. All recommendations and guarantees as to the suitability and performance of lightweight concrete under resilient flooring are the responsibility of the lightweight concrete manufacturer. The installer of the lightweight product may be required to be authorized or certified by the manufacturer. Correct on-site mixing ratios and properly functioning pumping equipment are critical. To ensure proper mixture, slump testing is recommended.

ii. Lightweight aggregate concretes having densities greater than 90 lbs. per cubic foot may be acceptable under resilient flooring.

iii. Concrete slabs with heavy static and/or dynamic loads should be designed with higher strengths and densities to accommodate such loads.

iv. Surface must be permanently dry, clean, smooth, and free of all dust and structurally sound.

12. INSTALLATION

a. LAYOUT AND INSTALLATION

b. Install using conventional tile and plank installation techniques. Plank products should have a minimum of 6 to 8" seam stagger.

c. Center rooms and hallways so borders are not less than half of a tile or plank.
d. Work out of multiple boxes at the same time.
e. In hallways and small spaces, work lengthwise from one end.
f. Ensure cut edges are always against the wall.
g. To cut products, score the top side of the material with a utility knife. Bend the product and finish the cut through the back side. It may be necessary to use a heat gun to cut around vertical obstructions. Allow the heated product to return to room temperature before installation.
h. If you cut the product into a fine point, it may delaminate. Use an ethyl cyanoacrylate-based super glue to fuse the points together. Clean all glue from the top surface immediately. Alcohol-based super glues may cause the vinyl to swell.
i. Roll the plank or tile with a 3-section 100 lb. roller. Re-roll the floor within the working time of the adhesive. Continue to roll the floor throughout the working day to ensure a proper bond.
j. Use floor protection after installation. DO NOT use a plastic adhesive-based protection system.

13. MAINTENANCE
    a. Initial Maintenance
        i. Sweep, vacuum or dust mop to remove dirt and grit.
        ii. If needed, add neutral cleaner to cool water following the manufacturer's instructions.
        iii. Scrub with a low-rpm machine or auto scrubber. Use a red pad or brush.
        iv. Never use brown or black pads (too aggressive and can damage the product)
        v. Remove the cleaning solution with a wet-dry vacuum or auto scrubber until the floor is dry.
        vi. Rinse the floor with clean water. Repeat the rinse process if necessary to remove all haze.
    b. Routine Maintenance
        i. Sweep, vacuum or dust mop to remove dirt and grit.
        ii. Add neutral pH cleaner to cool water following the manufacturer's instructions.
        iii. As needed, scrub with a low-rpm machine or auto scrubber to retain appearance. Use a red (light scrubbing) pad and neutral cleaner following the manufacturer's instructions.
    c. Preventative Floor Care
        i. Use walk-off mats that are as wide as the doorway and long enough for soil load and weather conditions.
        ii. Use mats with a non-staining backing.
        iii. Floor protectors should be used on all furniture legs.
        iv. The surface area of the floor protectors should be no less than 1" in diameter.
    d. Full maintenance instructions will be provided by the manufacturer.

END OF SECTION

SECTION 09 67 23
RESINOUS FLOORING AND EPOXY WALLS

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. Resinous seamless flooring and wall (full height) systems as shown on the drawings and in schedules.

1.3 SYSTEM DESCRIPTION (Floors and cove base)

A. The work shall consist of preparation of the substrate, the furnishing and application of a Flowfresh SL cementitious urethane based self-leveling seamless flooring system with full broadcast of ¼" decorative (chips) flakes.
B. Second Broadcast coat – install key 511-UV clear with full broadcast of ¼" decorative (chips) flakes.
C. Grout Coat – install Key 511-UV clear.
D. Topcoat – Install Flowseal PA clear Polyaspartic.
E. The system shall have the color and texture as specified by the Owner with a nominal thickness of 3/16" to ¼''. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.
F. Cove base to be applied where noted on plans and per manufacturers standard details using Key 510-CV clear and Key BMA (trowelsand).

1.4 SYSTEM DESCRIPTION (Key Chip 100 Wall coating system)

A. The work shall consist of preparation of the substrate, the furnishing and application of Key Chip 100 Wall Coating System.
B. Primer coat of Key 502 epoxy primer.
C. Body coat – install Key 511-UV with Universal color pack with full broadcast of ¼" decorative (chips) flakes.
D. Second Broadcast coat – install key 511-UV clear with full broadcast of ¼" decorative (chips) flakes.
E. Grout Coat – install Key 511-UV clear.
F. Topcoat – Install Flowseal PA clear Polyaspartic.
G. The system shall have the color and texture as specified by the Owner with a nominal thickness of 35 to 40 mils. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.

1.5 SUBMITTALS

A. System Data: Latest edition of Manufacturer's literature including performance data.
B. Samples: A sample of the proposed system. Color, texture, and thickness shall be representative of the appearance of the finished system.

1.6 QUALITY ASSURANCE

A. The Manufacturer shall have a minimum of 7 years' experience in the production, sales, and technical support of cementitious urethane, polyurethane industrial flooring and related materials.

B. The Applicator shall have been approved by the manufacturer in all phases of surface preparation and application of the specified system and have a minimum of 5 years relevant experience.

C. No requests for substitutions should be considered that would change the generic type of the specified system.

D. System shall follow requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.

E. A pre-installation conference shall be held between the Applicator, General Contractor and the Owner to review and clarify this specification, application procedure, quality control, inspection and acceptance criteria and application schedule.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping

1. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product name and batch number.

B. Storage and Protection

1. The Applicator shall be provided with a dry storage area for all components. The area shall be between 50^{o} F and 90^{o} F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
2. Copies of Material Safety Data Sheets (SDS) for all components shall be kept on site for review by the Engineer or other personnel.

C. Waste Disposal

1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.8 PROJECT CONDITIONS

A. Site Requirements

1. Application may proceed while air, material and substrate temperatures are between 50^{o} F and 90^{o} F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
2. The relative humidity in the specific location of the application shall be less than 90 % and the surface temperature shall be at least 5^{0}F above the dew point.
3. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

B. Conditions of new concrete to be coated with cementitious urethane material.

1. Concrete shall be cured for a minimum of 7 days prior to the application of the coating system pending moisture tests.
2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary nor desirable).
3. Sealers, release agents and curing membranes should not be used.
4. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect

against the effects of vapor transmission and possible delamination of the system.

C. Safety Requirements
   1. The Owner shall be responsible for the removal of foodstuffs from the work area.
   2. Non-related personnel in the work area shall be kept to a minimum.

1.9 WARRANTY

A. Key Resin Company / FlowResin warrants that its products are free from defects. FlowResin Americas. shall provide a materials warranty to the Owner for a period of one year from the date of manufacture. Liability, if any, is limited to product replacement.

PART 2 – PRODUCTS

2.1 FLOORING

A. Materials will be provided by the District and installed by the contractor.

B. FlowResin Flowfresh SL is supplied with Polygiene anti-microbial additive self-leveling with full broadcast of ¼" decorative (chips) Flakes, Key 511 flake broadcast coat, Grout coat of key 511-UV clear followed by Flowseal PA clear Polyaspartic topcoat seamless flooring system.
   1. Patch Materials
   2. Shallow Fill and Patching: Use FlowResin Flowfresh SL or SR (up to ¼ inch).
   3. Deep Fill and Sloping Material (over ¼ inch): Use FlowResin Flowfresh HF.

2.2 WALL

A. Materials will be provided by the District and installed by the contractor.

B. Key Chip 100 Wall Coating system consists of Key 502 epoxy primer, Key 511-UV with color pack with full broadcast of ¼" decorative (chips) Flakes, Key 511 flake broadcast coat, Grout coat of key 511-UV clear followed by Flowseal PA clear Polyaspartic topcoat seamless flooring system.

2.3 MANUFACTURER AND VENDOR

A. Manufacturer: Key Resin Company, 4050 Clough Woods Dr. Batavia, OH 45103.

B. It is recommended that the Contractor to reach out to one of the District's epoxy coating installers.
   Genesis Floor Covering, Inc.
   14101 Pontlavoy Ave., Santa Fe Springs, CA 90670
   Contact: Tanner Hauser, 562-345-5007

2.4 CEMENTITIOUS BACKER UNIT / CEMENT BOARD

A. Provide 5/8" thick cement board per epoxy coating manufacturer's requirements. All seams and fasteners shall be patched and skim coated to provide a smooth surface per epoxy coating manufacturer's requirements. Cement board shall be provided by the contractor.

2.5 DECORATIVE (CHIPS) FLAKES

A. Color(s) to be selected by the District from manufacturer's full range. Provide custom colors upon request.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.

1. Verify that substrates and conditions are satisfactory for flooring & wall coating installation and comply with requirements specified.

3.2 PREPARATION

A. General

1. All concrete surfaces shall be free of laitance, oil, grease, curing compounds, loose particles, friable matter, dirt, bituminous products and all other contaminants.
2. Moisture Testing: Perform moisture vapor testing per ASTM F1869 and or ASTM F2170. Document results per specification. If testing exceeds manufacture's recommend level for specified system, contact manufacture for recommendation.

   a. Contractor shall provide and install vapor mitigation system that has been approved by the manufacturer or other means to lower the value to an acceptable limit.

3. Mechanical surface preparation
   a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes, and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
   b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
   c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/8" key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also be applied to drain perimeters and expansion joint edges.
   d. Cracks and joints (non-moving) greater than 1/8" wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
4. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

3.3 FLOOR APPLICATION – Flowfresh SL Flake system at 3/16" to 1/4" nominal thickness.

1. Mix and install Flowfresh SL self-leveling cementitious urethane system at 60 to 63 sqft per kit (nominal thickness of 100 mils) with a full broadcast of ¼" decorative (ships) Flakes at 0.1 to 0.12 lbs. per sqft. Allow to cure for 8 to 12 hours at 70 degrees F and sweep/vacuum excess flakes from surface.
   2. Provide skim coat or other product as required by the manufacturer at existing and new concrete curbs to provide a smooth surface prior to epoxy coating application.

3. Integral Cove base: provide integral epoxy cove base formed from flooring up wall. Provide cove base cap strip at top of base if specified and trowel material up the wall to form smooth, integral transition and base 6" inches high with a 1" ratus unless otherwise indicated on plans of finished schedule.
4. Second broadcast: Mix and install key 511-UV clear epoxy at 100 sqft per mixed gallon (16 mils) with a full broadcast of ¼" decorative (chips) Flakes at 0.1 to 0.12 lbs. per sqft. Allow to cure for 12 to 16 hours at 70 degrees F and sweep/detail / vacuum excess flakes from surface.
5. Grout Coat: Mix and install key 511-UV clear epoxy at 100 to 150 sqft per mixed gallon (16 to 12 mils). Allow to cure for 12 to 16 hours at 70 degrees F.
6. Topcoat – Detail floor as needed. Mix and install Flowseal PA Polyaspartic at 200 to 250 sqft per mixed gallon (8 to 6 mils). Allow to cure for 24 to 36 hours at 75 degrees F with 50% RH.
7. Immediately prior to the application of any component of the system, the surface shall be dry, and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil- free compressed air.
8. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
9. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architector owner.
10. A neat finish with well-defined boundaries and straight edges shall be provided by the applicator.

B. WALL APPLICATION – Key Chip 100 Wall Coating System at 35 to 40 mils.

1. Primer coat – install key 502 clear epoxy primer at 250 sqft per mixed gallon
2. Body coat – install key 511-UV epoxy with universal color pack at 200 to 250 sqft per mixed gallon (8 to 6 mils) with full broadcast of ¼" decorative (ships) flakes at 0.1 to 0.12 per sqft.
3. 2nd Body coat – install key 511-UV clear epoxy at 160 sqft per mixed gallon (10 mils) with full broadcast of ¼" decorative (ships) flakes at 0.1 to 0.12 per sqft.
4. Topcoat – Sand / scape and detail walls as needed. Mix and install Flowseal PA clear Polyaspartic at 250 sqft per mixed gallon (6 mils). Allow to cure for 24 to 36 hours at 75 degrees F with 50% RH.
5. Match finished work to approved sample / mockup, uniform in thickness, color, texture and free from defects detrimental to appearance.
6. Texture needs to match approved samples / mockup.

C. Notes:

1. Match finished work to approved sample / mockup, uniform in thickness, color, texture and free from defects detrimental to appearance.
2. Texture needs to match approved samples / mockup.
3. Smooth texture finishes under all equipment & cove base throughout the kitchen.
4. Follow Manufacturers written application instructions.

3.4 FIELD QUALITY CONTROL

A. Tests, Inspection

1. The following tests shall be conducted by the Applicator:
    a. Temperature
        1. Air, substrate temperatures and, if applicable, dew point.
    b. Coverage Rates
        1. Rates for all layers shall be monitored by checking the quantity of material used against the area covered.

3.5 CLEANING AND PROTECTION

A. Cure flooring & wall materials in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.

B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

SECTION 099123
PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Exposed interior conduits and plumbing pipes (where occurs)
2. Hollow metal doors and frames
3. Louvers and access panel
4. Interior gypsum board
5. Other exposed (to both view and weather) items not specifically mentioned

B. Scope of work:

1. Contractor shall paint all factory primed products including but not limited to doors (all faces), frames, access panels, louvers, etc.
2. Contractor shall paint all new work that is exposed to view including but not limited to drywall, conduits, galvanized surface, etc.. Do not paint factory finished product, labels, tags, etc. See above paragraph 1.1A
3. Schedule: Contractor shall submit a paint schedule indicating all of the paint systems that will be used for the project. Contractor shall submit paint systems for substrates that are not specified in the contract document but required to complete the project. Contractor shall also verify the compatibility of the products against the substrate and each other.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each finish and for each color and texture required.
C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. District Standard Manufacturer: Dunn-Edwards
B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with SCAQMD and the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 5 g/L or less.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 5 g/L or less.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 5 g/L or less.
4. Floor Coatings: VOC not more than 5 g/L or less.
5. Shellacs, Clear: VOC not more than 5 g/L or less.
6. Shellacs, Pigmented: VOC not more than 5 g/L or less.
7. Flat Topcoat Paints: VOC content of not more than 5 g/L or less.
8. Nonflat Topcoat Paints: VOC content of not more than 5 g/L or less.
9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 5 g/L or less.
10. Floor Coatings: VOC not more than 5 g/L or less.
11. Shellacs, Clear: VOC not more than 5 g/L or less.
12. Shellacs, Pigmented: VOC not more than 5 g/L or less.
13. Primers, Sealers, and Undercoaters: VOC content of not more than 5 g/L or less.
14. Dry-Fog Coatings: VOC content of not more than 5 g/L or less.
15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 5 g/L or less.
16. Pre-Treatment Wash Primers: VOC content of not more than 5 g/L or less.

D. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

a. Acrolein.

b. Acrylonitrile.
c. Antimony.
d. Benzene.
e. Butyl benzyl phthalate.
f. Cadmium.
g. Di (2-ethylhexyl) phthalate.
h. Di-n-butyl phthalate.
i. Di-n-octyl phthalate.
j. 1,2-dichlorobenzene.
k. Diethyl phthalate.
l. Dimethyl phthalate.
m. Ethylbenzene.
n. Formaldehyde.
o. Hexavalent chromium.
p. Isophorone.
q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

E. Colors: As selected by the District from manufacturer's full range. Provide custom color as requested by the District

F. Low-Emitting Materials: Interior paints and coating 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. Colorants: The use of colorants containing hazardous chemicals, such as ethylene glycol, is prohibited.

2.2 PRIMERS/SEALERS

A. Galvanized Metal: ULTRASHIELD
B. Ferrous Metal: ENDURAPRIME
C. Wood: ULTRA-GRIP Premium
D. Drywall: VINYLASTIC Premium
E. Aluminum: SUPER-LOC
F. Stucco: EFF-STOP Premium
G. Lead Barrier Compound: LBC Type III by Fiberlock

2.3 INTERIOR FINSIH PAINT

A. Drywall: ARISTOSHIELD Semi-gloss
B. Doors and frames: EVERSHIELD Semi-gloss
C. Wood: EVERSHIELD Semi-gloss
D. Interior sides of doors, door frames, louvers, etc. are considered “exterior” and shall be painted with EVERSHIELD

2.4 EXTERIOR FINSIH PAINT

A. Stucco / plaster: EVERSHIELD Semi-gloss
B. Doors and door frames: EVERSHIELD Semi-gloss

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Gypsum Board: 12 percent.
   2. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Comply with the Surface Preparation Standards published by the Society for Protective Coatings (SSPC).
C. Comply with manufacturer’s written instructions and recommendations.

D. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

E. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

F. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:

a. Uninsulated metal piping.
b. Uninsulated plastic piping.
c. Pipe hangers and supports.
d. Tanks that do not have factory-applied final finishes.
e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
f. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:

a. Switchgear.
b. Panelboards.
c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
d. Exposed conduits and wiremolds

G. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

H. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

I. Coats: Provide a minimum of (1) coat of primer and (2) coats of finish paint for all substrates, including previously painted surfaces.

J. Thickness: Each coat of primer and paint shall have a minimum thickness as recommended by Dunn Edwards:

1.	ULTRASHIELD	4.8 mil WET	DRY 2.0 mil
2.	ENDRUARPRIME	5 mil WET	DRY 2 mil
3.	ULTRAGRIP PREM.	4.9 mil WET	DRY 1.5 mil
4.	SUPER-LOC	5.9 mil WET	DRY 2.0 mil

5.	EFF STOP	5.5 mil WET	DRY 2.0 mil
6.	EVERSHIELD	3.9 mil WET	DRY 1.5 mil
7.	ARISTOSHIELD	4.0 mil WET	DRY 1.5 mil

END OF SECTION 099123

SECTION 101100
VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Porcelain enamel marker boards with aluminum frames.
2. Horizontally sliding porcelain enamel marker boards with aluminum frames.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Visual display board assemblies.
2. Horizontally sliding visual display board assemblies.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

C. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints, including locations of field-assembled joints for factory-fabricated units too large to ship in one piece, if any.
3. Show locations and layout of special-purpose graphics.
4. Include sections of typical trim members.

D. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:

1. Samples of facings for each visual display panel type, indicating color and texture.
2. Actual factory-finish color samples, applied to color anodized aluminum trim.
3. Include accessory Samples to verify color selected.

E. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturer's special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace Writanium® face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Surfaces lose original writing and erasing qualities.
    b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty covers the cost of material replacement of defective Writanium® markerboards and chalkboards due to discoloration, crazing, cracking, or flaking. Warranty does not cover labor or miscellaneous material costs for removal and re-installation of markerboards and chalkboards.

3. Warranty Period:

    a. Manufacturer’s "Forever Warranty", stating that under normal usage and maintenance, Writanium® Porcelain Markerboards and Chalkboards are guaranteed for the life of the building.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLIES

A. Visual Display Board Assemblies: <**Insert drawing designation**>.

1. Basis of Design: Subject to compliance with the requirements, provide Platinum Visual Solutions "Drop-In Tray (DTS)" Writanium® Porcelain Markerboard and "Wall Mounted Horizontal Sliding Unit (WHS)" with Writanium® Porcelain Markerboard.
2. Prior to receipt of bids, additional Manufacturer's whose products equal or exceed the specified products in every regard to the specified products may request to be included as a specified manufacture by following procedures outlined in Division 01 Section "Substitution Procedures".

B. Visual Display Board Assembly: Factory fabricated.

1. Assembly: **markerboard**
2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.
5. Mounting Method: **Mechanically fastened directly to wall**

C. Markerboard Panel: Writanium® Porcelain-enamel-faced markerboard panel on 7/16-inch-thick particleboard core and honeycomb core.

1. Color: As selected by Architect from Manufacturer's full range of colors.

D. Aluminum Frames and Trim (Model DTS): Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; Type CH215 standard channel with 3/4 inch face.

E. Aluminum Frames and Trim (Model WHS): Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum.

F. Aluminum Finish: **Clear anodic**

G. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

H. Combination Assemblies: Provide manufacturer's standard exposed trim between abutting sections of visual display panels.

I. Marker or Chalk Tray: Manufacturer's standard; continuous.

1. Solid Type: Extruded aluminum with smoothly curved exposed ends.

J. Display Rail: Manufacturer's standard, extruded-aluminum display rail with **[natural cork] [linoleum impregnated]** insert.

1. Size: **[1 inch (25 mm)].**
2. Map Hooks: One map hook for every 24 inches (600 mm) of display rail or fraction thereof.
3. Flag Holder: One for each room.
4. Aluminum Color: Match finish of visual display assembly trim.

K. Panels and Accessories (Markerboard/Chalkboard only):

1. Display Rail: Manufacturer's standard, extruded-aluminum display rail with **natural cork** insert and end trim piece.

a. Aluminum Trim: Factory applied; in manufacturer's standard size and profile; with **Clear anodic** trim finish rest of unit.

2.3 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel (Writanium®) face sheet with **low**-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
2. Particleboard Core: 7/16 inch (11.1 mm) thick; with **0.015-inch thick, aluminum sheet**
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

B. Sliding Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel (Writanium®) face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Core: Manufacturer's standard 1/2 inch (12.7 mm) thick honeycomb panel.
2. Backing Panel: 28 ga sheet steel.
3. Subframe: 7/8" x 2" aluminum tube.

2.4 FIXED BACK PANELS

A. Fixed Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel (Writanium®) face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Core: Manufacturer's standard 1/2 inch (12.7 mm) thick honeycomb panel.
2. Backing Panel: 0.015" aluminum backing sheet.

2.5 WALL MOUNTED HORIZONTAL SLIDING UNITS

A. Provide Horizontal Sliding Units with Writanium® Porcelain Markerboards, Chalkboards and/or Tackboards for project from manufacturer's WHS Series.

1. Metal trim and accessories: WHS Series aluminum extrusions with clear satin anodized finish.

   a. Top Track HS500: One piece top track with integral fascia.
   b. Bottom Track HS550: Standard channel bottom track to accept nylon guide.
   c. Chalktray CR310: Standard continuous solid chalktray with ribbed section and smoothly curved ends.
   d. Map rail MR421: Standard 2" high continuous rail with colored cork insert.

2. Sliding Writanium® Porcelain Markerboard panel:

   a. Frame CH215: Standard channel frame with 3/4" face.
   b. Nylon Rollers: Two per panel up to 4' wide and three per panel up to 8' wide.
   c. Nylon Guides: Two per panel up to 4' wide and three per panel up to 8' wide.
   d. Finger Pulls: One pair per sliding panel.

3. Fixed Markerboard, Chalkboard and/or Tackboard:

4. Dimensions: As indicated on the Drawings.

2.6 MATERIALS

A. Porcelain-Enamel Face Sheet (Writanium®): PEI-1002, with face sheet manufacturer's standard three-coat process.

B. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish[**; with surface-burning characteristics indicated**].

C. Vinyl Fabric: Mildew resistant, washable, complying with ASTM F793/F793M, Type II, texture to be selected by the District, weighing not less than 13 oz./sq. yd. (440 g/sq. m); with surface-burning characteristics indicated.

D. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd. (508 g/sq. m); with surface-burning characteristics indicated.

E. Linoleum: 1/4-inch- (6-mm-) thick homogeneous tackable surface material made of primary natural materials consisting of linseed oil, cork, rosin binders and dry pigments mixed and calendared onto a natural jute backing. The uni-color extends throughout the thickness of the material

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500 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: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

3.3 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

C. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.

1. Mounting Height for Grades K through 3: 24 inches (610 mm) above finished floor to top of marker or chalk tray.
2. Mounting Height for Grades 4 through 6: 28 inches (711 mm) above finished floor to top of marker or chalk tray.
3. Mounting Height for Grades 7 and Higher: 36 inches (914 mm) above finished floor to top of marker or chalk tray.

3.4 CLEANING AND PROTECTION

A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101400
SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Incorporated Documents: Contract drawings, Provisions of the Bid Documents, General and Special Conditions, General Requirements, and Division 01 apply to the Work of this Section.

B. Section Includes: Furnishing materials, labor, and equipment necessary for the completion of identifying devices as indicated on the Drawings and specified herein.

C. Geometric restrooms signs and exterior toilet room signage,

1.2 DEFINITIONS

A. Accessible Route: A continuous unobstructed path that complies with ADA, and 2022 CBC.

B. Characters: Letters, numbers, punctuation marks, and typographic symbols.

C. Circulation Path: An exterior or interior way of passage from one place to another for pedestrians, including, but not limited to, walks, hallways, courtyards, stairways, and stair landings.

D. Common Use: Interior and exterior rooms, spaces, or elements made available for the occupancy by students, staff, or others visiting or utilizing facilities.

E. Facility: Portions of buildings, structures, site improvements, complexes, equipment, roads, walks, passageways, parking lots, or other real or property located on a Project site.

F. ISA: International Symbol of Accessibility

G. Pictogram: A pictorial symbol, which is recognized as representing activities, facilities, or concepts.

H. Sign: An Architectural element composed of displayed text, symbolic, tactile or pictorial information.

I. Space: A definable area, such as a room, toilet room, hall, assembly area, entrance, storage room, alcove, courtyard or lobby.

J. Tactile: An object that can be perceived through the sense of touch.

1.3 SYSTEM DESCRIPTION

A. Comply with the most stringent requirements of Americans with Disabilities Act Accessibility Guidelines (ADAAG) and 2022 CBC.

1. Tactile character type: Tactile characters on signs shall be raised 1/32 inch (0.794 mm) minimum and shall be sans serif uppercase characters accompanied by Contracted Grade 2 Braille (see note below).

    a. Tactile character size: Raised characters shall be a minimum of 5/8 inch (15.9 mm) and a maximum of 2 inches (51 mm) high.
    b. Finish and contrast: Contrast between character, symbols and their background must be 70% minimum and have a non-glare finish.
    c. Proportions: Characters on signs shall have a width-to-height ratio of between 3:5 and 1:1 and a stroke width-to-height ratio of between 1:5 and 1:10. CBC Section 1117B.5.3. All letters measured must be uppercase. After choosing a typestyle to test, begin by printing the letters I, X, and O at 1 inch high. Place the template's 1:1 square over the X or O, whichever is narrower. If the character is not wider than 1 inch, nor narrower than the 3:5 rectangle, the proportions are correct. Use the 1:5 rectangle to determine if the stroke of the I is too broad, and the 1:10 rectangle to see if it is too narrow. If all the tests are passed, the typestyle is compliant with proportion requirement.
    d. Braille: California (Contracted) Grade 2 Braille shall be used wherever Braille is required in other portions of these standards. Dots shall be 1/10 inch (2.54 mm) on center in each cell with 2/10 inch (5.08 mm) space between cells, measured from the second column of dots in the first cell to the first column of dots in the second cell. Dots shall be raised a minimum of 1/40 inch (0.635 mm) above the background. Braille dots shall be domed or rounded.
    e. Mounting location shall be determined so that a person may approach within 3 inches (76 mm) of signage without encountering protruding objects or standing within the swing of the door.

B. Room Identification Signs:

1. Each permanent room and space identified by a sign shall have a sign installed adjacent to the door it identifies, with raised characters and Braille. This includes entrances to rooms and spaces, which are entered by an exterior entrance or by a door off an interior corridor or courtyard.
2. If there is not adequate space for a sign immediately adjacent to the door, and the door opens inward, the gender pictogram, the ISA, and the raised characters and Braille can be included on the geometric sign installed on the door. In the case of restrooms with no doors, but only shielded entrances, the geometric sign can also include the required elements and be installed adjacent to the entrance.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

1. Provide message list for each sign required, including large-scale details of wording and layout of lettering.
2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
3. Furnish full-size spacing templates for individually mounted dimensional letters and numbers.

D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.

1. Samples for verification of color, pattern, and texture selected, and compliance with requirements indicated:
2. At least one actual sign for each type for review, these signs will not be returned to the contractor.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.

B. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of signs and are based on the specific type and model indicated. Signs by other manufacturers may be considered, provided that deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

C. Inspection: Tactile signs shall be field inspected for compliance after installation (11B-703.1.1.2).

PART 2 - PRODUCTS

2.1 BRAILLE AND RAISED-CHARACTER (TACTILE) SIGNS

A. Provide standard ¼" thick clear acrylic plastic signs. Color shall match the existing sign colors on campus (verify with District personnel).

B. Sign Plate and Lettering Sizes:

1. Room or Space Identification Signs: refer to drawings

C. Installation:

1. Room Identification Signs: See details on drawing. Plates installed on the interior face of door shall be secured with four 1/8-inch diameter Cadmium plated Phillips head screws, 2 per side at each corner. Plates installed on the exterior face or both sides of doors shall be secured through the door with two nickel plate brass binding posts or sex bolts with the screw portion on the interior side.

D. Raised Characters:

1. Edges of characters beveled or rounded.
2. Minimum of 1/8 inch between the top surfaces of adjacent characters measuring between the 2 closest points.
3. Helvetica Regular typestyles with proportions that comply with CBC 1117B.5.3.

E. Braille:

1. Rounded or domed dots in accordance with ANSI 703.5.
2. Specifications in accordance with CBC and ANSI 703.5, whichever is more stringent.
3. No indication of capital letters except for proper names, individual letters or acronyms, or beginnings of sentence in accordance with ANSI 703.5.

PART 3 - EXECUTION

3.1 GENERAL

A. Non-glare (non-reflective) materials shall be furnished for signs, which identify, direct to, or give information about facilities and their use. Parking, traffic signs, and exterior safety signs may be furnished with reflective materials. Identification sign for accessible parking spaces shall be furnished with reflective materials.

B. Characters shall have a minimum of 70 percent contrast with their backgrounds on signs which identify, direct to, or give information about facilities and their use.

C. Character styles, proportions and sizes on signs shall comply with CBC. Characters required to be tactile shall comply CBC

D. Braille translations of room and space identifications shall be Grade 2 and Braille cells and dots shall comply with ANSI 703.5 and CBC whichever is most stringent.

E. Pictograms and Symbols of Accessibility shall comply with the standards in 2022 CBC.

F. Restrooms shall be identified with a geometric symbol on the door, which complies with CBC.

G. Signs required by the State Fire Marshal shall comply with CBC.

3.2 METHODS OF INSTALLATION

A. Interior Identification Signs and Interior Directional Signs:

1. Fasten to wall with 4 tamper-proof round-head screws, one at each corner of sign. Furnish plastic anchors.
2. When concealed installation is specified, install backplate to wall as above. Fasten sign to backplate with very high-bond double-faced tape.
3. For installation on glass, fasten sign to glass with very high bond double faced tape. On opposite side of glass, anchor matching backplate to glass with very high-bond double-

faced tape.

B. Geometric Signs: Geometric toilet room signs shall be fastened to doors with 3 tamper-proof oval-head counter-sunk screws.

C. Exterior Post Mounted Directional Signs: Install by post mount. Size of required footing shall be as indicated.

D. Exterior Wall Mounted Identification Signs and Directional Signs:

1. Aluminum signs: Fasten to wall with 4 tamper-proof round-head screws, one at each corner of sign. Furnish lead anchors.
2. Acrylic signs: Install backplate to wall as above. Fasten sign to backplate with very high-bond double-faced tape and silicone.
3. For installation on glass, fasten sign to glass with very high bond double faced tape. On opposite side of glass, anchor matching backplate to glass with very high-bond double-faced tape.

E. Exterior Building Sign:

1. Each letter shall be furnished with a minimum of 3 cast mounting lugs on backside, drilled and tapped to receive installation bolts.
2. Letters shall be installed according to manufacturer's method. Letters shall be installed 3/4 inch away from wall surface, by an aluminum sleeve spacer.

3.3 CLEANUP

A. Remove and legally dispose of rubbish, debris, and waste materials off the Project site.

3.4 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 11 53 13
LABORATORY FUME HOODS AND RELATED PRODUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bench-top High-Performance Laboratory Fume Hoods.
2. Service fixtures (i.e. water, gas, etc.) and electrical service fittings in fume hoods.
3. Piping and wiring within service fittings, light fixtures, switches, and other electrical devices.
4. Fume hood base support.
5. Work Surfaces within fume hoods.
6. Laboratory sinks and cup sinks in fume hoods.
7. Filler panels and ceiling enclosures for fume hoods.

1.02 SCOPE AND CLASSIFICATION

A. This specification covers the requirements for the purchase of bench mounted laboratory fume hoods for use with exhaust blower systems.
B. Bench-mounted laboratory fume hoods in 6 - foot width, internal depth of 27.2" and external depth of 37.7" as required.
C. This specification sets the intent for quality, performance and appearance.
D. All equipment shall be installed according to the Manufacturer's installation requirements including but not limited to electrical Wiring Diagram, Plumbing for Gas Assembly, Cold & D.I. Water, Blower assembly, Vent, Vacuum Air and Site Conditions). The following specifications are General intent and specific requirements are indicated in manufacturer's literatures.

1.03 REFERENCES

A. The laboratory hoods must conform to the following regulations and standards.

1. ASHRAE 110, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Method of Testing Performance of Laboratory Fume Hoods
2. ANSI/AIHA Z9.5, American Industrial Hygiene Association, Laboratory Ventilation
3. OSHA, Federal Register 29 CFR Part 1910, Occupational Safety & Health Administration, U.S. Department of Labor, Occupational exposures to hazardous chemicals in laboratories.

B. The laboratory fume hoods must carry the listed mark for the following.

1. UL 1805, Underwriters Laboratories Inc., Standard for Laboratory Hoods and Cabinets

1.04 PERFORMANCE REQUIREMENTS

A. General Design Requirements (See Part 2 for details)

1. Fume hoods shall function as ventilated, enclosed workspaces, designed to capture, contain and exhaust fumes, vapors and particulate matter produced or generated within the enclosure.
2. Fume hood shall be a factory designed to function as a by-pass fume hood or as a variable air volume fume hood without modification.
3. Structure and Materials of construction
   a. Hoods are of double-wall construction
   b. Powder-coated, cold rolled steel exterior
   c. Galvanized steel support members

d. Sheet molded composite panel internal liner

4. Baffles
   a. Perforated primary baffle designed to pull air in horizontal streams to minimize the air roll pattern associated with traditional fume hoods.
   b. Baffle slot pattern designed to optimize face velocity profile.
   c. A secondary baffle is located behind the primary perforated baffle to counteract upward air streams that produce roll.
   d. Moving or adjustable baffles are not acceptable
5. Sash
   a. Maximum opening is 28".
   b. Unobstructed viewing height is 27".
   c. Hood incorporates a perforated sash handle to bleed air into the hood chamber directing fume concentrations away from the user's breathing zone.
6. Airfoil:
   a. Hoods are provided with an airfoil across the bottom of the sash area that allows airflow into the hood regardless of user's position.
7. Hoods are provided with an upper dilution air supply for bypass air to bathe the sash interior and upper interior and to provide 5-10% of the hood's air volume requirements.
8. Besides the exhaust blower, no additional blowers are required for specified containment.
9. Access for maintenance is from both the front, interior, and exterior sides of the hood.
10. Services:
    a. Hood manufacturer shall furnish and deliver all service outlets, accessory fittings, electrical receptacles and switches, as listed in these specifications, equipment schedules or as shown on drawings.
    b. Plumbing fittings mounted on the fume hood superstructures shall be pre-plumbed by the manufacturer per section 2.03.
    c. Final plumbing and electrical connections are the responsibility of the contractors fulfilling the requirements of Divisions 22 and 26.
    d. All electrical services are pre-wired to a single point internal junction box at the top of the hood.

B. Containment

1. The manufacturer shall provide after the award of contract to the District all factory testing and results report of testing with failure to meet passing criteria as grounds for rejection of the equipment. Test data shall be provided at no cost to the District.
2. Evaluation of manufacturer’s standard product shall take place in manufacturer’s test facility meeting the following criteria.
   a. Lab to be located at manufacturer’s place of business for the testing of bench-mounted laboratory hoods in accordance with ASHRAE Standard 110.
   b. Qualified personnel familiar with the laboratory and its operation shall perform the test.
3. Hood shall be tested to ASHRAE 110 modified test method as detailed below.
4. Some fume hoods may use face velocity controls, motorized baffles, integral auxiliary make up, or supply fans. Because all of these devices are subject to failure, containment testing shall show both operational containment and product containment with these systems off.
5. Fume hood sashes shall be placed in their fully open position, at least 28” from the work surface, unless noted otherwise.
6. Ambient Temperature: 68 to 74 degrees F
7. Average Face Velocity: Face velocity average shall be 40 and 50fpm, as noted below in subsection 8.d, parts 1 and 2 respectively, plus or minus 5%.
   a. An imaginary grid is formed comprised of equal 12” by 12” squares, or smaller,

across the face opening of the laboratory hood. Airflow velocity readings are taken at the intersections of these grids with calibrated hot wire anemometer over a twenty second period of time. Probe shall communicate readings to a computer data acquisition package, which will provide an average of each reading over the 20 second time period, and also an overall average upon completion of data acquisition. Face velocity shall be determined by averaging readings at the hood face.

b. Average face velocity must be achieved without exceeding the CFM noted in part C.

8. Tracer Gas Detection: Hood shall achieve a rating of 4.0AM0.00 maximum average and 4.0AM0.01 maximum spike (unless specifically otherwise noted), wherein:
   a. 4.0 = tracer gas release in liters/minute, AM = as manufactured, 0.01 = tracer gas in parts per million (PPM)
   b. With the ejector body 6" from the rear of the sash plane, the test shall be conducted for each ejector position noted.
      1) Left position with ejector 12" from the left interior wall.
      2) Center position with ejector equidistant from the sidewalls.
      3) Right position with ejector 12" from the right interior wall.
   c. Install the mannequin positioned in front of the hood, centered on the ejector.
   d. Detector probes shall be placed 3” in front of the sash plane. The test shall be conducted for each detector probe position and corresponding face velocity.
      1) Detector probe in the region of the **nose and mouth of the mannequin**. Test with average face velocity of **40 fpm**.
      2) With the mannequin height reduced 4”, place detector probe in the **chest of the mannequin**, and even with the height of the ejector. Test with average face velocity of **50 fpm**.
   e. Open tracer gas valve, and collect readings with a computer data acquisition package, which is capable of monitoring and visually recording a minimum of one reading per second for a minimal five-minute time period for each position.
   f. The single control rating of the fume hood shall be the results of the test position yielding the highest average levels of tracer gas in any of the six mannequin/ejector configurations.
   g. With the ejector and mannequin in the center position, detector probe in the region of the **nose and mouth of the mannequin**, average face velocity of **40 fpm**, tracer gas released, and concentration recorded, open and close the sash in a smooth motion. Test to be repeated three times, with peak values of 0.01 PPM or less.
   h. With the mannequin removed, the periphery of the hood is traversed by the probe at 1” in front of the hood opening at a rate of 3 inches per second. The hood shall have a maximum perimeter reading of 0.01 PPM or less.
9. Flow Visualization:
   a. Test the operation of the lower air bypass airflow opening and hood periphery by introducing light smoke under the airfoil, and around the perimeter of the sash opening. If any smoke that enters the hood reverses directions and escapes from any of these locations, the hood fails this portion of the test and receives no rating.
   b. Introduce smoke along both walls and the hood floor in a line parallel to the hood face and 6 inches (152 mm) back into the hood. Define air movement toward the face of the hood as reverse airflow and define lack of movement as dead air space. All smoke should be carried to the back of the hood and out.
   c. Introduce a large volume of smoke at the work surface in the center of the hood, and 6” inside the plane of the sash. The smoke shall not get entrained in an interior vortex and shall clear in a single pass.
10. All data on the above, including instrumentation and equipment, and test conditions shall be provided on a report, including the average face velocities, and a separate graph-type performance curve on all tracer gas tests for all required fume hood widths. Performance

test data for a 6' representative hood shall be conducted by an independent testing agency and by a specific individual certified to perform such tests by the National Environmental Balancing Bureau (NEBB).

C. Efficiencies

1. The fume hood shall maintain constant volumetric rate (+/- 5 CFM) and static pressure losses (+/- 0.01" H2O) across all sash positions. Without any modifications, the hood should also maintain a sufficiently restricted by-pass for use with a variable air volume (VAV) system.
2. The fume hood demonstrate a minimization of the volumetric rate of air (CFM) requirement at any given face velocity. Required CFM to achieve desired face velocity shall not exceed that which is noted in the chart below.
3. The fume hood shall demonstrate a minimization of static pressure loss (inches of H2O) at any given CFM. Static pressure loss at desired face velocity, and corresponding CFM, shall not exceed that which is noted on the print.

D. Illumination: Shall be a minimum average of 80 foot-candles inside the work area. Work area is defined as the area inside the lined portion of the fume hood, from the face of baffle to sash plane, from interior left to interior right, and from the work surface to a height of 28 inches.

E. Materials of Construction: Interior and Exterior materials of construction and finishes shall meet the requirements in Part 2 of this specification.

1.05 QUALITY ASSURANCE

A. Fume hoods shall be designed, including comprehensive engineering analysis, by a qualified, licensed Professional Engineer.

B. Manufacturer's Qualifications

1. Ten installations of equal or larger size and requirements. Provide contact at each.
2. Only hood manufacturers who have had fume hoods as a principal product for 50 years are considered.

C. Fume hoods that shall be **Comply with all regulatory requirements including but not limited to UL, ASHARE & Other Recognized Standards.**

D. Supply all equipment in accordance with this specification. Offering a product differing in materials, construction, or performance from this specification requires written approval obtained seven days or more before the proposal deadline.

E. The District/architect reserves the right to reject qualified or alternate proposals and to award based on product value where such action assures the owner greater integrity of product.

F. Manufacturer's warranty against defects in material or workmanship on its fume hoods Shall be for 3 years from date of installation and acceptance which includes replacement of parts and labor.

1.06 SUBMITTALS

A. Action Submittals

1. Laboratory hood specification sheets and product manuals shall be submitted by the hood manufacturer and include safe and proper operation and maintenance information.
2. Shop Drawings: Include plans, elevations, sections, and details.
   a. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports.
   b. Indicate locations and types of service fittings together with associated service supply connection required.
   c. Indicate duct connections, electrical connections, and locations of access panels.
   d. Include roughing-in information for mechanical, plumbing,

and electrical connections.

e. Provide face opening, volumetric rates, and static pressure drop data.

3. Submit a document detailing the information supplied on the Hood Safety Practices Label to verify compliance to specifications.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.
B. Schedule delivery of equipment so that spaces are sufficiently complete that equipment can be installed immediately following delivery.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: iQ Labs, 6172 Valduga Dr SW, Ste B, Byron Center, MI 49315
B. Basis-of-Design Product: iQ Labs Defender Series 72” W ADA compliant

2.02 ACCESSIBILITY FOR PERSONS WITH DISABILITIES

A. All fume hoods shall be furnished and installed in a manner to make them accessible to persons with disabilities in accordance with the latest versions of the California Building Code (CBC) and the American with Disabilities Act (ADA). The height of the highest point of access to the work surface above finish floor shall not exceed 34”. Fittings for piped services (shall be the lever handle type) and electrical receptacles and controls shall be of a design and mounted no higher than 48” above finished floor. A 36” wide 27” high knee clearance must be maintained under the fume hood worksurface.

2.03 MATERIALS

A. Hood Interior Liner and Baffle

1. Liner material must comply with UL 1805 and be listed within NRTL test report as proof of compliance.
2. General Material Properties
    a. Nonflammable, corrosion and chemical-resistant
    b. Sheet molded homogenous polyester panels
    c. Minimum thickness is 3/16"
    d. Smooth, white finish
3. Mechanical Properties
    a. Tensile Strength: 7,500 PSI (51.7 Mpa)
    b. Tensile Modulus: 1.7 x 10^6 PSI (11,700 Mpa)
    c. Flexural Strength: 21,000 PSI (145 Mpa)
    d. Flexural Strength at 130 degrees C: 12,900 PSI (89 Mpa)
    e. Compressive Strength: 32,500 PSI (224 Mpa)
    f. IZOD Impact Strength (Notched): 8.4 Ft Lb./in.
4. Flame and Smoke Characteristics
    a. Flame retardant, self-extinguishing, with a flame spread rating of 25 or less in accordance with ASTM-E84
    b. Oxygen Index: 35%

c. Smoke Density: 115

5. Physical Properties
   a. Water Absorption: 0.4%
   b. Specific Gravity: 4.81
   c. Coefficient of Thermal Expansion: 2 In/in/ degree C x 10^-5
   d. Thermal Conductivity: 1.9 BTU/Hr/Ft^2/In/degree F
6. Chemical Resistance
   a. Splash and Spill Resistance:
      1) Suspend sample panel in a vertical plane
      2) Apply five drops of each reagent listed with an eyedropper
      3) Apply liquid reagents at top of panel and allow to flow down full panel height
   b. Fume Resistance:
      1) Place 25 milliliters of reagent into 100 milliliters beakers and position panel over beaker tops in the proper sequence. Ensure beaker pouring lip permits air to enter the interior atmosphere.
      2) After 24 hours remove panel, flush with water, clean with detergent, rinse, wipe dry and evaluate
   c. Evaluation ratings: Change in surface finish and function shall be described by the following numerical ratings
      1) No Effect: No change in color or gloss
      2) Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material
      3) Good: Clearly discernible change in color or gloss, but no significant impairment of function or life
      4) Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period
      5) Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration
   d. Required minimum results for each reagent (Reagent: Fume Resistance Rating, Splash and Spill Resistance Rating)
      1) Hydrochloric Acid (37%): 2,1
      2) Sulfuric Acid (33%): 2,1
      3) Sulfuric Acid (77%): 1,1
      4) Sulfuric Acid (96%): 1,2
      5) Formic Acid (90%): 2,1
      6) Nitric Acid (20%): 2,2
      7) Nitric Acid (30%): 1,2
      8) Nitric Acid (70%): 3,2
      9) Hydrofluoric Acid (48%): 2,2
      10) Phosphoric Acid (85%): 1,1
      11) Chromic Acid (60%): 1,4
      12) Acetic Acid (98%): 1,1
      13) Ammonium Hydroxide (20%): 1,1
      14) Sodium Hydroxide (10%): 1,1
      15) Sodium Hydroxide (20%): 1,3
      16) Sodium Hydroxide (40%): 1,3
      17) Sodium Hydroxide Flake: 1,-
      18) Sodium Sulfide: 1,1
      19) Zinc Chloride: 2,1
      20) Tincture of Iodine: 3,3

21) Silver Nitrate: 2,1
22) Methyl Alcohol: 1,1
23) Ethyl Alcohol: 1,1
24) Butyl Alcohol: 1,1
25) Benzene: 1,1
26) Xylene: 1,1
27) Toluene: 1,1
28) Gasoline: 1,1
29) Dichloro Acetic Acid: 2,2
30) Dimethyl Formanide: 2,2
31) Ethyl Acetate: 1,1
32) Amyl Acetate: 1,1
33) Acetone: 1,1
34) Chloroform: 1,1
35) Carbon Tetrachloride: 1,1
36) Phenol: 2,2
37) Cresol: 1,1
38) Formaldehyde: 1,1
39) Trichloroethylene: 1,1
40) Ethyl Ether: 1,1
41) Furfural: 1,3
42) Methylene Chloride: 1,1
43) Mono Chloro Benzene: 1,1
44) Dioxane: 1,1
45) Methyl Ethyl Ketone: 1,1
46) Acid Dichromate: 1,2
47) Hydrogen Peroxide: 1,1
48) Napthalene: 1,1

B. Sheet Steel

1. Side panels and access panels 20-gauge (or heavier) sheet steel.
2. Hood corner posts are 18-gauge sheet steel.
3. Ceiling enclosure panels are 18-gauge sheet steel.
4. Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M.

C. Chemical Resistant Finish

1. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling.
2. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Third party validation required.
3. Powder-coat process required. Paint processes that release Volatile Organic Compounds (VOC) are not acceptable
4. Color for Fume Hood Finish: **Gray or** Standard color selected from options.

D. Safety Glass

1. Clear laminated safety glass.
   a. Clarity and temper test to be as specified in latest edition of Glass Tempering Association, *Engineering Standards Manual*, Section 8.1.
   b. Surface and interior visible quality to be as specified per ASTM C 1036, *Standard Specification for Flat Glass*, Table 4, Quality level Q3.

2.04 CONSTRUCTION

A. Superstructure:

1. Self-supporting, rigid structural assembly, to support inner wall consisting of fume hood liner and outer wall of sheet metal exterior.
2. Fabricated from galvanized steel.
3. Space shall accommodate fume hood wiring and plumbing components for service fixtures.
4. Access to fixture valves concealed in wall provided by exterior removable access panels, gasket access panels on the inside liner walls, or through removable access panels on the front posts.

B. Exterior

1. Fabricate from steel sheet with component parts screwed together.
2. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.
3. Interchangeable side panels shall lift off without the use of tools to allow access to plumbing lines, service fittings, electrical wiring, counterbalance sash weights, and light fixtures. Exposed fasteners or hardware, and Velcro type fasteners, are not acceptable.
4. Corner posts
    a. Pre-punched and plugged to accommodate up to 4 service fixtures per side
    b. All services are accessible from the front of the hood.
    c. Aerodynamic shape
    d. Accommodate two electrical duplexes per side.
    e. Right hand corner post includes electrical switches and pre-cut for Airflow monitor installation.
    f. Un-used penetrations shall be plugged.
5. Top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.
6. Panel above header shall be removable without the use of tools to allow access to mechanical connection, electrical wiring, counterbalance sash weights, and light fixtures. Exposed fasteners or hardware, and Velcro type fasteners, are not acceptable.

C. Dimensions

1. Overall exterior dimensions are as follows:
    a. 6-foot nominal width: 72” w x 54” h x 31.25” d

D. Hood Liner

1. Adhere interior liner components to superstructure.
2. Stainless steel fasteners shall be used on the interior ceiling for structural integrity.
3. Fasteners exposed to chemical environment are not acceptable.
4. Punch fume hood lining side panels to receive four service fittings, for use with remote controls, per side. Provide removable plug buttons for holes not used for indicated fittings.
5. Each side wall shall include an oval interior access panel to provide access to the side wall of the fume hood for plumbing service access. Access panel material shall be that of the liner, and gasketed to form a vapor proof seal.

E. Hood Baffle

1. Baffle system shall be designed to optimize the face velocity profile, and to capture a wide range of gaseous densities without adjustment or moving components.
2. The baffle system shall be constructed with the same material as the fume hood liner.
3. The baffles shall be removable for cleaning. The primary baffles shall be two pieces to allow removal without the use of tools.
4. Exposed components to be non-metallic. Metal components exposed to chemical environment are not acceptable.
5. Moving parts or adjustment of any kind is not acceptable.

F. Exhaust Connection

1. 316 stainless steel with Chemical-Resistant Finish
2. Ducting shall go inside the duct collar to ensure condensate travels into the hood and evaporates. Duct collars that allow duct connection over the collar are not acceptable.

G. Airfoil

1. Cold Rolled Steel, 304 stainless steel, with Chemical-Resistant Finish.
2. Airfoil shall have an aerodynamic radius to sweep the air into the hood with minimal turbulence. Airfoil directs airflow across work top to remove heavier-than-air gases.
3. Must have 5 rows of perforations to allow the air to bypass underneath and through the foil and sweep across the work surface to prevent any back flow of fumes escaping from the front of the hood opening. This airflow continues even if blocked by the presence of the operator.
4. Foil must extend back under the sash to prevent closure of the lower bypass opening when the sash is in the fully closed position, directly on top of the airfoil.

H. Sash Assembly

1. Glass: Glaze with laminated safety glass with unobstructed, side-to-side view of fume hood interior and service fixture connections.
2. Dimensions: The full sash opening height is 28", the total unobstructed viewing height is 27" measured from the work surface.
3. Sash Tracks: Steel with Chemical Resistant Finish.
4. Sash Handle: e Sash handle includes a perforated air passage directly atop the handle to bleed air into the hood chamber and direct chemical fumes away from the user's breathing zone. The handle is ergonomic in design and is easy to grasp when operating
5. Sash guides: Corrosion resistant coated cold rolled steel.
6. Sash System
    a. Vertical Sash (Cable and Pulley)
        1) Hoods have a single vertical sash counterbalanced by a single weight.
        2) Sash and weight to be connected via aircraft cable meeting MIL-W-83420 Military Specification.
        3) Rear pulleys shall be connected to prevent sash tilting and permit one finger operation at any point along full width sash handle.
        4) Maximum 7 pounds pull required to raise or lower sash throughout its full length of travel.
        5) Design system to hold sash at any position without creep and to prevent sash drop in the event of cable failure.
        6) Include a defeatable, and automatically resetting sash stop positioned for an 18” sash height.
        7) Maximum 7 pounds pull required to raise or lower sash throughout its full length of travel.
        8) Design system to hold sash at any position without creeping and to prevent sash drop in the event of chain failure.
        9) Include a defeatable, and automatically resetting sash stop positioned for an 18” sash height.

I. Electrical Components:

1. Lighting
    a. Provide UL Listed, high-efficiency, quick-start, LED lighting systems, including bulbs.
        1) 6 Foot Hoods - 1 each, 17-watt LED lamps

b. Vapor-Proof: all electrical components shall be outside of the contaminated air space. Lighting shall be located behind a laminated safety glass shield, sealed to the top of the hood liner.
c. The LED light assemblies shall be serviceable from outside the fume hood cavity, without the use of tools.
d. Light switch to be included on the lower right corner post, at heights compliant with the Americans with Disabilities Act (ADA).

2. Fume Hool Alarm
   a. Provide TEL AFA 500 Alarm Panel.
3. Blower Switch
   a. Hoods shall be provided with blower switch, on the lower right corner post, at heights compliant with the Americans with Disabilities Act (ADA) and California Building Code.
4. Electrical Receptacles
   a. The hoods shall accommodate up to four (two per corner post) electrical receptacles as indicated to include:
      1) 115-volt, 60 Hz, three-wire polarized and grounded electrical duplex, with Ground Fault Circuit Interruption (GFCI)
   b. Receptacles shall be individually wired to field wiring box, and each rated at 20 Amperes.
   c. Cover plates shall be acid resistant thermoplastic.
5. Wiring
   a. Every electrical component shall be individually wired to a single point internal field wiring box (including individual duplexes/receptacles).
   b. Field wiring box to be 7” x 4” x 2.5”, grounded, and have (12) 7/8” diameter knock out penetrations.
   c. Final field wiring and circuit dedication is to be by Electrical Contractor.
   d. Each receptacle circuit shall accommodate being wired to a dedicated building circuit rated at 20A, or the receptacles wired to a single circuit with the total load not exceeding 20 Amperes.
6. Fume hood to have third party validation of compliance to UL 1805 and UL 61010-1 by a Nationally Recognized Testing Laboratory (NRTL)

J. Electrical Requirements
1. Hoods to be UL Listed
2. Lighting: UL Listed
3. Wiring
   a. Hoods to be field wired to meet CEC 2022 codes for electrical equipment in a classified space having a potentially explosive atmosphere.

K. Upper Dilution Air Supply
1. Located behind and above the sash to introduce between 5 and 10% of the required hood air volume and maintain sufficient exhaust air volume through hood to adequately dilute hazardous fumes regardless of sash position.
2. This device bathes the sash interior above the work area to eliminate chemical fumes along the sash plane near the operator's critical breathing zone.
3. Shall act as a bypass opening controlled by sash position. If on a constant volume mechanical system, the hood shall not have a change in static pressure or exhaust volume across all sash positions.
4. Shall offer a significant restriction on the by-pass opening to allow the use of a VAV mechanical system without modification to the by-pass opening.

L. Hood Safety Practices Label: Corrosion resistant plate attached to the left corner post of the fume hood with the following Hood Safety Practices:

1. For use with substances that produce hazardous levels of airborne chemicals: gas, fumes, vapors, dust
2. Do not put your head in the hood.
3. Minimize drafts and sudden movements in front of the hood.
4. Work a minimum of six inches inside the hood.
5. Elevate equipment above the work surface.
6. Keep sill and baffle unobstructed.
7. Do not use the hood for storage.
8. Adjust the sash to smallest opening possible when in use.
9. Close sash when unattended.
10. Do not remove any of the hood components.
11. Do not place flammable solvents near heat, flame or sparks.
12. Do not evaporate large amounts of flammable liquids.
13. Wipe up spills immediately.
14. Routinely validate airflow.
15. If the ventilation system malfunctions, or airflow alarm indicates unsafe condition, close sash and discontinue hood operation immediately-call for help.
16. Do not use Biohazards and Perchloric Acid

M. Fume Hood Accessories

1. Service Fixtures: Color-coded hose nozzle outlets and valves mounted inside the fume hood and controlled from the exterior with color-coded index handles
   a. The hoods shall be provided with a total of up to 8 service fixtures as indicated in schedule.
   b. Hose connectors located inside the fume hood cavity are chemically resistant, glass-filled polypropylene with 6 serrations.
   c. Service lines shall be factory installed from valve to outlet
      1) Copper tubing unless otherwise noted
      2) Brass service lines for gas
      3) Stainless steel service lines for Deionized Water
      4) Connections shall be made with quick-connect compression fittings on the inlet and outlet of the valve body, soldered and brazed connections that are not easily disassembled are not acceptable.
      5) Inlet tubing shall be provided by contractor.
   d. Valves
      1) All handles shall be lever type in complaint of ADA and CBC.
      2) Extruded brass valve and rotating seat, TFE-coated silicone bronze stem and TFE packing.
      3) Fixture handles shall be color coded as well as labeled for the designated type of service.
      4) Fixtures shall be rated at maximum pressure of 200 psi.
      5) Valves are front or rear loaded, located on the fume hood corner post for remote use, and include:
         a) Cold tap water
         b) Natural gas
         c) Vacuum
         d) Deionized/Distilled water (Nickel plated and stainless steel components)
2. Rear Finish Panel: Shall be the same materials and coating as the hood exterior.
3. Provide vent kits at both corrosive cabinets

4. Lattice Rod Assemblies: Provide at each fume hood.
5. Safety label: Provide self-adhesive polyester label. Labels shall indicate safe operating conditions with respect to fume hood sash position.

N. Specialty flammable and acid cabinets

   a. Provide iQ lab Pro-line series chemical resistant specialty flammable and acid cabinets.
   b. Width and height of cabinets shall be coordinated and determined based on the information shown on the drawings and bleow:

      1) Knee clearance
      2) Max worksurface height
      3) Max height above finish floors of all switches, utility fitting lever handles, and outlets.

O. Work Surface and Cupsinks (see also Specification section 064116)

1. 1.25” thick, molded from solid modified epoxy resin, with smooth, non-specular, black finish.
2. One inch radius front edge for optimal fume hood performance.
3. 3/8” dished area to match the fume hood interior work space and form a water tight pan for spill containment.
4. Include a 2.5” diameter hole on each side for service pass-through and piping. Hole to be covered by hood superstructure upon installation.
5. Include two 1.5” diameter penetrations to accommodate base cabinet venting. Holes to be located outside of dished area and under the fume hood baffles. Include plugs.
6. Cup sink:
   a. 3 x 6” dimension, polypropylene construction
   b. Provide with strainers and tailpieces, NPS 1-1/2
   c. To sit flush with dished area of work surface
   d. Cup sink(s) to be located **on both sides of the fume hood. Cupsinks shall be centered with water fittings.**

2.05 EXAMINATION

A. Examine areas, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
B. Coordinate with other trades for the proper and correct installation of plumbing and electrical rough-in and for rough opening dimensions required for the installation of the hood.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.06 INSTALLATION

A. General: Install fume hoods according to shop drawings and manufacturer's written instructions.
B. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework.
C. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
D. Neighboring splash blocks shall not be attached directly to the hood.
E. Install according to standards required by authority having jurisdiction.
F. Sequence installations to ensure utility connections are achieved in an orderly and expeditious manner.

G. Touch up minor damaged surfaces caused by installation. Replace damaged components as directed by Architect.

2.07 FIELD QUALITY CONTROL

A. NFPA 45 requires that fume hoods be field tested when installed.
B. Field test installed fume hoods according to ASHRAE 110-2016 to verify compliance with performance requirements.

1. Adjust fume hoods, hood exhaust fans, building's HVAC system, and make other corrections until tested hoods perform as specified in fume hood schedule.
2. After making corrections, retest fume hoods that failed to perform as specified.

2.08 ADJUSTING AND CLEANING

A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
C. Clean adjacent construction and surfaces that may have been soiled in the course of installation of work in this section.
D. Provide all necessary protective measures to prevent exposure of equipment and surfaces from exposure to other construction activity.
E. Advise contractor of procedures and precautions for protection of material and installed equipment and casework from damage by work of other trades.

END OF SECTION

SECTION 11 53 33
ISIMET LP1 LABORATORY UTILITY SAFETY PACKAGE

TO SAFELY CONTROL AND MONITOR GAS, WATER AND ELECTRICITY IN EACH SCIENCE CLASSROOM/LABORATORY

PART 1 - GENERAL

1.01 SUMMARY

A. This document provides the minimum requirements for safely providing and monitoring the gas, water and electricity in each science classroom/laboratory. It also provides the minimum necessary requirement for addressing gas, water and electricity in the classroom should an emergency condition occur.

1.02 SCOPE OF WORK AND MINIMUM REQUIREMENTS OF A SCIENCE LAB SAFETY PACKAGAGE

A. Provide an LP1 Laboratory Safety Utility Controller Package for each science room/laboratory. This System is to include, at a minimum, the following items:

1. (1) Laboratory Safety Utility Controller with locking enclosure
2. (1) Gas Solenoid with locking enclosure
3. (2) A Cold-Water solenoid (ONE solenoids) with locking enclosure,
4. (1) Electrical disconnect with locking enclosure,
5. (1) Fuel Gas Sensor
6. (1) Panic button
7. (1) Emergency Notification Beacon
8. (1) Emergency Shower monitor.

B. Contractor to provide installation labor, necessary supervision, materials and equipment for complete installation of the LP1 in each science room/laboratory required to ensure proper and complete operation of all systems. (Miscellaneous appurtenances are not necessarily specified or indicated on the Drawings. Contractor shall provide all labor and materials not specifically indicated on the Drawings or specified in these Specifications.)

C. Installation is to be completed per the Instructions.

1.03 Manufacturer Qualifications

A. ISIMET LP1 Package is basis of the design. Alternatives packages containing all components, as listed in Section 1.2.A are acceptable as long as the minimum requirements of Section 1.3.C. are met.

B. Any Alternative to ISIMET, of any component, shall be submitted for approval prior to installation.

C. Minimum General Requirements of the Laboratory Package are:

1. Except for electrical components, the Controller and other components are to be assembled and manufactured in the United States.
2. Utility Controller shall be assembled and listed to the following:
   a. NEMA 1 rating for enclosures
   b. UL Listed to provide as rated for two-hour fire rated wall when located in fire rated wall.
   c. UL Listed to “Industrial Control panels” category
   d. UL Listed to “Cabinets” category
   e. Utility Controller shall comply with Underwriter’s Laboratory UL916 Standards.
3. All components referenced in section 1.2.A must be procured from the same manufacturer of the Laboratory Utility Controller.
4. Access to the internal components of the Safety Utility Controller must be secured by a

keyed-lock. (Access into the Utility Controller cannot be protected solely by only screws - of any type.)

5. Activation of gas, water and electricity within the classroom/laboratory must require a enabling keyed switch.
6. The gas water and electricity must be able to be shut down, for emergency shutdown, by both an emergency-stop button and at least one panic button within the Laboratory.
7. The lab must have a system in place that will shut down gas if gas is detected by means of a fuel gas sensor.
8. The Controller must have the ability to automatically shut down after a certain period of time.
9. The Controller and Emergency shower monitor must have the ability to shut down gas and electricity should the emergency shower be activated.
10. The system shall be so designed that all utilities default to “off” during an emergency or panic situation and cannot reset to on without an authorized keyed operation.
11. Controller shall have programable features that enable user to change timings and features.
12. A system containing transducers does not exclude the need for a Fuel Gas Sensor.
13. Utility Controller must have been manufacturing the Controller for at least 5 years.

1.04 CODES AND REGULATIONS REFERENCES

A. General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
B. The Utility Controller must be manufactured and listed to the criteria in Section 1.3.C.1
C. Installation of the Components and Package per the following Regulations

1. American disabilities Act
2. UL 61010
3. State and local building codes
4. National Building Codes
5. NFPA 70 National Electrical Code
6. NFPA 72 National Fire Alarm Code Uniform Building Code
7. All requirements of the local Authority having jurisdiction.

1.05 QUALITY ASSURANCE

A. General

1. It is the intent of these Specifications and the Drawings, to secure the highest quality in all equipment and materials, and to require first-class workmanship, in order to facilitate trouble free operation and minimum maintenance of the electrical system.
2. All work, including installation, connection, calibration, testing and adjustment, shall be performed by qualified, experienced personnel who are technically skilled in their trades, are thoroughly instructed, and are competently supervised by a certified electrician. The resulting complete installation shall reflect professional quality work, employing industrial standards and methods. Any and all defective material or inferior workmanship shall be corrected immediately at no additional cost to the District.
3. All equipment and materials shall be new, listed by UL and bearing the UL label, unless exception to this requirement is inherent to an individual item specified herein, or exception is otherwise specified, or approved, via a written allowance.
4. Equipment and materials shall be the products of reputable, experienced manufacturers. Singular items in the project shall be the products of the same manufacturer. All equipment and materials shall be of industrial grade and heavy-duty construction, shall be of sturdy design and manufacture, and shall be capable of long, reliable, trouble-free service.

5. Contractor shall furnish manufacturer's electrical equipment of the types and sizes specified which has successfully operated for not less than the past five years, except where specific types are named by manufacturer and catalog number or designation under other Sections of the Contract Documents.

1.06 WARRANTY REQUIREMENTS

A. Provide verification that the warranty of the Controller is at least 1 year.
B. Once the contractor verifies the system is installed correctly, provide the acknowledgement that manufacturer of the system components, has received the warranty card.

1.07 SUBMITTALS

A. General: Comply with Division 1 Submittals Procedure
B. Equipment is not to be ordered without approved submittals. All deviations from the Contract Documents shall be indicated within a submittal. Each deviation shall reference the corresponding drawing or specification number, show the contract document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.
C. Product Data: (For each Component of the Laboratory Utility Control Package.)

1. Manufacturer,
2. Model Number
3. Detail all options and accessories
4. Catalog Data Sheet

D. Provide detail wiring diagram for power and wiring between all components and integration into the building system.
E. Provide Manufacturer’s operation and maintenance information as well as Installation instructions.
F. Provide specifics on Panic Button(s) and Utility Controller location.

PART 2 - PRODUCTS

The LP1 Package includes the minimum components and Devices for controlling the gas, water and electricity in the science lab. The following LP1 Package components shall be provided as shown on Drawings and as listed in the Equipment Schedule.

2.01 UTILITY CONTROLLER:

A. At each science classroom and elsewhere as shown on Drawings, provide a Utility Controller with panel mounted switches to activate remote solenoids and relays to control the domestic water, gas, and electrical convenience outlets or other indicated services or devices. Unit shall control utility outlets at student workstations or other locations as indicated by Drawings. The Controller shall be equipped with an enabling key switch that restricts activation of output circuits, to the Instructor. Deactivation of output circuits shall not require engagement of enabling key.

2.02 E - SERIES ENCLOSURE WITH ELECTRICAL DISCONNECT

A. At each science classroom and as shown on Drawings, provide an E-Series Enclosure with mechanically held contacts for each circuit as shown on Drawings. The enclosure shall be integrated with Utility Controller as shown on Drawings. Locate enclosure as shown on Drawings.

2.03 S - SERIES SOLENOID ENCLOSURE WITH SOLENOIDS

A. At each science classroom and where shown on Drawings, provide an S-Series Enclosure. Provide with integral in-line strainer for each domestic water service assembly. Enclosure shall be integrated with Utility Controller as shown on Drawings. Number of solenoid assemblies,

intended use and pipe sizes are as noted in Equipment Schedule. Locate enclosure as shown on Drawings. Provide shock arrestor in flow stream at each domestic water service assembly.

2.04 REMOTE PANIC BUTTON

A. Where shown on Drawings and where classroom size and configuration restrict maximum clear path range distance from Remote Panic Button to Utility Controller or other additional Panic Buttons per Code and verify if Panic Button needs to be near Exit door. Integrate Assembly with Controller.

2.05 MONITORING BEACON:

A. Where shown on Drawings and in Equipment Schedule, furnish and install a wall mounted Panic-Alarm Light Indicator. Location and mounting height shall be as directed by Architect. Make final wiring connection to Indicator.

2.06 EMERGENCY SHOWER MONITORING UNIT:

A. Where shown on Drawings and in Equipment Schedule, furnish and install an Emergency Shower Monitoring Unit. Install flow-switch assembly in piping system directly up-stream of the shower.

2.07 FUEL GAS SENSOR

A. Where shown on Drawings and in Equipment Schedule, furnish and install a Fuel Gas Sensor in order to gas within the classroom.

2.08 LA - SERIES CONTROL PANEL (OPTIONAL COMPONENT/DEVICES):

A. Where shown on Drawings, provide an LA Series Control Panel at Prep Room and at instructor's demonstration station having utility outlets. LA Series shall control all utilities at station and integrate with Utility Controller at remote output contacts. Panel shall be mounted at station on surface face of casework. Panel shall be equipped with an enabling key switch that restricts operation to the instructor and a momentary panic button assembly.
B. Where shown on Drawings, provide an LA - Series Control Panel at instructor's demonstration station. Panel shall control all utilities at the station and be mounted on surface of casework.

PART 3 - INTEGRATION AND CONFIGURATION

3.01 Energy Management Control System – "EMS"

A. Where no "EMS" interface is available then Controller should be programmed for "first keying" whereby unit will operate for the designated time prior to programmed shutdown.

3.02 Utility Controllers

A. Utility Controller shall be capable of field adjustments to meet specific project modification requirements. Configurations shall be limited to jumper placement on the circuit board and specific program position changes on digital display at PC Board without requirement for additional modifications to equipment.

3.03 Classroom Utilities:

A. Each utility service with outlets at student workstations shall be controlled by Utility Controller. Control of services shall not be combined onto one output circuit unless indicated on Drawings. Services shall be activated by Controller door panel switches and the engaging of the service enabling key. Activation of utility services shall be restricted to the Instructor by means of the enabling key switch. Where systems include domestic hot and cold water, a single output circuit shall control those systems simultaneously.

3.04 Panic Reset:

A. Unless stated elsewhere on Drawings, the Utility Controller shall be configured so that reset of Panic State may occur at service enabling key switch on door panel.

3.05 Fume Hoods:

A. Where indicated by the Drawings, configure classroom fume hoods so that Utility Controller will disable the fume hood during room non-occupied mode. Operating power shall be routed through control relay located in ELC-Series Enclosure for the specified room. Fume hood shall not be operational until after first enabling key engagement.

3.06 Instructor Demonstration Stations and Prep Rooms:

A. Integration with Controller shall permit shutdown of station on “ems” withdrawal and reactivation upon “ems” active only upon key engagement at LA Series Panel. Panic button at Controller or station shall disable station. Reset after panic at the station shall be independent from primary Controller. Panel shall be mounted at station on surface of casework and as directed by the Architect.

3.07 Exhaust Fan:

A. Where indicated by the Drawings, classrooms having an exhaust fan shall have fan configured with Utility Controller. Fan shall be integrated with Utility Controller. Fan shall activate upon pressing of the Panic Button. Fan shall shut off when Emergency Stop is activated. Exhaust fan shall not be operational until after first enabling key engagement.

3.08 Panic Button:

A. Each Utility Controller System shall be configured so that pressing the panic button will disable all utilities at all student workstations and any integrated demonstration stations. .

3.09 Emergency Showers:

A. Where shown on Drawing, provide an Emergency Shower Monitoring Unit to recognize flow at the emergency shower. Upon flow, Controller shall integrate with Controller and set system in Panic state. A delay setting, if desired, is to be field configured.

3.10 Fuel Gas Sensor:

A. Unit shall integrate with Controller and turn OFF designated outputs.

3.11 Hand-Held Key Fob Panic Button:

A. When indicated in Equipment Schedule that *Line of Sight* Utility Controller is provided, key fob Panic Button shall deactivate all output circuits while sending alarm and activating purge fan.

PART 4 - EXECUTION

4.01 INSTALLATION:

A. Install in accordance with manufacturer's recommendations and instructions and codes per 1.4.B

B. Furnish and install all devices as shown on Drawings and as specified herein. Where device is to be installed by other trades, furnish and then turn over to appropriate trade for installation.

4.02 PLUMBING:

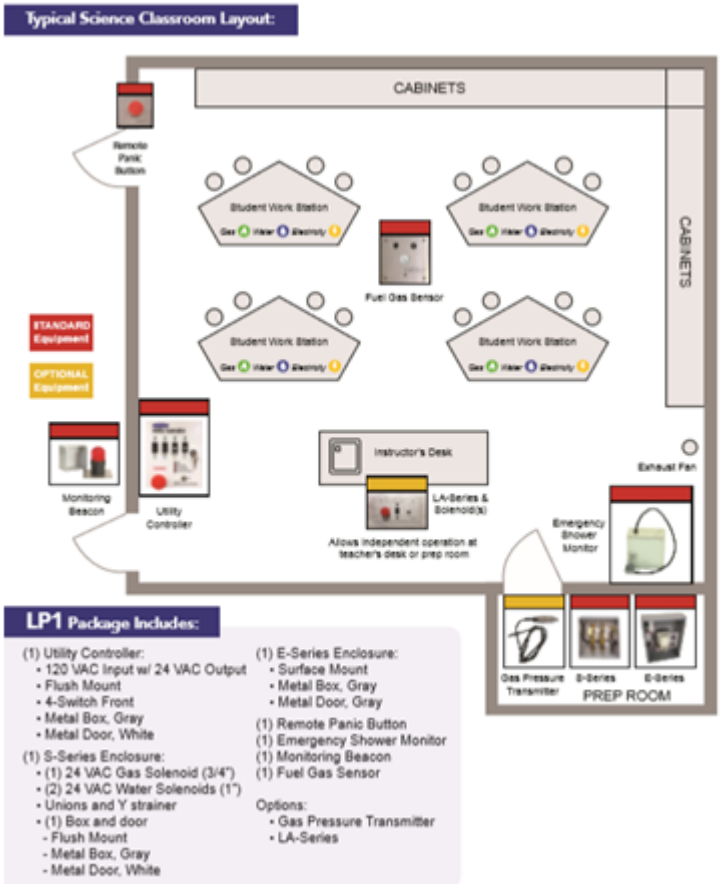
A. Contractor shall furnish necessary piping and fittings.

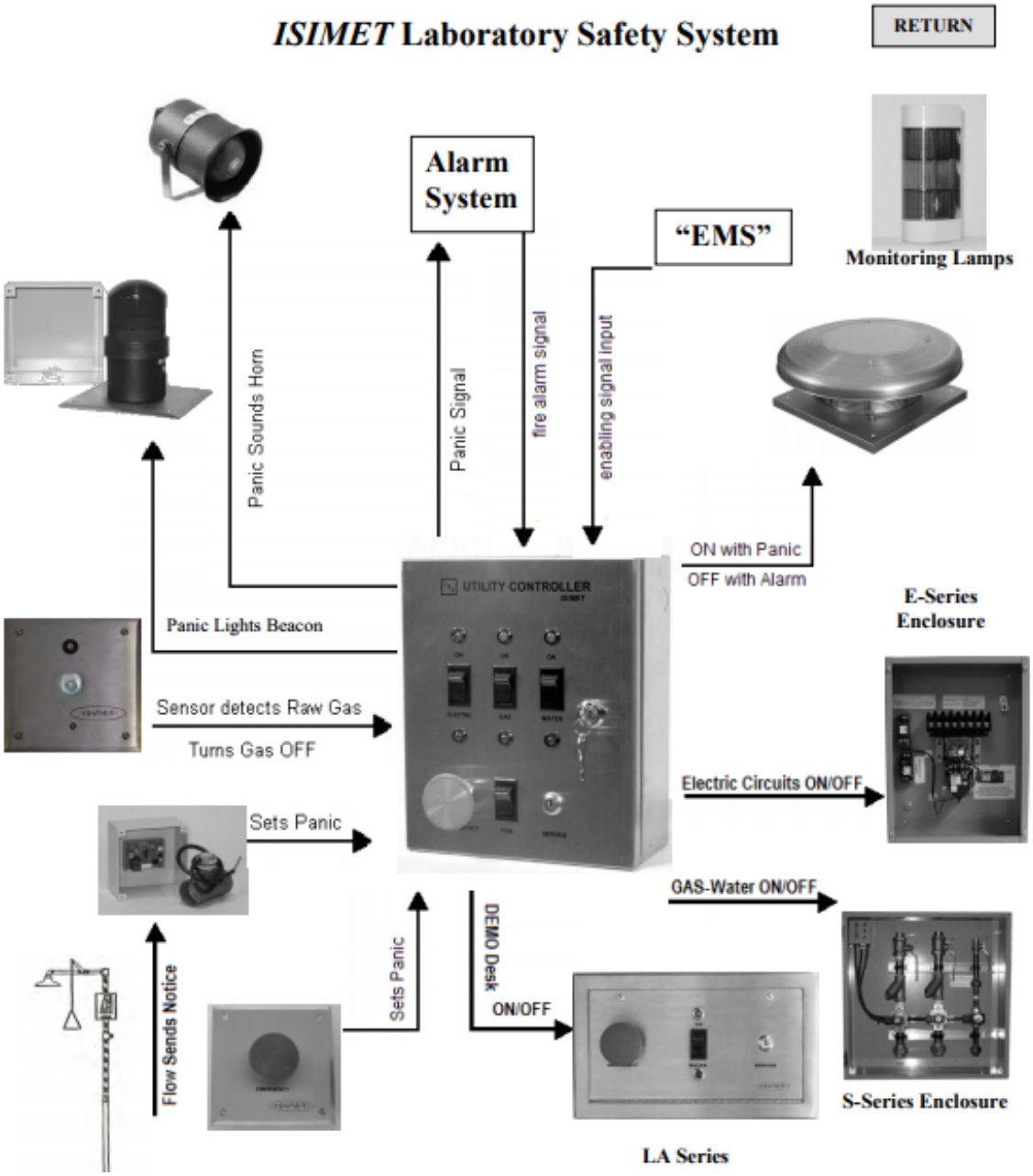
4.03 ELECTRICAL:

A. Electrical Contractor shall furnish all conduit and wiring, making final wiring connections to all equipment as indicated by Drawings and specifications. Contractor shall be responsible for all system configurations, integration, test and start-up.

4.04 SPECIAL NOTE ON THE NEED FOR WIRING CONDUIT:

A. Unless otherwise specified for wiring systems, provide conduits for control and integration wiring from point of connection to each device to accessible point above ceiling.





END OF SECTION

SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

A. Related Sections:

1. Section 22 05 10: Plumbing Systems
2. Section 22 05 20: Plumbing Equipment and Systems Tests
3. Section 22 05 40: Plumbing Demolition and Repair
4. Section 22 05 50: Basic Plumbing Materials and Methods

1.02 SYSTEM REQUIREMENTS

A. Plumbing system shall be complete, tested, and demonstrated to be in perfect operating condition.

B. In the event the District should choose to enter upon and use any portion of the work (beneficial occupancy) prior to the completion of operational testing, capacity testing and Plumbing Systems, but after the passing of the established completion date, the contractor shall adequately staff the project to operate (manually, if necessary) and maintain the equipment and systems until such time as they have been demonstrated to the District to acceptably meet all the contract requirements.

1.03 EQUIPMENT AND MATERIALS, GENERAL

A. Submittals Required:

1. Prior to the start of any work, Contractor shall provide pdf copies of a list of all materials and equipment covered by Division 22 shall be submitted by the Contractor in conformance with the requirements of Division 1 and reviewed by the Architect/District and Engineer. Contractor shall allow ample time for checking and processing and shall assume all responsibility for delays incurred due to rejected items. No installation of material concerned shall be made until stamped submittals have been obtained from the District. Acceptance of material and equipment submittals shall in no way obviate compliance with the plans and specifications.
2. Additionally, each item proposed shall be referenced to the section, page, and paragraph of the specifications. For each item proposed, give name of manufacturer, trade name, and the catalog performance data for all equipment, including all applicable optional items as specified. Lists shall be complete for the project and shall be submitted at one time, bound in sets in three ring loose leaf stiff covered binders, indexed, with tabs for easy reference. All sets shall be identical.
3. Additional items to be included in submittals:
   a. Sterilization test reports.
   b. Test data & reports.

B. Requirements of equipment which increases the scope of the work.

1. The contract plans indicate the installation of the equipment of one set of manufacturers. Other acceptable manufacturers which are equal or superior to specified design intent may be considered subject to approval & evaluation from Architect and District.
2. If the installation of the particular equipment the Contractor has submitted under Division 22 requires changes in material or labor from that required in the contract plans and specifications, such drawings shall be submitted as prior to bidding.
3. Any changes in piping, wiring, controls, or installation procedures required by the equipment shall be made at no additional cost to the District, and with no reduction in scope.

C. Equipment Layout Shop Drawings:

1. The Contractor shall submit "Equipment Layout Drawings" for each equipment room or area containing items of equipment furnished under this section.
2. Layout drawings shall consist of a plan view of the room, to scale, showing the projected outline of all equipment, complete with indication of all required clearances including those needed for removal of service. The location of all floor drains, piping, ductwork, electrical, plumbing, supports and other equipment shall be indicated. Sectional views shall be furnished as required to show overhead clearances.
3. Submit dimensioned drawings of ductwork and related accessories and equipment with sizes and location of ducts, diffusers, grilles, registers, automatic fire dampers, access panels, etc.
4. Construction drawings or part thereof shall not be used for shop drawing submittals. Contractor shall prepare and draw their own shop drawings and submit for review and approval.
5. Contractor shall review the drawings thoroughly including construction drawings by other disciplines prior to preparation of shop drawings and coordinate equipment, ductwork and piping layout with any obstructions.
6. Request for information (RFI) generated by the contractor will not be entertained unless shop drawings are submitted.

D. Operation and Maintenance Manuals:

1. Manual shall be indexed with tabs for easy reference bound in 3 ring binders and shall include valve charts, piping diagrams, control diagrams, cleaning reports, test reports, service instructions and parts list of all machinery and an electronic digital copy in PDF format.
2. This manual shall be submitted for approval at least 30 days before final inspection. Failure to submit the diagram and service manual will delay final inspection and acceptance of the work.
3. Two copies of the manual shall be delivered to the District on or before the date of the final inspection, and each copy of the service manual shall be identical.
4. After review by the Architect, the control diagrams shall be mounted in a neat frame with suitable backing, under clear glass and installed where directed.
5. Where applicable, the following specified information, together with any pertinent data, shall be included in the service manual.
    a. Part numbers of all replaceable items.
    b. Manufacturer's cuts and rating data or curves.
    c. Lubrication and other maintenance data.
    d. Test reports.
    e. ASME data sheets for each pressure vessel.
    f. Supplier's names, addresses and phone numbers.
    g. Valve chart indicating location on job.
    h. Cleaning report.
    i. Domestic water sterilization certification.

1.04 REFERENCES

A. References made herein, or in any of the Mechanical Sections listed above, to standards, codes specifications, or recommendations of various technical societies, trade organizations, or governmental agencies are to the edition in effect at the time of the proposal, including all addenda.
B. Furnish, for the use in the Construction field office, one copy of each field installation standard referred to in these specifications.

1.05 RECORD DRAWINGS

A. Provide complete sets of mechanical drawings in PDF format as record drawings, which shall be separate, clean, blue line prints reserved for the purpose of showing a complete picture of the work

as actually installed.

B. These drawings shall also serve as work progress report.

C. Sheets and the Contractor shall make any notations, neat and legible, thereon daily as the work proceeds. These drawings shall be available for inspection at all times and shall be kept at the job at a location designated by the Engineer.

D. All buried service piping and indicated future connections outside of any building shall be located both by depth and by accurate measurement from a permanently established landmark such as a building or structure. Measurements shall be verified by the Engineer prior to backfilling.

E. At completion of the work, these record drawings shall be signed by the Contractor, dated and returned to the Architect.

1.06 SURVEY OF SITE

A. Before submitting proposals for this work, each bidder shall become familiar with plans and specifications and shall have examined the premises and understand the conditions under which he will be obliged to operate in performing his contract. No allowance will be made subsequently in this connection for any error through negligence on the part of the Contractor.

1.07 CODES

A. All work performed under this section of the specification is under the following listed jurisdictional agencies and will be so inspected for code compliance.

ADA	Americans with Disabilities Act.
ANSI	American National Standards Institute.
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers.
ASME	American Society of Mechanical Engineers.
ASTM	American Society of Testing Materials.
AWS	American Welding Society.
AWSC	American Welding Society Code.
AWWA	American Water Works Association.
CEC	California Energy Commission.
NFPA	National Fire Protection Association.
OSHA	Occupational Safety & Health Administration
SFM	State Fire Marshall
SMACNA	Sheet Metal & Air Conditioning Contractor
National Association. UL	Underwriters Laboratories, Inc.
UBC	Uniform Building Code
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
CCR	State of California Code of Regulations
ETL	Electronic Testing Laboratories

B. Materials, equipment, and their installation shall comply with the requirements of the General Safety Orders, Department of Industrial Relations, State of California.

C. All reference codes and standards shall be the latest edition.

1.08 PERMITS, LICENSES, AND INSPECTIONS

A. Refer to the "General Conditions" of these specifications regarding these items.

1.09 DRAWINGS/SPECIFICATIONS

A. For purposes of clarity and legibility, the drawings are essentially diagrammatic and although size and location or equipment is drawn to scale wherever possible, Contractor shall make use of all data in all of the contract documents and verify this information at building site. Contractor shall fully inform himself regarding the peculiarities and limitations of the spaces available for the installation of work and materials furnished under this Division.

B. Drawings indicate required size and termination of pipes and ducts and suggest proper routes of piping and duct to conform to the structure, to avoid obstructions and to preserve clearance. However, it is not the intention to indicate all necessary offsets and it shall be the responsibility under this section to install ductwork and piping in such a manner as to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear and make all equipment requiring inspection, maintenance and repair, accessible without further instructions or extra cost to the District.

C. Check with other divisions of the work so that no interferences shall occur and in order that grade lines may be established for the work. No extras will be allowed for changes made necessary by interference with the work of other trades.

D. Drawings and Specifications: Specifications are intended to cover all labor, materials, equipment and standards of mechanical workmanship to be employed in work shown on drawings, called for in these Specifications, or reasonably implied by terms of same. Drawings and specifications are intended to supplement one another and part of work that may be mentioned in one and not represented in other, shall be done the same as if it has been mentioned or represented in both. Large scale drawings shall take precedence over layouts and shall scale details. Omission from specifications or drawings of any minor details of construction, installation, materials, or essential specialties shall not relieve Contractor from furnishing same in place complete.

1.10 WARRANTY AND DAMAGE RESPONSIBILITY

A. Furnish to the District a written warranty against defects in materials and workmanship in conformance with the requirements of Division 1. The Contractor shall be responsible for damage to the grounds, buildings, or equipment, and the loss of refrigerants, fuels, or gases caused by leaks or breaks in pipes or equipment new or existing resulting from the work of this Division.

1.11 DEFINITIONS

A. Definitions: Terms used herein and in the individual mechanical sections of the specification are defined as follows:

1. This Division: The Mechanical Division of the Specifications; a portion of the specifications that includes all the Sections of the specifications listed herein under "Work of This Section".
2. Individual Mechanical Section: Any one of the sections of the specifications listed under "Work of This Section", herein.
3. Other Divisions: The portion of the specifications that does not include the Mechanical Division.
4. Similar to: An alternative item of material or equipment which, in the opinion of the Engineer, matches the named item as to arrangement, materials, function and performance. The performance shall match or exceed that scheduled or advertised for the named item.
5. Utility Services: Those existing active, functioning systems, both primary and
6. secondary, which provide a facility and its occupants with heating, cooling, ventilating and sanitary functions.
7. Concealed: Hidden from sight as in trenches, chases, hollow construction, or above furred spaces, or exposed to view in tunnels, attics, shafts, crawl spaces or other unfinished areas.
8. Accessible: Possible for a 6'-0", 180-pound person to approach adequately and with sufficient

work room to service, repair or replace concealed equipment.
9. Exposed: Not concealed as defined above except machinery and fan rooms.
10. Riser: A vertical pipe or duct having a vertical length greater than one story height.
11. Drop: A vertical pipe or duct that does not penetrate a floor.
12. Up-Feed Connection: A vertical pipe or duct that penetrates a floor, but has a vertical length of less than one story height.
13. Main: A pipe or duct which branches.
14. Branch: A pipe or duct which does not re-branch.
15. Header: A pipe or duct of constant size that serves a battery of closely spaced inlet or outlet connections.
16. Piping: Includes pipe, fittings, valves, hangers, and all pipe mounted devices that make up a system.
17. Unfinished space: A room or space that is ordinarily accessible only to building maintenance personnel. A room listed in the finish schedule as having exposed and unpainted construction for walls, floors, and ceiling. A room specifically mentioned as "Unfinished".
18. Finished Space: A room or space that is not Unfinished as described above; any space ordinarily visible to a regular occupant, including exterior spaces.

1.12 CERTIFICATION OF WELDERS

A. Where welding is required by work of this Division, such work shall be performed only by welders qualified and certified by a recognized, approved agency (DSA). Such certification shall bear date not more than twelve months prior to date of starting work under this Division, unless welder has been constantly employed by Contractor since last certification.

1. Pipe welding shall comply with the latest revision of applicable code, ASME Boiler Construction Code, American Welding Society Processes, ASME Code for pressure piping, and State and Federal requirements. Before welding is performed, contractor shall submit to Engineer evidence of compliance of welding procedure and operator's qualifications according to provisions of governing codes. Standard procedure Specifications and operations qualified by National Certified Pipe Welding Bureau shall be considered as conforming to requirements of these Specifications.
2. Welders shall have State of California C-60 License.

1.13 PRODUCT DELIVERY STORAGE AND HANDLING

A. During loading, transporting and unloading, exercise care to prevent damage to materials. Use padded or strap slings as appropriate for handling materials. Lift equipment by lift points provided or recommended by manufacturer. Do not drop pipe, fittings, valves and specialties. Upon receipt, inspect materials for defects or for compliance with Contract Documents. Tag, stencil or permanently identify materials to adequately identify specialty items. Do not allow stainless steel to contact carbon steel during delivery, storage, handling or during or after installation.

1. Store all materials on site in enclosures or under protective covering to keep clean and dry. Do not store materials directly on ground. Store stainless steel on wood.
2. Store loose materials such as fittings, gaskets, bolts, nuts, small valves, traps, and specialties in bins of sufficient number to provide proper separation. Protect ends of large fittings, valves and pipe from weather and abuse. Properly grease all machined surfaces.
3. Remove rust spots from stainless steel by brushing with stainless steel brush.

1.14 SEISMIC RESTRAINTS

A. Contractor shall be responsible for all anchors and connections of mechanical work to the building structure to prevent damage because of an earthquake, including piping, manufactured equipment, and the integrity of shop fabricated and field fabricated materials and equipment. Reference details per "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" as published by SMACNA and PPIC, latest edition.

PART 2 - PRODUCTS

2.01 GENERAL

A. The products, assemblies, and methods shall be as described in the pertinent Mechanical Sections of the work.
B. Materials: New and of recent manufacturer, and of quality as specified herein and consistent with building design and intent.
C. Manufacturer: Unless otherwise provided, all mechanical items shall be substantially the same as the specified item manufacturer, which on date of opening of bids, have been in successful commercial use and operation for not less than one year in projects and units of comparable size.

2.02 MANUFACTURED PRODUCTS

A. Manufacturer's names and model numbers on the drawings are to establish type and class of material and equipment and, except for "or equal" requirements of the general conditions, products shall be by one of the manufacturers named by the specifications which shall include the names on the drawings as if therein written. When no names are listed in the specifications, any manufactured product equal to the manufacturer named on the drawings and which complies with the specifications may be acceptable.
B. The scheduled capacity requirements take precedence over the listed manufacturer's equipment size.
C. Wherever possible, all materials and equipment used in the installation of this work will be of the same brand or manufacture throughout for each class of material or equipment.
D. All rotating equipment shall operate in perfect dynamic balance.
E. Each item of manufactured equipment shall bear the manufacturer's non-ferrous metal nameplate. The manufacturer's name, model number, serial number and capacity ratings shall be permanently stamped or etched thereon.
F. No item of material or equipment shall be installed for any purpose in any manner not recommended by the manufacturer in his published literature. If recommended manufacturer installation requires additional pipe, ductwork or accessories it shall be installed by the contractor without additional cost to the District.

2.03 ALTERNATE EQUIPMENT

A. Equipment layout, piping connections, etc., are based on units as scheduled on the Drawings. If alternate or approved substitution equipment is used, it is the responsibility of this Contractor to make necessary modifications to provide an operating installation, including electrical requirements, controls, all service clearances around the equipment and shall be in complete conformance with the Uniform Mechanical and Plumbing code and all specifications and recommendations of the manufacturer without any additional cost to the District.

PART 3 - EXECUTION

3.01 PROTECTION, CARE AND CLEANING

A. The premises shall be maintained as required by Division 1.
B. Materials and Equipment:

1. Effectively protect materials and equipment to be installed on the project against moisture, dirt, and damage during the construction period, to the satisfaction of the District. Special care shall be taken to provide protective covering of bearings, open connections to pumps and tanks, coils, and similar equipment that are particularly vulnerable to grit and dirt.
2. Keep interior of all ductwork free of dirt, grit, dust, insulation, and other foreign materials at all times. Do not operate air distribution equipment until building is cleaned and air filters

installed in order to prevent soiling of diffusers, ducts, air handling equipment and buildings.

3. Drain and flush piping to remove grease and foreign matter. Thoroughly clean out valves, traps and strainers and demonstrate the cleanliness to the District.

3.02 EXCAVATION AND BACKFILL

A. General:

1. Do all excavation and backfill required to install the work of this Division both inside and outside.
2. Perform all excavation and backfilling in accordance with the requirements of the District.

B. Excavation: Bury required piping to a depth of not less than 36" below finish grade unless noted otherwise.

C. Backfilling: Do not backfill until after final inspection and approval of the piping installation by IOR, Architect & District Construction Manager.

3.03 INSTALLATION OF EQUIPMENT

A. Equipment shall be secured in place using fasteners as recommended by SMACNA's "Guideline for Seismic Restraints of Mechanical Systems" latest edition. Bolt sizes as a minimum shall be per the following schedule:

Bolt Size Inches	Equipment Weight Per Bolt, Pounds
3/8	50
1/2	120
5/16	225
3/4	300
7/8	950

B. All concrete work unique to the work of this Division and not a part of the structure (see structural drawings and details for anchorages and support to equipment), shall be done completely. Work shall include furnishing all dimensioned drawings for bases, pads, openings, etc., and finishing and installing all anchor bolts, inserts, etc. Coordinate with General Contractor.

3.04 EXISTING UTILITIES AND SERVICES

A. Location and character of principal existing utilities, including dimensions as shown on the drawings for convenience only, are believed complete and correct, but shall be subject to verification by the Contractor, as the Architect assumes no responsibility for their correctness.

3.05 SEISMIC RESTRAINT CODE REQUIREMENTS

A. California Code of Regulations, Title 17 and 24; SMACNA and NFPA.

3.06 ELECTRICAL WORK

A. Furnish a complete electrical interlock wiring diagram and describe sequence of operation to show all field wiring for operating the particular equipment the contractor proposes to install. The diagram shall identify the wire color and the connection terminals of each item of equipment furnished for complete operating systems.

B. Any additional line or low voltage electrical wiring and conduit required over that shown in the Electrical Division of the work as required for complete and perfectly operating systems, shall be furnished under this Division in complete conformance with the requirements of the Electrical Division.

3.07 OPERATING INSTRUCTIONS

A. After all systems have been completely installed, verified to be operating perfectly and all tests completed and accepted, arrangements shall be made to operate all systems for a period of one week. Ten (10) days advance written notification of this period shall be given the District. During this period, the Contractor may make necessary minor but not interruptive adjustments. At this time, he shall instruct the District's operating personnel in the operation and maintenance of the various items of equipment.
B. The Contractor shall furnish, without additional cost to the District the services of competent instructors who will give full instruction to the District's designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment or system specified.
C. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. The number of man-hours of instruction shall be a minimum of 8 hours in increments, as scheduled by the district's Representative.

3.08 EMERGENCY REPAIRS

A. The District reserves the right to make temporary repairs as necessary to keep equipment in operating condition which shall neither void the Contractor's guarantee bond nor relieve the Contractor of his responsibility during the bonding period.

3.09 INTERRUPTION OF EXISTING UTILITIES OR SERVICES

A. The Contractor shall submit to the Engineer for approval a written schedule for the shutdown, removal, installation and connection of materials. Any shutdown of utility services shall be coordinated with the District. Prior written notification of seventy-two (72) hours minimum shall be given for any such shutdowns.

3.10 INITIAL LUBRICATION, ADJUSTING AND FILLING OF SYSTEM

A. Before operating any of the mechanical systems, lubricate equipment bearings and check belts, pulleys, and other moving parts of alignment and tolerances in accordance with equipment manufacturer's operating instructions. Flush piping and liquid systems and fill with operating fluids. After tests, adjust valves and other parts of the work for quiet operation. Clean strainers by removing and washing basket or screen. Change lubricating oil in compressors. Suppress all vibration and noise.

3.11 STARTUP

A. Startup of all major equipment and other special equipment shall be performed by manufacturer's start-up technicians. Contractor shall be responsible for procuring such service.

3.12 WATER STERILIZATION

A. The entire domestic water piping system shall be sterilized before being turned on for use by the District. The Plumbing Contractor shall request an inspection by the Health Department and shall deliver certification to the District.

END OF SECTION

SECTION 22 05 10
PLUMBING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. All labor, materials and equipment for a complete and operable plumbing system, consisting of domestic cold water supply, DI water, waste/sewer and vent connections, Acid Neutralizer piping as indicated, natural fuel gas, and waste and vent systems for new plumbing fixtures including all fittings, valves, trenching, backfilling, saw cutting, sleeves, rough-in and final connections to equipment as specified and as indicated on the drawings and unless otherwise herein specified, shall be complete, tested and ready for use.
2. The work includes, but is not necessarily limited to the following:

a. Plumbing labor, materials and equipment and rough-in and all final connections to all equipment and fixtures requiring such connections, whether such equipment and fixtures are furnished under this section or under other sections of these specifications or not indicated on the drawings or specifications, which are required for proper operation of the systems, in accordance with the true intent and meeting of the Contract Documents, shall be provided and incorporated in the work by and at the expense of the Contractor.
b. All necessary drilling, cutting, and patching are required for the work. Repair all concrete slabs as necessary. Patching materials and finishing shall match the surrounding work.

1.02 EXAMINATION OF SITE

A. Before bidding on this Work, the Contractor shall thoroughly familiarize himself with all of the existing conditions and the requirements of the Project.

1. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and to accept all conditions presented in the Drawings, herein specified or at the site.
2. No request for additional payment will be considered as valid due to failure to allow for conditions which may exist. All openings through roofs and walls shall be acceptable to the Architect and District's representative.

1.03 PERMITS AND INSPECTIONS

A. All work shall comply with the requirements of all applicable CA 2022 codes, laws, ordinances, regulations, and other authorities having jurisdiction.

1.04 COORDINATION

A. Coordinate this Work with the work of other trades to expedite the Project progress.
B. Work closely with all trades making certain all items are covered. No extras will be allowed for any controversies arising between the trades.

1.05 CLOSING IN WORK

A. Do not allow any of the work of this Section to be enclosed or covered up until approved by

enforcing agencies. If any work is covered up before such inspection and approval, uncover it, and after it has been inspected, tested and approved, restore it to its original condition at no additional cost to the Owner.

1.06 RESPONSIBILITY

A. Be responsible for the safety and good condition of all material and equipment of the entire installation until final acceptance of work by the District.

1.07 VERIFICATION OF DIMENSIONS

A. All scaled and figured dimensions are approximate and are given for estimating purposes only. Before proceeding with the work of this Section, carefully check and verify all dimensions and sizes.

1.08 CUTTING AND PATCHING

A. Do all cutting and patching required for installation of Work under this Contract. Patching is to match surrounding materials and finish.
B. Holes or notches shall not be cut in structural members without written consent of the Architect/Structural Engineer.
C. Arrange for and place all necessary sleeves or openings in the structure where allowed.

1.09 MATERIALS

A. All materials, appliances and equipment shall be new and listed by UL or other Testing laboratories free from all defects and of the make, brand and quality specified or as accepted by the Architect as herein provided. This shall apply to all parts of the work whether or not this particular paragraph is referred to by number.
B. Except as otherwise specified; all materials used in the fabrication and construction of the various parts of the equipment included in this work shall be in accordance with the latest standard specifications of the American Society for Testing Materials. All articles provided for the same general purpose or use shall be of the same make except as otherwise specified.

1.10 SHOP DRAWINGS

A. Submit PDF copies of a list complete for all materials and equipment specified and listed which he proposes to install. These lists shall set forth the Specification page number; manufacturer's name, model number, sizes, non-standard accessories specified, and such other information required to identify all items.

1.11 CONFLICTS BETWEEN CONTRACT DOCUMENTS

A. In the event of conflicting requirements between items on the drawings, or between items in the specifications, or between items on the drawings and in the specifications, the more stringent or costly shall govern, unless decided otherwise by the Engineer, who shall be the sole judge in these matters.

1.12 CONFLICT IN SHOP DRAWINGS OR SUBMITTALS

A. Contractor agrees that shop drawing submittals processed by the Architect do not become

contract documents and are not change orders, that the purpose of the shop drawing review is to establish a reporting procedure and is intended for contractor's convenience in organizing his work and to permit the Architect to monitor the contractor's progress and understanding of the design.

B. The process of review of the contractor's submittals is not the purpose of testing the Architect's perception. If submittals and the contract documents are discovered either prior to or after the shop drawing submittals were processed by the Engineer, the contractor agrees that the contract documents shall control and shall be followed.
C. It is also the responsibility of the contractor to review the shop drawings or submittals to be submitted prior to submittal to the Architect for his review. If shop drawings or submittals are received without the contractor's review stamp, the shop drawings or submittals will be returned to the contractor prior to the Engineer's review.

1.13 EXISTING UTILITY LINES

A. Location and character of principal existing utilities, including dimensions as shown on the Drawings, for convenience only, are believed complete and correct but shall be subject to verification by the Contractor, as the Owner assumes no responsibility for their correctness.
B. Adjust location or alignment of the new work as necessary to avoid or to connect to existing utilities or piping without additional cost to the District.

1.14 INTENT OF DRAWINGS

A. The drawings are essentially diagrammatic. The size and location of equipment and fixtures are drawn to scale wherever possible.
B. The Contract Drawings show the extent and general arrangement of the work covered under this section.
C. The work shall be followed as closely as possible; however, proper adjustments shall be made, with the Architect's concurrence, to secure maximum headroom, a neat arrangement to keep passageways and openings clear, provide accessibility and provisions for maintenance, and meet all Code requirements, at no additional charges.

1.15 EXCAVATING, TRENCHING AND BACKFILLING

A. The mechanical work shall include all saw cutting, excavating, trenching, and backfilling required for the installation of piping, anchor blocks, and any other devices that are a part of this work.
B. Backfilling shall be performed in accordance with the applicable portions of other sections herein before.
C. Backfill shall not be placed until the mechanical work installed has been inspected, tested, and approved by the special inspector concerned.

1.16 CUTTING AND PATCHING

A. The Contractor shall do all drilling, cutting, and patching of the general construction work, rough, finish, and trim, which may be required for the installation of the work. All patching shall be of the same materials, workmanship, and finish as the original work, and shall accurately

match the surrounding work. All cutting and patching shall be done under the Engineer's supervision.

1.17 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP

A. Unless otherwise specified, all equipment and materials used in the installation shall be ASME, and IAPMO requirements. All workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed.
B. All materials and equipment shall be installed as recommended by the manufacturer.

1.18 ESCUTCHEON PLATES

A. Provide polished dull chrome-plated cast brass set screw flanges where pipes pass through walls, floors, ceilings, and partitions in exposed portions of the buildings. Escutcheon plates shall be provided in pipes at fixture and shall be polished chrome plated. Steel escutcheon plates are not acceptable.

1.19 DAMAGE BY LEAKS

A. The contractor shall be responsible for all damage to any part of the premises caused by leaks or breaks in piping, equipment, or fixture furnished and/or installed by him, for a period of one year from the date of acceptance of the work by the Owner.

1.20 RECORD DRAWINGS

A. Keep an up to date, on the site accurate, dimensional reproducible set of record drawings, showing all work which is installed per contract drawings or differently from that shown on the contract drawings. Record drawings shall include the location and the depth of buried or concealed piping, or equipment, etc.
B. Upon completion of the work, deliver the record drawings to the Engineer for final approval.

1.21 CLOSING-IN OF UNINSPECTED WORK:

A. Do not allow or cause any of the work to be covered up or enclosed until it has been inspected, tested, and approved by the Engineer's representative and local inspector. Should any of his work be covered up or enclosed before such inspection and test, uncover the work at no expense to owner and after it has been inspected, tested, and approved, make all repairs with such materials as may be necessary to restore all his work and that of other trades to its original and proper condition.

1.22 PRELIMINARY OPERATION:

A. Should the Owner demand that any portion of the plant, apparatus, or equipment be operated for beneficial use prior to the final completion and acceptance of the work, the Contractor shall consent.
B. Such operation shall be under the supervision and direction of the Contractor, but all the expense therefore will be paid by the Owner, separate and distinct from any money paid on account of the Contract. Such preliminary operation or payment therefore shall not be construed as an acceptance of any of the work of this Contract.

1.23 FINAL OPERATION

A. Upon completion of the installation of the equipment, the Contractor shall place a competent man in charge who shall operate the equipment, instructing the Owner's operators in all details of operation and maintenance of the equipment and controls for a period of 4 hours.
B. Two hard copies & PDF of operation and maintenance manuals for each site shall be delivered to the Architect for approval prior to final completion of the project.

1.24 GUARANTEES:

A. As a condition precedent to the issuance of the final certificate for completion payment, the deliver to the Architect a special written guarantee. Guarantee all workmanship, equipment and materials for a period of Three year from the date of acceptance of the installation. Be responsible for all damages to premises caused by leaks or breaks in piping during this period. Should any other defects occur during this period promptly repair or replace the defective items as directed by the District at no cost.
B. Warrant the complete and perfect operation of the entire system and that all apparatus will perform in accordance with the detailed drawings and Specifications.
C. Warrant that all equipment shall be supported in such a manner as to be free from objectionable vibration and noise.

1.25 SEISMIC RESTRAINT REQUIREMENTS:

A. Hangers for suspended equipment piping shall be sway braced in two directions, per "Guidelines for Seismic Restraints of Mechanical Equipment" by SMACNA.
B. All prefabricated equipment is to be designed and constructed in such a manner that all portions, elements, subassemblies, and/or parts of said equipment and the equipment as a whole, including its attachments, will resist a horizontal and vertical load equal to the operating weights of those parts multiplied by the factors indicated on the plumbing drawings.
C. Load is to be applied at the center of gravity of the part and to be in any direction horizontally and vertically. Anchorage, support, and/or attachment of said prefabricated equipment to the structure shall be in accordance with "Guidelines for Seismic restraints of Mechanical Equipment" by SMACNA.
D. Submit shop drawings and calculations for seismic restraints and anchorage of the equipment to the Engineer and Structural Engineer for review and approval. Installation of equipment or supporting elements shall not begin until shop drawings are approved by the Engineer and District’s representative.
E. Refer to seismic notes on Structural plans.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall be new and in perfect condition; all materials for similar uses shall be of the same type, material, and manufacture for ease of future maintenance.
B. Accessibility: All equipment shall be readily accessible for maintenance and repairs. Provide

all necessary staging, scaffolding, ladders, or similar facilities necessary to install work.

C. Exposed Trim: All trim, piping, and fittings allowed to remain exposed in finished parts of the building shall be chromium-plated brass, or rough piping may be covered with chromium-plated brass tubing.
D. Protection: All Materials, fixtures, and equipment shall be covered or sealed upon installation so as to be provided for safety and to ensure that operation and appearance will be maintained after subsequent construction operation.

2.02 COOPERATION WITH OTHERS

A. Organize the work so that progress will harmonize with the work of all trades, so that all work may proceed as expeditiously as possible.
B. Be responsible for the correct placing of the work and the connection thereof to the work of all related trades.

2.03 PIPING

A. All drain, waste, vent, sewer and storm lines underground inside of buildings and to points 5 feet outside of building shall be of cast iron soil pipe, fittings and couplings, and shall be NSF Certified to conform to the CISPI 301 standard, and shall comply with ASTM A 888, latest edition. Pipe and fittings shall be marked with the collective trademarks of the Cast Iron Soil Pipe Institute and NSF International, indicate the manufacturer's name, country of origin, and date of manufacture, or receive prior approval of the engineer with stainless steel couplings per CISPI-310-78. Provide Polywrap tubular polyethylene protection for cast-iron. Provide appropriate adapters, materials and methods for connections to pipes of different materials as required.
B. Soil, waste and storm drain piping inside of building, above ground, shall be either coated service weight cast iron soil pipe with cast iron soil fittings, WW-P-401 or cast-iron No-Hub joint soil pipe No. CISPI-301-78 with stainless steel couplings per CISPI-310-78. Provide appropriate adapters, materials and methods for connections to pipes of different materials as required.
C. Domestic cold-water piping inside the building above ground shall be type "L" copper tubing with wrought copper fittings and solder joints. Hot water piping shall be insulated. All domestic water pipes, fittings and valves shall be lead-free.
D. Domestic cold-water piping inside the building below ground shall be type "K" copper tubing with wrought copper fittings and solder joints. Hot water piping shall be insulated. All domestic water pipes, fittings and valves shall be lead-free.
E. De-ionized Water (DIW) piping inside the building above ground shall be Linear Low-Density Polyethylene (LLDPE) pipe conforming to ASTM D-1693, FDA, and NSF. All joints and connections shall be push-to-connect tube fittings equipped with locking clip clamps. Provide all necessary adapters, materials, and installation methods as required per the fitting manufacturer's recommendations to proper connection between the LLDPE pipe and any other system components. This includes but is not limited to connections to other pipe materials, valves, equipment, or other appurtenances.
F. Laboratory waste acid waste and vent piping inside the building shall be Polyvinylidene Fluoride (PVDF) pipe suitable for laboratory waste, acid waste, and vent applications. The pipe

shall conform to ASTM D3227 and be rated for the expected chemical and temperature conditions. All joints in the PVDF piping system shall utilize Rionfuser CF clamp-free electro-fusion joints. These joints shall be installed according to the manufacturer's published instructions and using approved Rionfuser equipment.

G. Gas piping inside the building below ground shall be Double-wall black steel pipe conforming to ASTM A53, Schedule 40, Type S, shall be used for both the carrier pipe (inner pipe) and the casing pipe (outer pipe). Both pipes shall be of the same material and schedule. All joints for both the carrier pipe and the casing pipe shall be welded. Welding shall be performed by qualified welders certified in accordance with ASME. Welding procedures shall be submitted for approval prior to commencement of work.

H. Gas piping inside the building above ground shall be Double-wall black steel pipe conforming to ASTM A53, Schedule 40, Type S, shall be used for both the carrier pipe (inner pipe) and the casing pipe (outer pipe). Both pipes shall be of the same material and schedule. 2" and Smaller:

1. For pipe sizes 2 inches and smaller, malleable iron screwed fittings shall be used. Fittings shall conform to ASME B16.3. Threads shall be clean and sharp, and joints shall be made using an approved thread sealant suitable for gas service.
2. Larger Than 2": For pipe sizes larger than 2 inches, wrought steel welding fittings conforming to ASTM A234 shall be used. Welding shall be performed by qualified welders certified in accordance with ASME. Welding procedures shall be submitted for approval prior to commencement of work.

I. Laboratory Gas Piping inside the building above ground, Utility Chase/Inside Casework shall be Corrugated Stainless Steel Tubing (CSST) complying with ANSI LC 1 "Fuel Gas Piping Systems Using CSST" and listed with CSA, ICC, and IAPMO. The tubing shall be ASTM A240 Type 300 corrugated stainless steel with a minimum wall thickness of 0.010 inches. The tubing shall be jacketed with UV-resistant polyethylene meeting the requirements of ASTM E84 for flame spread and smoke density. All mechanical tube fittings shall be SAE CA360 brass incorporating a double-wall flare sealing mechanism and a jacket-lock jacket capturing system for steel tubing protection. Fittings shall be listed for use with the specified CSST and gas type.

2.04 PIPE CONNECTIONS:

A. All connections between 85% red brass pipe, type "K", “L” or type "M" copper tubing and steel pipe shall be made with Maloney, or approved equal, dielectric unions or flanges, which will prevent the flow of electrical current from one type of metal to another.

B. Sleeves shall be fire rated (3-hour fire resistance) Pyro Pac rubber link seal sleeve series L.S. with galvanized link-seal sleeve series W.S., complete for fire rated wall or floors. Use standard link seal sleeves and rubber link seals for non-rated wall.

C. Provide appropriate adapters, materials and methods for connections to pipes of different materials as required.

2.05 VALVES:

A. All valves shall be manufactured by Nibco (ball type), unless otherwise noted. All valves of the same type shall be of the same make. The valves shall be line size and shall be solder joint type for copper tubing. Ball valves shall be Nibco S-585-66-LF full port, two-piece bronze body, lead-free, stainless-steel ball and stem.

B. Unions in copper pipings,2 1/2 inches and smaller shall be Nibco, #733, or approved equal, 2

inches and larger shall be Nibco #740. For steel piping: Crane No. 300 AAR, galvanized malleable iron, ground joint, brass-to-iron seat.

C. Drop ear elbows, 90 degrees, shall be Nibco No.707-5, copper-to-copper or Nibco No. 707-3-5, copper to FSPS, for use at counter and wall trim connection.
D. Use stainless steel ball valves for isolating shut-off valves whenever possible.

NOTE: Check valves installed in vertical piping and in discharge piping from pumps shall be non-slam check valves, Miller No. 162 or Stockham No. WG-970 or approved equal.

2.06 ROOF FLASHING:

A. Flash all vents and other piping stubbed up through roof with a waterproof flashing constructed of 18- gauge galvanized sheet metal or aluminum not less than .040 inches thick. Extend base of flashing on the roof not less than 18 inches from the pipe. Extend flashing up the pipe not less than 6 inches and in contact with the pipe for 1 inch at top.

2.07 PIPE ISOLATORS:

A. Isolate all pipe hangers or piping supports from hot and cold-water piping with "ACOUSTO PLUM" system, Semco Series 100 for IPS piping, and series 500 for tubing, or Potter-Roemer PR- Isolators, Series 100 for IPS piping, and Series 300 for tubing. Where pipes pass through openings or touch any part of the structure, wrap with 1/4 inch thick waterproofed felt wrap.

2.08 CLEANOUTS:

A. Provide and install cleanouts where indicated on drawings and at all bends, angles, upper terminals, and not over 100-foot intervals in any horizontal piping, as required by the local Plumbing Code.
B. All cleanouts shall have an extra heavy cast iron body and extra heavy bronze plug. All flush with floor cleanouts shall have adjustable watertight covers. When waterproofing membrane is used, the cleanout body shall have integral anchoring flange and heavy clamping collar. All cleanouts shall be as follows:

1. INTERIOR FINISHED ROOM FLOORS: Cleanouts to have nonskid nickel-bronze top, and be Smith No. 4043, Josam No. 58350, Zurn No. Zn-1324, or approved equal.
2. INTERIOR FINISHED ROOM WALLS: Cleanouts shall have bonderized prime coated steel cover, and be Smith No. 4532 P.C., Josam No. YL-1590-B, Zurn No. Z-1320, Wade No. W-8460-R or approved equal. Install 26-gauge galvanized sleeve from tee through opening to finished wall surface.
3. Exposed cast iron lines, above ground, wall, shall be Smith No.4405, Josam No. Y-30, Zurn No. Z-1305, Wade W-8550-R or approved equal.
4. Interior finished room floors shall have nickel bronze top, Smith No. 4043, Josam No. Y-670-FB, Wade No. W-7000 Series Zurn No. ZN-1400-2, or approved equal.

2.09 FLOOR DRAINS

a. Provide new floor drains in compliance with ANSI – ASME A112.6.3 with heavy duty square stainless-steel strainer and membrane clamp as Manufactured by MIFAB # F1000 -C -S A1 body, Strainer size as required, Membrane clamp A1- C1, Hardware set HS-1 with variations and accessories as applicable to the application & location of floor drain.

2.10 TRAP PRIMER

a. Provide 120 VAC Mini – Prime Electronic Trap Priming Manifold MP -500, see Appendix “A”

2.11 PIPE HANGERS AND SUPPORTS:

A. Tolco, Michigan Co., or approved equal. Provide lateral bracing where hangers exceed 18 inches long. Isolate hangers and supports from water piping with Semco Trisolators. Insulate at openings, of structure with 1/2 inch felt wrap.

2.12 PIPING IDENTIFICATION:

A. Secure "Brady" pipe identification system at eight feet on center, classifying the material carried, to each pipeline. All line valves shall be identified with "Brady" valve tags.

2.13 ACCESS DOORS, BOXES AND COVERS:

A. Provide and install where indicated on-drawings and adjacent to all concealed valves and equipment requiring service. Doors shall be metal hinged, adequately sized, and fire rated to match construction. Minimum access door size shall be 12” x 12”.

2.14 PLUMBING FIXTURES REQUIREMENTS:

A. Verify all fixture and equipment locations with the Architectural plans and shall furnish and connect all fixtures and equipment shown thereon.

2.15 PLUMBING FIXTURE:

A. Refer to Plumbing Fixture Schedule on Drawings.
B. Protective Shielding Pipe Covers: All accessible Lab sinks shall be provided with protective shielding pipe covers. Provide product by Truebro, Inc. or equal. Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.01 WORKMANSHIP:

A. All workmanship shall be performed by skilled mechanics using the best standard practices of the trade.

3.02 GENERAL PIPING INSTALLATION:

A. Thoroughly clean all piping before installation. Cap all openings during construction.
B. All above ground piping shall be concealed wherever possible. Underground piping shall have a minimum cover of 24 inches.
C. Provide a union on one side of all valves at equipment connections and in other locations as required for ease of servicing of equipment.
D. Make suitable provisions for maximum expansion and contraction of piping. Provide swing joints and anchors as necessary.

E. No bullhead tees, close nipples, or bushings will be allowed in piping.
F. All connections between 85% red brass, type "K" underground or type "L" copper tubing and steel pipe, shall be made with dielectric unions or flanges which will prevent the flow of electrical current from one type of metal to another.
G. Arrange piping to maintain headroom and keep passageways and access openings clear and offset as required to coincide with structural features of building. Do not spring, bend, or force pipe into place. Use fittings for all offset or changes in alignment of piping. Except for water piping below floor, use long sweep bends. Run piping to drain at low points, free of traps, sags, and bends. Provide ample space between pipes for proper thickness of covering.
H. Horizontal sanitary and storm drain piping shall be installed to a uniform grade of not less than 1/4 inch per foot, unless shown or directed otherwise. Vent piping shall be installed to provide proper ventilation of the plumbing and graded to provide for its drainage. Buried sewer, waste, and storm drain piping shall be continuously supported along the full length of the pipe.
I. Openings in pipes, drains, fittings, apparatus, and equipment shall be kept covered or plugged to prevent accumulating obstructions in the piping.
J. Water piping shall be run free of traps, sags, and bends, and graded and valved to provide for the complete drainage and control of the system.
K. All threaded piping shall be made up with an approved pipe dope, applied to male thread only, covering the entire thread.
L. At all exterior locations, install all yard boxes, and clean out to grade in the center of a concrete collar surrounding the yard box or clean out. The collar shall be full depth and a minimum 3" wide around the object but a minimum size of 12" x 12" x 12" deep. The concrete collar shall be square with the building, level and true with grade.

3.03 PLUMBING FIXTURE INSTALLATION:

A. Traps and trap arms shall be set at right angles to walls, in line with fixture outlets, without any offsets, angles, or bends. Fixture connections shall be properly aligned to prevent any undue strain on equipment or fixture.
B. Each fixture shall be set level and in continues contract with floor or wall.
C. Exposed plated, polished, or enameled connections from fixtures shall be put up with special care showing no tool marks or threads.
D. Trap installations, exposed above the floor, shall have chromium-plated brass escutcheon plates, casings, and uniform code pattern traps.
E. Trim shall be polished chromium-plated brass, by the same manufacture for each type. Where stop valves are required in exposed piping, they shall be short stem polished chromium-plated type. Flush valves shall all be by the same manufacturer.
F. Plumbing fixtures, equipment, faucets, and trim shall be identical in each category.
G. All fixtures installed in floors with waterproof membranes shall be provided with approved membrane clamps.

3.04 VENT PIPING AND FLASHINGS:

A. Sanitary plumbing vents shall terminate 12 inches above the roof and be flashed as per specification under Roof Flashing.
B. The tops of flashing shall be sealed, and counter flashed.

3.05 VALVES:

A. Valves shall be arranged and located to give complete control of all apparatus and plumbing fixtures, and as indicated, to isolate batteries of fixtures or sections of water systems. All valves shall be easily accessible.
B. In no case will expose valves be allowed in finished portions of buildings. Provide access plates over valves in finished walls and valve boxes for valves in ground outside of building.

3.06 EXPANSION:

A. Expansion of piping shall be provided for by swings, offsets, and anchors where required for a satisfactory installation. Anchors shall be constructed of structural shapes of sufficient strength for purpose intended.

3.07 ACCESS DOORS:

A. Access openings for shut off valves and cleanouts shall be fitted with not less than 18-gauge metal frames, 16-gauge doors with concealed hinges, locks operated with Allen head wrench, and anchor straps. Access doors shall be prime coated for painted walls, and polished chromium for tile walls, Karp # 214-P-AKL, 12" x 12", or approved equal.
B. Each access door shall be securely fastened into place and protected from construction damage.

3.08 HANGERS AND SUPPORTS:

A. Piping shall be firmly held in place by adjustable split ring malleable iron hangers, supports and pipe rests, located adjacent to fittings, at each offset or change of direction, at the ends of branch over 5 feet long, at riser pipes, and along piping where necessary to prevent sags, bends, or vibrations.
B. Maximum spacing for supports of horizontal piping shall be as follows: steel or brass pipe: 1 1/4-inch or large, 10 feet steel or brass pipe: 1-inch, 8-feet steel or brass pipe: 3/4-inch, 6 feet copper tubing: 1 1/4-inch, 8 feet copper tubing: 1-inch or smaller, 6 feet.
C. Hanger rods shall be solid mild steel in accordance with the following schedule: 2 inches and smaller: 3/8-inch diameter rod 2 1/2 inches to 3 1/4 inches: 1/2-inch diameter rod 4 inches to 5 inches: 5/8-inch diameter rod.
D. Piping on roofs shall be supported and secured on redwood blocks anchored to roof and set in mastic.

3.09 UNION, FLANGES, AND PIPING CONNECTIONS:

A. Connections between copper tubing and valves, 2 inches and smaller, shall be made with brass,

copper tubing to pipe threaded adapters. Connections between copper tubing and other types of piping having threaded openings shall be made with fitting adapters.

B. Provide dielectric couplings or unions at points where copper tubing or piping joins steel piping, or equipment made of a material containing iron.
C. Unions are required on the inlet and outlet sides of all apparatus or equipment having screwed connections, 2 inches and smaller and also on the outlet side of all screwed valves, 2 inches and smaller, to facilitate easy removal for repair and replacement.
D. Unions are not required where valves are underground or are accessible only through hand size access plates.
E. Connections between copper tubing and other types of piping having threaded openings shall be made of brass, copper, to IPS ground joint unions.

3.10 TESTING AND ADJUSTING OF PLUMBING EQUIPMENT:

A. No piping work, fixtures, or equipment shall be concealed or covered until they have been inspected and approved by the Mechanical Engineer who shall be notified by the contractor when the work is ready for inspection.
B. Should any work be enclosed or covered up before such inspection and test, the contractor shall, at his own expense, uncover the work, and after it has been inspected, tested and approved, make all repairs with such materials as may be necessary to restore all his work and that of other sections to their original and proper conditions.
C. All work shall be completely installed, tested as required by this section and the local ordinances, and shall be leak tight before inspection is requested. All tests shall be repeated to the satisfaction of those making the inspection.
D. Plumbing fixtures shall be filled with water and checked for leaks or retarded flow.
E. Each piece of plumbing equipment and the entire plumbing system shall be adjusted and readjusted as required to ensure proper functioning and left in first-class operating condition.
F. After soil, waste and storm pipe have been tested at the cleanout plugs shall be removed, heavily flushed with graphite impregnated grease, replaced, and screwed up snugly. Nylon plugs shall not be coated.
G. All soil, waste, storm drain, and vent piping shall be filled with water to the highest point in each system with all air removed. The lines shall be flushed by removing the test plug. Piping may be tested in sections, providing all portions to be concealed shall be subjected to not less than a 10-foot head. The standpipe installed for head test shall be 1-inch minimum diameter.
H. Sewer and storm drain piping shall be filled with water to its highest point, but at not less than 5 PSIG pressure.
I. All test shall be maintained without leaks or pressure loss for not less than six hours, with allowance for temperature changes, except for transit pipe.

END OF SECTION

SECTION 22 05 20
PLUMBING EQUIPMENT AND SYSTEMS TESTS

PART 1 - GENERAL

1.01 SUMMARY

A. Related Sections

1. Section 22 05 10 Plumbing Systems

1.02 QUALITY ASSURANCE

A. Qualifications of Agency and Personnel: Obtain the services of a qualified independent testing organization, acceptable to the Engineer, to perform the testing and balancing work as herein specified. The testing organization shall submit proof that it meets the technical standards for membership in the AABC as published in the AABC; or the organization is a member of the Associated Air Balance Council; or, certified by the National Environmental Balancing Bureau (NEBB). The testing organization shall not be affiliated with the installing mechanical contractor.
B. Performance Criteria: Work shall be performed in accordance with the approved Testing, Adjusting and Balancing (TAB) Agenda.
C. Test Equipment Criteria: The basic instrumentation requirements and accuracy/calibration required by AABC Section II or the NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.

1.03 THE TESTING, ADJUSTING AND BALANCING AGENDA:

A. Definition: The proposed procedures and proposed forms, diagrams, and reports for documenting the testing, adjusting and balancing work.
B. Preparation: By the testing, adjusting and balancing agency for review and approval by the Engineer.
C. The Agenda shall include one complete set of the AABC or NEBB publications listed in Paragraph 1.05 C, applicable publications.
D. The agenda shall also include the following detailed narrative procedures, system diagrams and forms for test results.

1. Specific standard procedures required and proposed for each system.
2. Specified test forms for recording each procedure and for recording sound and vibration measurements.

1.04 SUBMITTAL DATA

A. Requirements: In addition to the requirements of Section 22 05 00, GENERAL PROVISIONS, the submittal material shall include six copies of descriptive data for all products and materials including.

1. Sample Forms:
   a. Complete forms proposed for use in compiling and recording test data.

B. Work Certification: Submit the name of the person/organization proposed to perform the work described in the Section for review within 30 days after contract award. Include in the submittal the certified qualifications of all persons responsible for supervising and performing the actual work.
C. Upon approval of the testing, adjusting and balancing agency, submit agenda for approval.
D. After completion of tests submit complete test reports for approval. Where test results differ from specified design conditions, indicating a contract deficiency, include explanatory comments in report. Contractor shall submit final reports prior to requesting the final inspection for the

project.

1.05 APPLICABLE PUBLICATIONS

A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referred to by the initials of the organization.
B. American Society of Heating Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) Latest Edition.
C. Associated Air Balance Council (AABC): National Standards for Field Measurement and Instrumentation Total System Balance, Fourth Edition.
D. American Society of Mechanical Engineers (ASME):
E. Underwriters Laboratories (UL)
F. National Environmental Balancing Bureau (NEBB)

1.06 PRODUCT HANDLING

A. Protection: Protect installed work and materials of all other trades.
B. Replacements: In the event of damage, immediately do all repairs and replacements at no additional cost to the District.

1.07 COORDINATION

A. Coordinate all activities in accordance with provisions of Section 22 05 00.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. General: Products and materials shall be described in the pertinent Sections of the Mechanical Specifications.

PART 3 - EXECUTION

3.01 REQUIREMENTS

A. General

1. The contractor shall notify the Engineer at least 7 working days in advance of the time when any test is to be performed.
2. As required hereinafter, the Contractor will arrange and pay for special testing agencies. The Contractor shall provide, install and remove on completion of tests all special fittings, openings.
3. and other devices as needed to perform the tests. Furnish all labor as necessary to start, operate, adjust and modify all equipment and systems for both testing and the verification of tests.
4. For tests not requiring a testing agency, provide all equipment and instruments required for testing, including fittings for additional openings.
5. Verification. All test shall either be observed by or the tests rerun, and the results verified in the presence of, and approved by a representative of the Engineer, at their option as required herein.
6. Prepare a formal report as required herein.

B. At least fourteen (7) days before specified occupancy or date of completion of overall contract, the Contractor shall put all heating, ventilating, and air conditioning equipment and plumbing system into operation and shall continue the operation of same during each work day, for not less than 5 - eight- hour periods, until all adjusting, balancing, testing, demonstrations, and instructions on the systems have been completed. Final instructions and demonstrations and preparation of reports shall be made during the two-week period. When an individual building is ready for occupancy, all the above equipment, relative to that portion of the work shall be put

into service, tested and adjusted.

C. Coordinate testing, adjusting and balancing procedures with any phased construction requirements for the project so that usable increments of finished work may be accepted for beneficial occupancy. Systems serving partially occupied phases of the project may require balancing for each phase prior to final balancing.
D. Conduct final procedures after the system has been completed and is in full working order. Put all HVAC systems into full operation and continue operation of the systems during each working day. Accomplish testing, adjusting and balancing procedures in accordance with the agenda approved by Engineer.

3.02 PIPING PRESSURE TEST

A. Perform engineering tests required to demonstrate that the operation of the mechanical systems and their parts are in accordance with the Specifications covering each item or system, and furnish materials, instruments, and equipment necessary to conduct such tests. Tests shall be conducted in the presence of the IOR, the Engineer and the representatives of the district. Work shall not be concealed or covered until required approvals are obtained.
B. Pressure gauges used in testing shall have one-pound graduations; vacuum gauges shall have one inch mercury graduations. Air shall be bled from lines requiring hydrostatic or water tests.
C. Systems shall be pressure tested in accordance with the Pipe Test Schedule below. The pipe test shall show no loss in pressure after a minimum duration of four hours at the test pressures indicated. Where local codes require higher test pressures than specified herein for Fire Sprinkler Systems, the local codes shall be followed.
D. Piping systems may be tested as a unit or in sections as directed by the Architect, but the entire system shall successfully meet the requirements specified herein, before acceptance by the Architect.
E. Repair of damage to the pipes and their appurtenances, or to any other structures resulting from or caused by these tests, shall be performed by the Contractor.
F. Provide a pressure gauge located at the highest point of the system being tested with a shut-off valve and bleeder valve so arranged to check gauge operation.
G. The test welded joint on piping under 100 psi air pressure with soap suds prior to hydrostatic test.
H. Subject all welded joints on high pressure systems to hammer test while under hydrostatic pressure.

3.03 PIPE TESTING SCHEDULE

System Tested	Test Pressure (psig)	Medium, Duration
Waste, vent and storm drain, condensate drain from air vent, allow to stand conditioning equipment.	Fill with water to top of highest vent, allow to stand Two hours, or longer, as directed by Inspector. Minimum head required for any joint shall be 10 feet in building. Extend stack. 15-feet above the highest horizontal line to be tested.	Water
Domestic Water Piping	150 Water,	5 hours

3.04 PROJECT COMPLETION TEST

A. Upon completion of the mechanical work, or such a time prior to completion as may be

determined by the District, all mechanical equipment and systems shall be operated and tested for a period of at least five consecutive 8-hour days to demonstrate the satisfactory overall operation of the building or project as a completed unit.

B. The tests shall commence after preliminary balancing and adjustments to equipment and systems have been completed, and all running equipment have been checked and thoroughly lubricated.
C. Welding done on this project may be subject to radiographic inspections at random in accordance with requirements specified in Section 22 05 00.

3.05 OPERATIONAL TEST

A. Before starting or operating any equipment systems, make a thorough check to determine that all systems have been flushed and cleaned as required and that all equipment has been properly installed, lubricated and serviced.
B. Replace or revise any equipment, systems or work found deficient during tests as required, to the entire satisfaction of the District.
C. Make any final adjustments or balancing found necessary to be made to the equipment or systems, to place them in acceptable operating condition and to the specified performance during any or all of the tests.
D. Provide, maintain, and pay all costs for equipment, instruments, and operating personnel as required for all tests.

3.06 REPORT

A. After tests have been approved on the entire system or any portion thereof, the Contractor or the testing agency, as applicable, shall certify in writing the time, data, name and title of the person approving the test. This rough field of data shall also include the description and what portion of the system has been approved. The person making the inspection shall sign the certification.
B. Maintain a complete record of the rough field data of all testing that has been approved and make it available at the job site to all authorities concerned.
C. The testing company or contractor shall prepare a formal typewritten report, indexed, with stiff covers to contain all the required test data.
D. The report shall reference all readings to locations on a schematic sketch of the piping systems.
E. Deliver a copy to the District for review.
F. After review, verification, and acceptance, one copy of each of these test reports will be furnished to the Contractor for inclusion in each operating instruction manual.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Ball valves.

1.02 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene-diene terpolymer.
C. FKM: Fluoroelastomer.
D. NBR: Nitrile butadiene rubber (also known as Buna-N).
E. NRS: Nonrising stem.
F. OS&Y: Outside screw and yoke.
G. PTFE: Polytetrafluoroethylene.
H. RPTFE: Reinforced polytetrafluoroethylene.
I. RS: Rising stem.

1.03 ACTION SUBMITTALS

A. Product data.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast-copper solder-joint connections.
6. ASME B16.22 for wrought-copper solder-joint connections.
7. ASME B16.34 for flanged- and threaded-end connections.
8. ASME B16.51 for press joint connections.
9. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.
E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system

pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.
G. Valve Bypass and Drain Connections: MSS SP-45.
H. Valve Actuator Type:

1. Gear Actuator: For quarter-turn ball valves **NPS 4** and larger.
2. Hand Lever: For quarter-turn ball valves smaller than **NPS.**

I. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.02 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Threaded Ends - Brass, One Piece:
B. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Brass Trim:

1. Standards: MSS SP-110, MSS SP-145, IAPMO/ANSI Z1157.
2. CWP Rating: Minimum 200 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass.
5. Ends: Press.
6. Press-End Connections Rating: Minimum 200 psig.
7. Seats: PTFE or RPTFE.
8. Stem: Brass.
9. Ball: Chrome-plated brass.
10. Port: Full.
11. O-Ring Seal: NBR or EPDM.

2.03 BALL VALVES, GENERAL PURPOSE

A. Ball Valves, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Brass Trim:

1. Standard: MSS SP-110.
2. SWP Rating: 150 psig
3. CWP Rating: 600 psig
4. Body Design: Two piece.
5. Body Material: Forged brass.
6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
7. Seats: PTFE.
8. Stem: Brass.
9. Ball: Chrome-plated brass.
10. Port: Full.

PART 3 - EXECUTION

3.01 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

D. For valves in horizontal piping, install valves with stem at or above center of pipe.
E. Install valves in position that does not project into aisles or block access to other equipment.
F. Install valves in position to allow full stem and actuator or manual operator movement.
G. Verify that joints of each valve have been properly installed and sealed to ensure there is no leakage or damage.
H. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
I. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.02 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: (Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing: Valve ends may be grooved.
8. For Grooved-End Steel Piping: Valve ends may be grooved.
9. Wafer-Type Valves: Flanged connections.

3.03 LOW-PRESSURE, COMPRESSED-AIR BALL VALVE SCHEDULE - 150 PSIG OR LESS

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves threaded or soldered ends - brass, two piece with full port and brass trim; **threaded** or **soldered** ends.
2. Ball valves, threaded ends - bronze, two-piece, safety exhaust; **200 psig**.

B. Pipe NPS 2-1/2 and Larger:

1. Ball valves, flanged ends - iron, Class 125.

3.04 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball valves, lead free, press ends - bronze, two piece with full port and bronze or brass trim.

END OF SECTION

SECTION 22 05 40
PLUMBING DEMOLITION AND REPAIR

PART 1 - GENERAL

1.01 SUMMARY

A. Principal work in this section:

1. Work included:
   a. Removal and disposal.
   b. Protection of existing work to remain.
   c. Removal and disposal of items as shown.
   d. Removal and disposal of existing items as necessary.
   e. Debris removal.

1.02 GENERAL PROVISION

A. Field conditions: Take into consideration as necessary all obvious existing conditions and installations on the site as though they were completely shown or described. Accept the site of the work as it exists and clear obstructions to the work shown.
B. Examine the site and all conditions and limitations thereon and thereabouts. Take into account all such existing conditions and limitations whether or not the same are specifically shown or mentioned on the Drawings. Include whatever in needed to complete the work in every part as shown, described, required or implied to attain the completed condition contemplated by the Contract.
C. Include the reworking of abutting surface as required to make new work join and match existing surfaces to remain.
D. Protection of personnel: Erect signs, barricades and such other forms of warning as may be required to prevent personnel from putting themselves in the way of injury.
E. Existing work to remain: Provide such forms of protection as may be necessary to prevent damage to existing work and equipment to remain.
F. Existing operating equipment: Existing equipment in operation shall remain operating unless otherwise instructed by the District's Representative.
G. Prior to the demolition, Contractor shall inspect the area to be demolished with the District's Representative to ascertain the equipment ductwork; piping and accessories to be demolished are accounted for.

1.03 PROJECT PHASING

A. Removal or demolition, of existing equipment shall be performed in phases as indicated on the drawings or as directed by the District's Representative.
B. All ductwork, piping and other items that will remain and reused shall be secured and protected accordingly.

PART 2 - PRODUCTS

2.01 PRODUCTS AND MATERIALS

A. As necessary for the completion of this work.
B. Temporary barriers: All barriers shall be flame resistant fabrics.

PART 3 - EXECUTION

3.01 REQUIREMENTS

A. Check Drawings and site conditions carefully and thoroughly investigate existing construction.

B. Items of existing work indicated to remain upon completion of the Contract, but which require removal to complete the work, shall be carefully removed and replaced upon completion. The replaced work shall match its condition at the start of the work.
C. Unless otherwise shown, patch and finish surfaces as necessary to match existing, and in accordance with the requirements of the various Specification Sections. Paint the entire wall area (not just affected portion) to match condition of adjacent wall.
D. Prepare surfaces as necessary to provide proper condition to receive subsequent schedule finishes.
E. All removed materials not otherwise designated, and all debris from work of this Section becomes the property of the Contractor, who shall remove it from the Site and dispose of it as required by the authorities having jurisdiction.
F. Do not allow materials and debris designated by demolition activities accumulate. Remove daily and dispose of site in a legal manner. Transport removed materials and debris in sealed bags and containers.
G. No debris from the demolition shall be disposed of on school grounds; all debris and rubbish shall be hauled from the site.
H. All openings shall be in a sealed condition at the end of each working day.

END OF SECTION

SECTION 22 05 50
BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Related Sections:

1. All other sections in Division 22.

1.02 QUALITY ASSURANCE

A. Standards: Comply with applicable national, state, and local codes and Industry standards.
B. Qualifications of Manufacturer: Products used in the work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a 5-year history of successful production acceptable to the Industry standards and Architect/district.

1.03 SUBMITTAL DATA

A. Requirements: In addition to the requirements of Section 22 05 00 GENERAL PROVISIONS, the submittal material shall include six copies of descriptive data for all products and materials including, but not limited to, the following:

1. Complete material list of all items proposed to be furnished and installed under this section.
2. Manufacturers' specifications and other data required to demonstrate compliance with the specified requirements.
3. Shop Drawings Showing:

a. Complete system layout and description of components and all piping work.
b. Schedule and description of pipes, fittings, and valves.
c. Special valves of all types.
d. Specialty fittings.

4. Manufacturer's Recommended Installation Procedures: The manufacturer's recommended installation procedures, when accepted by the Engineer, will become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.

1.04 COORDINATION

A. Coordinate all activities in accordance with the provisions of Division 22 specifications.

PART 2 - PRODUCTS

2.01 VALVES GENERAL

A. Each valve shall have the manufacturer's name or brand, the figure or list number and the rated working pressure cast or stamped on the body or bonnet or other equivalent means of easy identification.
B. Valves without specified materials or working pressure shall be selected to match materials and pressure ratings of the fittings as a minimum.
C. Ball valves shall be Nibco S-585-66-LF full port, two-piece bronze body, lead-free, stainless-steel ball and stem.

D. All gate and globe valves shall be back seating type suitable for repacking under pressure.

1. The minimum working pressure is 200 PSI. See class rating for each application.
2. Globe valves shall have composition discs suitable for the temperature and pressure of the service.
3. Ball and butterfly valves on insulated piping shall have the neck extended two inches above the outside diameter of the flange to accommodate the full thickness of the insulation. Extension shall be of same valve manufacturer.
4. Automatic Valves.

a. Solenoid valves:

1) Solenoid valves shall be 125 lb. WOG, brass bodied, screwed, stainless steel trim, resilient seated, normally closed 2-way, and 120 volts, 60 hertz, ADSCO Bulletin 8210 for sizes 3/8" to 3"; Bulletin 8222 for 125 lb. steam, sizes 3/8" to 3", General Controls, ALCO, Magnetrol or equal.

2.02 STRAINERS

A. Strainers shall have machined and gasketed caps either straight threaded or bolted.
B. Strainer open area of screen shall be at least three times the cross-sectional area of the pipe in which installed based on iron pipe size (IPS) and may be either woven wire or perforated with equivalent openings as specified in pipe schedules.

2.03 YARD BOXES

A. For service shut-off valves on gas and domestic water and for cleanouts, shall be Brooks Product with vandal-proof cast iron cover and name of service clearly marked on cover. Box shall be of size to permit easy removal of valve.

1. Cleanouts: All site cleanouts in grass, planter, and asphalt paving areas shall be terminated at grade in Brooks No. 1-RT concrete box with galvanized cast iron cover marked “SEWER”.

2.04 DIELECTRIC ISOLATORS

A. General.
Isolators shall be so constructed that the two pipes being connected are completely insulated from each other with no metal-to-metal contact, and suitable for service on which used. Insulating couplings are not acceptable.
B. Unions.
For piping 2" and smaller, unions shall be brass solder sweat with ground-joint and micarta sleeving.
C. Flanges.

1. For piping 2-1/2" and larger, flanges shall be flanged sets with neoprene gasket for flat face flanges with bolt hole punches to receive bolt sleeves of 1/32" micarta with 1/8" thick micarta washers.
2. All others: Insulating flanges or unions, suitable for 125 psig WSP.

D. Manufacturer.

1. Dielectric isolator shall be as manufactured by F.H. Maloney, EPCO, Cathodic Protection Service, Corro Ban Products, W.C. Vallett, or equal.

2.05 FLEXIBLE PIPING CONNECTIONS

A. Flexible connections for copper piping; corrugated seamless bronze flexible hose with bronze wire braid.
B. Flexible connections for steel piping: Corrugated stainless steel with stainless steel wire braid.
C. Designation and length as recommended by manufacturer for system's test and operating pressures and temperatures.
D. Recommended Manufacturers: (or equal)
E. Metraflex, U.S. Flex, Anaconda.

2.06 INSTRUMENTS

A. General.

1. Pipe mounted thermometers and pressure gauges shall be as scheduled herein and shown on the plans.

B. Instruments.

1. Liquid sensing thermometers.

a. Red reading mercury column type or magnified mercury column type with wide angle of vision and high magnifications of mercury column.
b. Thermometers shall have one piece heavy extruded or cast aluminum or brass case with glass front. Thermometers mounted over 8 ft. high shall have multi-angle hinge with a positive locking device.
c. Scale shall be black numerals and divisions of light color background accurate to plus or minus one of the smallest scale divisions throughout the entire range. Scale shall have maximum of two degrees between graduations and 20 degrees between figures.
d. Minimum scale length shall be nine inches.
e. Provide extended necks for insulated pipes, tanks and equipment. Provide a steel bulb chamber and brass separable socket for each thermometer. Fill the void between bulb chamber and bulb with conductive grease.
f. Thermometers shall be Marsh Instrument Co., Trerice or equal.

2. Pressure gauges.

a. Gauges shall be of the Bourdon tube type, Marsh Instrument Co., Trerice or equal.
b. Gauges shall have 3-1/2" minimum dial face, white with black numbers and graduations, steel or aluminum case with double strength glass, nickel plated ring and built in or add on pulsation dampeners.
c. Movement shall be of the phosphor bronze seamless Bourdon tube type with recalibrating bushed rotary gear movement and link fitted with a black aluminum pointer with means for face calibration.
d. Accuracy in the middle third of dial range shall be plus or minus 1% of total dial range.

2.07 PIPE SUPPORTS

A. General.

1. Supports shall be defined as hangers, brackets, framing, guides, and anchors.
2. Supports shall be factory fabricated units with published load limits.
3. Supports fabricated of steel shapes and installed in weather exposed locations, in equipment rooms or regularly occupied areas shall be hot dip galvanized after fabrication.
4. Supports for fire protection installation shall be in accordance with NFPA Standard No. 13.

B. Horizontal piping.

1. Hangers shall be of the following types:

   a. For piping 4" and smaller adjustable malleable iron split ring type, Grinnell Fig. No. 104, or Fig. 174, B-line Fig. B3171, Super Strut, or equal.
   b. Rod lengths shall be adjustable.
   c. Trapeze hangers may be used for parallel piping arrangements. Submit detail drawings and calculations for approval. For four or less pipes 2-inches and smaller, framing manufactured by Unistrut selected to accept five times the weight or thrust of the pipe per manufacturer's ratings, are acceptable. Framing finish shall be a light-colored polyester paint. Submit calculations.
   d. Hang rods for both single and trapeze hangers from suitable clips, beam clamps or self-drilling expansion type or from 3/8" diameter rods and percussive driven studs. Verify with Structural Engineer.

2. Brackets shall be Grinnell 194 or 195, B-Line Fig. B3063 or B3066, Super Strut or equal.
3. Roll stands shall be Grinnell Fig. 271, B-Line Fig. B3117SL or equal.

C. Vertical piping.

1. Clamps shall be Grinnell Fig. No. 261, B-Line Fig. B3373, Super Strut or equal.

D. Rods.

1. Solid mild steel minimum size as follows:

PIPE SIZE	ROD SIZE
2" and smaller pipe	3/8" diam. rod
2-1/2" to 3-1/2" pipe	1/2" diam. rod
4" to 5" pipe	5/8" diam. rod
6" pipe	3/4" diam. rod

E. Insulated piping.

1. Provide shields between supports and the pipe insulation.
2. Shields shall be 16-gauge galvanized steel for all piping and shall be performed to proper radius and shall extend up to the centerline of the pipe. Lengths shall be 4" for pipe sizes 2-1/2" and smaller, and 7" for larger pipes. Pipes 4" and larger at rollers, guides and supports shall have 14 gauge shields. All shields at rollers, guides, and supports shall be securely strapped in place.
3. Insert sections of insulation shall be Type P-4 at each support as specified in Section 15180: Insulation.

F. Vibration isolation.

1. Vibration isolation shall be as specified in Section 15160: Vibration Isolation and Seismic Restraints.
2. Where isolation elements are required on hangers provide 2-piece rods.

3. Pipe Isolators:

    a. Manufactured hair felt pad enclosed in corrosion resistant metal shield with end flanges to assure the pads proper retention between the support and the pipe, Trisolators S-100 or equal.
    b. Provide plastic isolating suspension clamp on all water piping to prevent contact between the pipe and the structural framing. "Flexi-Fin" isolating suspension clamp or equal.

G. Concrete fasteners.

1. Percussion driven studs shall be Ramset No. 2049, Drivet Remington, or equal.
2. Self-drilling anchors shall be Rawl Philips Red Head, Wej-it or equal.

H. Floor Supports: Grinnell Figure 264, B-Line Fig. B3093 or equal.
I. Wall Supports: Grinnell Figure 168, 195, B-Line Fig. B3153 or equal.
J. Riser clamps for copper piping: Super Strut CT-720-F copper plated, plastic coated, B-Line Fig. B3373CT or B3373CTC or equal.
K. Riser clamps for other piping: Super Strut C-720, B-Line Fig. B3373 or equal.
L. Beam clamps: Super Strut U-520, B-Line Fig B318 or Fig. B3050 or equal.

2.08 SLEEVES, CORE DRILLING AND ESCUTCHEONS

A. General.

1. Sleeves shall be permanently installed type where waterproofing is required cast-in-place or dry-packed in core drilled hole.
2. Escutcheons shall be prime coated steel type except for escutcheons specified in Section 15470 - Plumbing Fixtures.

B. Sleeves shall be as follows:

1. Exterior walls below grade and floor slabs on grade: Concrete pipe dry-packed in place with annular space caulked watertight.
2. Floor slabs inside partitions, furred spaces and interior concrete walls: Core drill as necessary.
3. Floor slab with waterproof membrane: Cast iron sleeve with integral flashing clamp, Smith No. 1722 or equal by Josam, Zurn or Wade.

C. Escutcheons shall be as follows:

1. 6" and smaller: Prime coated steel with set screw, Beacor No. 13 or equal by F & S Manufacturing Co.
2. Larger than 6": Prime coated brass with set screw, Beacor No. 3 or equal by F & S Manufacturing, Fig. 605 or equal.
3. Raised sleeves in floor slabs: Deep drawn prime coated steel or brass, F & S Manufacturing Fig 605, or equal by Beacor.

D. Caulking shall be as follows:

1. Watertight: Projects Research Co. "Rubber Caulk" No. 150 heavy type DAP, Dow Corning, General Electric, or equal.
2. Fireproofing: Caulked glass fibrous rope.

3. Sound attenuating: Caulk with a compressible polyurethane foam strip saturated with polybutylene, Poly-Tite Compriband, or equal.

2.09 FLASHING

A. General.

1. Flashing shall be with 24-gauge galvanized steel base, fitted with elastomer collar.
2. Manufacturer: Flashing assembly shall be Water-Tite by IPS Corporation.

2.10 ACCESS PANELS

A. General.

1. These specifications cover prefabricated wall and ceiling access panels normally required to provide access to equipment requiring servicing and adjustment.
2. The types of wall access panels required are similar to Milcor Styles UFR (fire rated) or M (non-rated), for the appropriate locations and with hinge, metal gauge, latch, optional cylinder locks, and other modifications necessary to conform to requirements specified hereinafter. Panels shall be U.L. labeled to match wall rating requirements.
3. The types of ceiling access panels required are similar to Milcor Styles UFR (fire rated) only, for both rated and non-rated conditions, for the appropriate locations with hinge, metal gauge, latch, optional mortise, cylinder locks keyed to building keyway as approved by District, and other modifications necessary to conform to requirements specified hereinafter. Panels shall be U.L. labeled to match ceiling rating requirements.

B. Location.

1. Furnish for installation by the pertinent trade, access panels wherever fans, air handlers, air filters, valves, balance valves, damper operating mechanisms, fire damper access doors and similar items normally requiring adjustment or servicing are installed in concealed spaces.
2. Where furred ceilings are of the removable panel type of construction, the removable panels will be used for access to small equipment such as valves, dampers and controls.

C. Sizes.

1. Access panels shall be of a size to permit removal of equipment for servicing, but not less than 12" x 12" minimum opening.
2. Where proper servicing of the equipment requires the entrance of a serviceman, the access opening shall be sized accordingly with minimum opening not less than 18" x 24".

D. Construction.

1. Access panels shall be neatly constructed and substantially made of steel complete with frame and with necessary components for attaching to walls, ceilings or other construction, as required. Hinges shall be of concealed type. Minimum door and frame gauges for Type M panels shall be USS No. 16 and for Type UFR panels shall be 20 gauge and 16 gauge, respectively, with thermal insulation. Panels and frames shall be furnished with a factory-applied prime coat, except panels in tile walls shall be chrome plated and polished or satin finish Type 304 stainless steel.
2. Panels to be installed in acoustical tile ceilings shall be as specified in paragraph one above except that the door panels shall be recessed and faced with acoustical tile to match the ceiling tile so the frame will be concealed. The depth of the door recess shall be such that door facing tile are flush with ceiling tile.

E. Exceptions.

Normally, access doors to large attic spaces and large pipe spaces behind toilet batteries will be furnished under another section, and when so furnished will be shown on the architectural plans. Examine all plans carefully and furnish any access panels or doors to equipment in these spaces where they are not to be furnished under the other section.

2.11 CHANNEL FRAMING

A. General.

1. Channel combinations and accessories shall be of compatible design in arrangements and combinations as shown on the drawings. Channels and accessories shall have a hot dipped galvanized finish.
2. Manufacturer: Channel framing shall be as manufactured Superior Strut and Hanger Company, Unistrut, B-Line Systems Inc. or equal.

2.12 PIPE WRAPPING

A. Buried piping.

1. Underground copper or steel piping buried directly in the soil shall be coated and machine wrap as follows:

a. Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. Primer shall be Trenton Wax Tape Primer, Denso Paste Primer, or equal and shall have the following properties:

Color	Brown
Pour Point	100°F to 110°F
Flash Point	350°F
Coverage	1 gallon/100 square feet

b. Wax tape shall consist of a synthetic fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. Wax tape shall be Trenton No. 1 Wax Tape, Denso “Densyl Tape” or equal and shall have the following properties:

Color	Brown
Saturant Pour Point	115°F to 120°F
Thickness	40 mils minimum
Tape Width	Various
Dielectric	100 volts/mil

c. Wrapper shall be polyvinylidene chloride plastic with three 50-gauge piles wound together as a single sheet. Plastic wrapper shall be Trenton Poly-Ply, Denso Tape PVC Self-Adhesive, or equal and shall have the following properties:

Color	Clear
Thickness	1.5 mils
Tape Width	6 inches

2. Wax Tape Coating application

a. Surface shall be clean and free of all dirt, grease, water and other foreign material prior to the application of the primer and wax tape.
b. Apply primer by hand or brush to all surfaces to be wrapped, including, overlapping adjacent dielectric and cement mortar coatings by 4 inches minimum. Work the primer into all crevices and completely cover all exposed metal surfaces.
c. Apply the wax tape immediately after the primer application. Work the tape into the

crevices around fittings. Wrap the wax tape spirally around the pipe and fittings. Use a minimum overlap of 55% of the tape width. Apply wax tape were shown on drawings and to buried mechanical and restrained joints, joint bolts, grooved-end couplings, flexible couplings, joint harnesses, and valves. Apply per Manufacturer's recommendations.

d. Work the tape into the crevices and contours of irregularly shaped surfaces and smooth out so that there is a continuous protective layer with no voids or spaces under the tape.
e. Wrap the completed wax tape installation with plastic wrapper. Wrap spirally around the pipe and fittings. Use a minimum overlap of 55% of the wrapper. Secure plastic wrapper to pipe with adhesive tape.

3. Application of Polyethylene Sheet Coating

a. Wrap completed wax tape coating system with polyethylene film and secure around the adjacent pipe circumference with adhesive tape per AWWA C105.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPING

A. General.

1. Furnish and install all piping, equipment trim, etc., including all work necessary to make complete and properly operating systems, whether all details are mentioned in these specifications or indicated on the drawings.
2. Rough-in work: Pipe sizes shown on the drawings are nominal inside diameter except copper tubing for refrigerant service which is outside diameter. Wherever five-inch size pipe is shown, six inch may be substituted. Unless noted otherwise, make all pipes trim full line size.
3. Proceed as rapidly as the building construction will permit, so as to be completed, tested and approved before being enclosed.
4. Carefully inspect each piece of pipe and each fitting to see that there is no defective workmanship on the pipe or obstructions or dirt in the pipes and fittings. Material having burrs, slag intrusions, cracks, eccentricity, excessive roughness, damage due to rough handling, etc., will be rejected and shall be removed from the job site.
5. Whenever work is not in progress and at the end of each workday, cap or plug all openings in completed piping to prevent the entrance of materials that would obstruct the pipes. Leave in place until removal is necessary for completion of installation.
6. No piping shall be permanently closed up, furred in, or covered over before it has been tested and inspected as specified herein and is accepted by the Architect.
7. Install piping parallel to walls and to present a neat appearance both as to workmanship and grouping.
8. Piping shall clear all obstructions, preserve headroom and keep openings and passageways clear whether shown on the plans or not.
9. Should structural difficulties prevent the running of pipes or the setting of equipment at the point indicated by drawings, the necessary minor deviations there from, as determined by the Architect, be allowed, but must be made without additional cost.
10. Locate piping to clear steel reinforcing bars in beams. Offset reinforcing bars in walls to clear piping and sleeves. Get approval from Structural Engineers.
11. Joists, girders, beams, columns or reinforcing steel shall not be cut or weakened.
12. Conceal all piping within the building wherever possible, unless otherwise noted on drawings. Exposed piping, wherever necessary, shall if possible be run in unfinished rooms.
13. Do not use couplings except where required pipe runs between fittings that are longer than the standard length of the type of pipe being used and except where their use is specifically approved by the Architect.
14. Copper, bronze, and brass solder type fittings, including unions and flanges, shall have sockets of proper diameters to suit outside diameters of copper and brass pipe and copper

tubing with which they are being used. The expanding or swaging of tubing to fit IPS fitting sockets will not be permitted.

15. Cut pipe accurately to measurements established at the site. Work into place without springing or forcing. Properly clear all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted.
16. Pipe damage: Show no tool marks or threads on exposed plated, polished or enameled connections to fixtures. Tape finished surfaces to prevent damage during plastering. Brass and copper piping shall have no tool marks wherever installed.
17. Make all changes in direction with fittings and changes in main size by reducing fittings. Unless otherwise noted, for pipe size change on all horizontal pump circulated water supply and return piping, use eccentric couplings flat on top.
18. Dielectric insulation.
    a. Provide dielectric insulation at all points where copper water piping including brass nipples is connected to ferrous metal such as steel piping, tanks, water heaters, etc.
19. Pitch pipe lines to be free of sags, traps or unnecessary bends as required for proper drainage. Provide a gate valve of same size as line but 3/8" minimum and 3/4" maximum size at each low point.
20. Unions and Flanges.
    a. Provide unions or flanges suitably located to facilitate maintenance and removal of all equipment or automatic pipe mounted apparatus.
    b. Faces of flanges to be connected shall, in all cases, be alike.
    c. Provide two unions at threaded three way mixing valves.
21. Shop or field fabricated fittings, bushings, street ells, and long screw nipples are not acceptable and shall not be used. Reducer couplings, tees or ells shall not be used.
22. Equipment by others: For rough-ins and final connections to equipment furnished by others, ascertain exact sizes, type, services and locations before starting work.
23. Springing, bending or forcing of pipe into place shall not be allowed. Use fittings for all off-sets or changes in alignment of piping.
24. Flexible Pipe Connections.
    a. Provide flexible piping connection on each pipe connection to equipment mounted on or suspended from isolators with one half inch or more static deflection or where such connections are shown on plans.
25. Install piping outside of building at not less than 18" below finish grade in landscaped, unpaved areas or finished sub-grade surface in paved areas. Natural gas piping outside of buildings shall have 24" of cover or as recommended by Gas Company.
26. Isolate all domestic and industrial water piping with approved isolating suspension clamps. Piping shall not meet building structure.
27. Excavation, Trenching and Backfill: Do all necessary trench excavation, shoring, backfilling and compaction required for the proper laying of the pipelines.
    a. Backfill shall be clean soil free from rocks and debris. Compact to ninety percent (90%) of surrounding soil. All piping shall be installed in sand bed and covered with six inches (6”) of sand prior to backfill.
    b. Gas piping shall have minimum twenty-four inches (24”) of cover and all other piping shall have not less than eighteen inches (18”) of cover, unless otherwise noted on the drawings or as required to connect into existing utility lines. Offset gas and water piping as required to permit crossover of piping systems.
    c. Bottoms of Trenches: Cut to grade and excavate bell holes to ensure the pipes bearing for their entire length upon the outside periphery of the lower third of the pipe.
    d. Water piping shall not be run in the same trench with sewer or drainage piping, except when separated per codes.
    e. Horizontal sanitary and drain piping shall be installed to a uniform grade of not less than

one-fourth inch (1/4”) per foot, unless otherwise indicated or directed.

f. Before laying of any pipe of digging of any trenches, Contractor shall determine by actual excavation and measurement exact locations and depth of existing utility and service lines to which he is going to connect. In event depth of existing sewer main is not sufficient to permit installation of piping as detailed on drawings or to make connection in manner indicated, Contractor shall confer with the Architect and District’s representative before proceeding with this work.

g. Trenches used for multiple utilities shall be wide enough to allow access to each separate utility from the ground above. Using normal tools for trenching. No utility may be placed directly above of below another, except that utilities may cross one another at no less than 45 degrees.

h. All underground water piping 3” and larger shall be provided with thrust blocks, for both solvent joint and mechanical joint piping, in accordance with IAPMO IS 8-95.

i. Tracer wire: Install along all underground plastic piping runs a Type HMW, 30 mil PE Insulated, 12 ga solid copper tracer wire, per ASTM B3, B8, and ANSI.C8.35.

28. Install sewer piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and coupling in accordance with manufacturer’s recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed. Use proper size increasers, reducers, and coupling, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
29. Tap Connections at Sewer Piping: Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work. Make branch connections from side into existing 4- to 21- inch piping by removing section of existing pipe and installing wye fitting, into existing piping. Encase entire wye with not less than 6 inches of 3000-psi 28-day compressive-strength concrete. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.02 INSTALLATION OF VALVES

A. General.

1. Valves shall be full line size. Automatic valves are excepted.
2. All valves shall have proper clearances for handling operation and shall close tight at the specified test pressure.
3. On 3-piece construction ball valves, remove center section of the valve prior to soldering to prevent any damage to the Teflon seats. Reinstall center section after soldering.

B. Arrangement.

1. Install valves in the systems so located, arranged and operated as to give complete regulation of all apparatus, equipment, and fixtures.
2. Install valves for accessibility and easy maintenance.
3. Install valves with stems horizontal or vertically upright.
4. Wrenches: Plug valves (cocks): Provide 12" wrench for valves 2" and smaller, 18" wrench for 4" valves, and 36" wrench for valves 6" and larger.
5. Provide valve box at each valve or cock in ground. Set cover flush with finished grade except in planted areas set 1" above ground.
6. Balance valves. Install balance valves where shown and on each circulating return branch where two or more branches occur on domestic hot water system.
7. Provide readily accessible lubricated gas shut-off valve in gas supply to each gas burning appliance ahead of union connection thereto, and in addition to any valve on appliance.

8. Hose bibbs. Mount with outlet 18" above floor or finished grade, unless shown otherwise.

C. Location.

1. In all branches and headers of water piping serving a group of two or more plumbing fixtures.
2. On both inlet and outlet of all apparatus and equipment.
3. For shutoff of branch mains.
4. For flushing and sterilizing the systems.
5. Where shown on the drawings.
6. Ahead of each automatic valve for water service.

3.03 PIPE SUPPORTS

A. Installation.

1. Securely support all piping from building construction with manufactured iron hangers, brackets, trapezes, guides, anchors and sway braces to maintain pipe alignment and prevent sagging, noise and excessive strain due to uncontrolled movement under operating conditions.
2. Relocate any hangers as necessary to correct unsatisfactory conditions that may become evident when system is put into operation.
3. Supporting of pipe by wire, rope, wood or other makeshift devices will not be permitted.
4. Burning of holes in beam flanges or narrow members will not be permitted.
5. Where calculated maximum travel exceeds one inch, provide rollers at all non-suspended type support and on all but one of the largest pipes on trapeze supports.
6. Where rods exceed 12" in length for pipes 2" and larger and all trapezes, provide lateral sway bracing at every third hanger. Equip each with a longitudinal sway brace. Sway brace rods shall either be two hanger rods set at 45 degrees on both sides without a vertical hanger or 1- 1/2" x 1-1/2" x 1/8" angle iron to 2" pipe size and 2"x 2" x 1/4" for larger pipe, set on 45 degrees. Secure bracing to pipe a structure as for hangers. Fit all hanger rods do not sway braced at the top with a swivel.
7. Fasten hanger rods to structural steel members with beam clamps with retaining clips; to concrete with steel or malleable iron inserts.
8. Sheet lead, lead wool or wood plugs will not be accepted as a substitute for cinch anchors as a means of attaching materials and equipment to concrete.
9. Support cast iron, plastic and glass drainage pipe on each floor.
10. Support for insulated pipe shall be outside the insulation. Protect pipe insulation at every hanger, support or guide with inserts and shields. The galvanized steel shield shall be applied between the hanger or support and the pipe insulation. Provide saddles at all rollers for insulated pipe not equipped with inserts and shields.

B. Manifolding:

1. Parallel runs of piping, except for fire protection, may be supported on trapeze hangers, spaced as required for the smallest pipe carried.
2. Support piping in chases on channel framing.
3. For piping over 2" construct framing of welded assemblies of steel shapes. Provide calculations that the design will carry five times the weight of thrust of the pipe.

C. Support spacing:

1. Maximum spacing for horizontal piping supports shall be as follows:

Material	Size	Spacing
Steel or Brass pipe	3/4" and smaller	6 ft.
Steel or Brass pipe	1" and 1-1/4"	8 ft.
Steel or Brass pipe	1-1/2" to 3"	10 ft.

Steel or Brass pipe	4" and larger	14 ft.
Copper tubing	1" and smaller	6 ft.
Copper tubing	1-1/4" and larger	8 ft.
C.I. Soil Pipe	All sizes	5 ft. ea. Joint

2. Where building structure does not permit the specified spacing, provide additional adequate struts or blocking. Location and details shall be submitted to the Architect for approval.
3. Support piping at each change of direction, at ends of branches, at base and top of riser pipes and drips, and wherever necessary to prevent sag, bending, or vibration, in addition to above listed hanger spacing.

3.04 PIPE ANCHORS

A. Shot driven anchors.

1. Supports may be secured to the concrete structure by shore anchors as long as the pin does not penetrate the concrete more than 3/4 inch and it is rated for the load it will carry, if approved by the Structural Engineer. Submit calculations.
2. For loads that exceed the shore anchor rating, use drilled anchors.

B. Drilled anchors.

1. Drilled anchors shall be of the self-drilling expansion type with self-cutting annular broaching grooves, or they may be of the non-drilled type with expansion tip.
2. Anchors shall have a recommended load with a minimum of safety factor of four. Submit calculations.

3.05 PIPE JOINTS

A. General.

1. Remake any leaky joints with new materials. The use of thread cement, caulking or patch welding to make the old joint tight is absolutely prohibited.

B. Solder and brazed joints.

1. Cut square; remove burrs and clean both the pipe or tubing and inside of female fitting to a bright finish with steel wool, wire brush, sandpaper or emery cloth. Apply solder flux with brush tubing. Remove internal part of solder-end valves prior to soldering.
2. Joining copper tubing and brass pipe shall be as follows:

   a. Domestic piping 3" and smaller: 95-5 Tin-Antimony Grade 5A.
   b. Drainage piping: 95-5 Tin Antimony.
   c. For all reinforced non-ferrous piping connections, water piping larger than 3", steam condensate, all chilled water and heating hot water using type "L" copper, or type "K" copper, and all refrigerant piping: Use over 1100 DEG F brazing alloy, ASTM B250, Class BCUP-5. Sil-FOS 15% silver brazing alloy, Harris Stay-Silv 15 or equal.

C. Screwed Piping.

1. Cut square and clean with machine cutter, hack saw or carborundum pipe wheel. Wheel cutters are not acceptable. Deburr with file or pipe reamer. Do not ream to exceed I.D. of pipe and thread to ANSI B2.1 requirement.
2. Use Teflon tape, Armite #250, "Tyte-Unite" or Enterprise "Threadseal" sealing compound on outside threads for joining all services, except refrigerant piping, and Acorn #3500 for cleanouts.
3. Litharge and glycerin may be used for sealing threads of compressed air piping and shall be used for refrigerant piping.

4. No more than two full threads shall remain exposed after making up joints.
5. Do not wrap pipe threads and slip joints with string, paper, putty or similar fillers. Threaded joints must be made tight with tongs or wrenches. Piping in finished areas shall bear no tool marks. Caulking of any kind will not be permitted.

D. Welded Piping.

1. Oxyacetylene or electrical arc process.
2. Weld in accordance with and by welders who have qualified under the latest Edition, American National Standard Code for pressure piping ANSI/ASME B31.1, Chapter 5, and subsequent Addenda. Welder qualifications shall be issued by an independent testing laboratory or by the by the authorities having jurisdiction approved by the District.
3. Remove foreign matter from pipe ends before tacking or welding.
4. Align ends concentric and tack weld.
5. Weld and reinforce to full thickness of pipe. Welds shall be continuously fused to pipe and to prior pass weld, shall have full penetration without slag inclusions or porosity. Fillet type welds for flanges and socket fittings shall have a throat dimension not less than the pipe wall thickness.
6. Welding rods: Oxwall No. 1-HT Class EG010, or equal.
7. Fabricated fittings are not acceptable.
8. Connections:

   a. Slip-on flanges shall be both face and back welded.

9. Hammer each pass clean of slag and scale.
10. The Owner reserves the right to inspect and to x-ray test any welds per latest Edition, American National Standard Code for Pressure Piping ANSI/ASME 3.1 Chapter 6, and subsequent Addenda.

3.06 ACCESS TO EQUIPMENT

A. General.

1. Install all piping equipment and accessories to permit access for maintenance.
2. Any relocation of piping, equipment and accessories required to provide maintenance access shall be accomplished at no additional cost to the Owner.

B. Access.

1. Provide access doors where any valves, motors and equipment requiring access for servicing, repairs, or replacement are located in walls, chases or above ceilings.
2. The location of access doors shall be coordinated with and installed by the applicable trade installing walls or ceiling.
3. Contractor shall arrange for the necessary openings in the building to allow for admittance of all apparatus.

3.07 SLEEVES, CORE DRILLING AND ESCUTCHEONS

A. Sleeves.

1. General.

   a. Provide pipe sleeves where each pipe or prefabricated pipe conduit passes through floors, walls, or ceilings, whatever the construction.
   b. Provide minimum of 1/2" clearance around all sides of pipe and extend full thickness of the construction. Where piping is to be insulated, allow for full thickness of insulation, plus 1/2" clearance all around.

c. Cast iron sleeves: Secure waterproofing membrane under flashing clamp. Caulk annular space watertight.
d. Steel or concrete sleeves: Dry pack in place and caulk annular space.
e. Extend sleeves in equipment room floors 2" above finish floor with annular space caulked watertight.
f. Extend sleeves on waterproofed floors 1 inch above floor. Use fire retardant material in sleeves through fire separations.

2. Locations and types.

a. For floor slabs on grade, provide permanent sleeves of clay pipe, concrete pipe or cement asbestos pipe. Where sleeves cannot be installed, such as at connections to floor drains, take necessary precautions to ensure that drains or pipes are not in contact with reinforcing steel. Caulk space between pipes and pipe sleeves with oakum and mastic and make watertight.
b. Provide sleeves through all other (non-concrete) construction of the same materials as pipe of size and length as hereinbefore required.

B. Core Drilling.

1. Size core drilling holes adequately to allow for dry packing sleeves in place; to allow for insulation to extend through holes; to allow for fireproof caulking of clearance around pipes to prevent direct contact between pipes and structures.
2. Locations of core drilling shall be approved by the Architect prior to drilling.

C. Escutcheons.

1. Provide chromium plated escutcheons with screw or spring clamping device on all piping that penetrates floors, walls and ceilings where exposed to view. Escutcheons shall completely cover opening.

3.08 STRAINERS

A. General.

1. Strainers shall be full line size.
2. Valve blow-down connection with a gate or ball valve sized same as the connection. Plug valves not piped to drain.

B. Location.

1. Ahead of each automatic control valve for water service.
2. Where shown on the drawings.

3.09 FLASHING

A. Furnish and install roof vent flashing with 24-gauge galvanized steel base, fitted with elastomer collar. Unit shall be Water-Tight manufactured by IPS Corporation as per corresponding dimensional characteristics, or equivalent.

3.10 PIPE WRAPPING

A. Cleaning and wrapping all underground steel piping.

1. Piping shall be machine coated and wrapped as follows:

a. Clean.
b. Prime

c. Coal tar enamel
d. Fiberglass inter wrap .020"
e. Coal tar enamel.
f. Kraft paper

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Con-dictions and Division 01 Specification Sections, apply to this section and all other sections of Division 22.

1.02 SUMMARY

A. This section includes the requirements for identification of piping and equipment in the building using the following:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe system labels.
4. Stencils.
5. Valve tags and schedules.
6. Ceiling tags
7. Laminate signs
8. Warning tags.

B. All plumbing equipment, systems, piping, shall be identified

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Samples: For color, letter style, and graphic representation required for each identification material and device.
2. Data: Installation details, material descriptions, dimensions of individual components for each type of tag and sign.
3. Equipment Label Schedule: Submit a sample equipment label schedule for each plumbing system. Include the equipment tag designation, name and location in an “xl” file format.
4. Valve Tag Schedule: Submit a sample valve tag schedule for each plumbing system. Include the valve tag designation, name and location in an “xl” file format.

1.04 CLOSEOUT SUBMITTALS

A. Operation & Maintenance Manual: Include a copy of the approved submittal for each product and material along with any applicable maintenance data in the project operation and maintenance manual.
B. Equipment Label Schedule: Include a complete equipment label schedule for each plumbing system. Include equipment tag designation, name and location, the operation and maintenance manual, in an “xl” electronic file format.
C. Valve Tag Schedules: Include a complete valve tag numbering schedule for each plumbing sys- tem. Include the system identification, valve number and location, in the operation and maintenance manual, in an “xl” electronic file format.

1.05 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.

1.06 WARRANTY/GUARANTEE

A. See Division 22, Specification Section “Basic Mechanical Requirements – Plumbing” for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

A. Labels, Signs and Tags: All labels, signs and tags shall conform to ANSI/ASME A 13.1 and OSHA requirements for letter/color combinations.
B. Basis of Design: The basis of design shall be mechanical identifications materials manufactured by the Seton Name Plate Corporation as follows:

1. Equipment Labels – Style M4562 – M4565
2. Warning Signs – Style M4562 – M4565
3. Plumbing Pipe Labels – Size 8SM - 32
4. Valve Tags – Style 374

C. Other Acceptable Manufacturers: Subject to compliance with requirements, provide mechanical identifications materials from one (1) of the following:

1. Craft Mark Pipe Markers
2. Pipe Markers – Division of Brimar Industries

2.02 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, one eighth (1/8) inch thick, and having predrilled holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than two and one half (2-1/2) inches by three quarter (3/4) inches.
3. Minimum Letter Size: One quarter (1/4) inch for name of units if viewing distance is less than twenty-four (24) inches, one half (1/2) inch for viewing distances up to seventy-two (72) inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two thirds (2/3) to three fourths (3/4) the size of principal lettering.
4. Fasteners: Self tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's label as indicated on the construction documents.

2.03 WARNING SIGNS AND LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving one eighth (1/8) inch thick and having predrilled holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than two and one half (2-1/2) inch by three quarter (3/4) inch.
3. Minimum Letter Size: One quarter (1/4) inch for name of units if viewing distance is less than twenty-four (24) inches, one half (1/2) inch for viewing distances up to seventy-two (72) inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two thirds (2/3) to three fourths (3/4) the size of principal lettering.
4. Fasteners: Self tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include caution and warning information, plus emergency notification instructions.

2.04 PLUMBING PIPE SYSTEM LABELS

A. General Requirements: Do not use pipe labels or plastic tapes for bare pipes conveying fluids at temperatures of 125°F (52°C) or higher.
B. Pipe Labels: Pretensioned, semirigid vinyl or plastic formed pipe labels to partially cover or cover full circumference of pipe and to attach to pipe without adhesive.

1. Label Material: Comply with the following:

a. Vinyl Formed Labels:

1) External diameters up to two (2) inches – 20 mil vinyl.
2) External diameters two and one half (2-1/2) inch and larger – 30 mil vinyl.

b. Plastic Formed Labels: per manufacturer's recommendations.

2. Small Pipes: For external diameters less than six (6) inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
b. Adhesive lap joint in pipe marker overlap.
c. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than three quarter (3/4) inch wide; full circle at both ends of pipe marker, tape lapped one and one half (1-1/2) inches.

3. Large Pipes: For external diameters of six (6) inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three (3) times letter height (and of required length), fastened by one of the following methods:

a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than one and one half (1-1/2) inches wide; full circle at both ends of pipe marker, tape lapped three (3) inches.
b. Strapped-to-pipe (or insulation) application of semi-rigid type, with Manu- facture's standard stainless-steel bands.

4. Pipe Label Contents: Comply with the following:

a. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions and as separate unit on each pipe label to indicate flow direction.
b. Lettering Size: At least one and one half (1-1/2) inches high.
c. Pipe Label Designation and Colors: See table below.

PLUMBING SERVICE DESIGNATION	LABEL DESIGNATION	FIELD/LETTER COLOR
Sanitary Waste	Same as Service Designation	Green / White
Sanitary Vent	Same as Service Designation	Green / White
Laboratory Waste	Same as Service Designation	Green / White
Laboratory Vent	Same as Service Designation	Green / White
Domestic Cold Water	Same as Service Designation	Blue / White
Laboratory Cold Water	Same as Service Designation	Blue / White
RO / DI Water	Same as Service Designation	Green / White
Laboratory Vacuum	Same as Service Designation	Green / White
Natural Gas Piping	Same as Service Designation	Yellow/Black

2.05 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of three quarter (3/4) inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.06 VALVE TAGS AND SCHEDULE

A. General: Valve tags are required to identify what systems the valves are installed in, where the valves are located and what duty the valves perform.
B. Valve Tags:

1. Description: Stamped or engraved with one quarter (1/4) inch letters for piping system abbreviation and one half (1/2) inch numbers with:

a. Brass Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
b. Fasteners: Brass wire-link chain

2. Plastic Laminate Valve Tags: Provide manufacturer's standard three thirty second (3/32) inch thick engraved plastic laminate valve tags, with piping system abbreviation in one quarter (1/4) inch high letters and sequenced valve numbers one half (1/2) inch high, and with five thirty second (5/32) inch hole for fastener.

a. Provide One and one half (1-1/2) inch sq. black tags with white lettering, except as otherwise indicated.
b. Provide size, shape and color combination as specified or scheduled for each piping system.

3. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately three sixteenth (3/16) inch high letters and sequenced valve numbers approximately three eights (3/8) inches high, and with five thirty second (5/32) inch hole for fastener.

a. Provide one and one eighth (1-1/8) inch sq. white tags with black lettering.
b. Provide size, shape and color combination as specified or scheduled for each piping

system.

c. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

4. Valve Tag Data: Provide tags for each Valve provided:

PLUMBING VALVE SERVICE
Domestic/Lab Cold Water
Laboratory RO / DI Water
Laboratory Vacuum
Natural gas

C. Valve Schedules: Provide a valve schedule in an "xl" file format for each Plumbing piping system. File shall include the valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room, space, equipment, pipe riser), and valve duty. Also mark valves for emergency shutoff and similar special uses as required by the project.

1. Numbering System: Valves shall be in numerical order starting with one (1) for each plumbing system.

2.07 CEILING MARKERS

A. Ceiling Grid and Access Panel Markers: Provide Kroy type clear adhesive printed labels with three sixteenth (3/16) inch high letters to identify the location and type of concealed components.

B. Ceiling Marker Data: For Plumbing printed data shall be as follows:

ITEM	SERVICE	LABEL
LP Drain	Low Point Drain	PL Valve – LPD – *
PRD Valve – DCW	Pressure Reducing Valve	PL Valve – PRDV – DCW
PRD Valve – DHW	Pressure Reducing Valve	PL Valve – PRDV – DHW
PRD Valve – LCW	Pressure Reducing Valve	PL Valve – PRDV – LCW
PRD Valve – LHW	Pressure Reducing Valve	PL Valve – PRDV – LHW
San Cleanout	Sanitary Drain Cleanout	PL – Cleanout – SAN
SW Cleanout	Storm Water Drain Cleanout	PL – Cleanout – SW
AW Cleanout	Acid Waste Drain Cleanout	PL – Cleanout – AW

* System ID: Domestic Cold Water (DCW), Laboratory Cold Water (LCW), Laboratory Hot Water (LHW), Laboratory RO/DI Water (LRO/DI)

2.08 ENGRAVED PLASTIC LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: One eighth (1/8) inch, except as otherwise indicated.

C. Fasteners: Self tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
D. Nomenclature: Include the following, matching terminology on schedules as closely as possible.
E. Size: Provide approximate two and one half (2-1/2) inch x four (4) inch markers for control devices, dampers, and valves; and four and one half (4-1/2) inch x six (6) inches for equipment.

2.09 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Three (3) inches by five and one quarter (5-1/4) inches minimum.
2. Fasteners: Self tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Architectural Specification Section "Interior Painting."
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 to major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of fifty (50) feet along each run. Reduce intervals to twenty five (25) feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

3.04 VALVE TAG INSTALLATION

A. Provide valve tags for all valves installed in plumbing piping systems. Valve duty usually includes the following:

1. Shut off duty for a room, equipment and/or a floor.
2. Balancing duty.
3. Riser isolation duty.
4. Drain valves.
5. Control valves.
6. Shut off duty for back flow preventers.
7. Shut off valves in branch piping serving hose bibbs.
8. Exclude stop valves for faucets, etc., at plumbing fixtures and hose bibbs.

3.05 VALVE TAG SCHEDULE

A. Include the valve schedule file in the electronic operation and maintenance manual.

3.06 WARNING TAG INSTALLATION

A. Write required message on and attach warning tags to equipment and other items where required.

3.07 CEILING MARKERS

A. Location: Install each ceiling marker label and a dot on the surface of the ceiling grid ‘T’ bar and/or on the frame of an access door.

3.08 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
B. Cleaning: Clean face of identification devices.

END OF SECTION

SECTION 22 70 00
DI WATER SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. Work Included: Provide all labor, materials, equipment, tools and services, and perform all operations required in connection with or properly incidental to the construction of a complete and fully recirculated deionized water distribution system with outlets as indicated on the Drawings, as required for a complete and functional system and capable of delivering deionized treated water to locations shown on the drawings. All treated water piping shall be circulated to the point of the wall stub-out to serve treated water faucets and equipment.

1.02 QUALITY ASSURANCE:

A. Acceptable Manufacturers: Products shall comply with these specifications and be as designed and manufactured by US Water Systems, including all accessories necessary for a fully operable system. The system shall be a 200-RO-DI-100 (100 GPD RO De-Ionization System) with a Deck-mounted manual laboratory faucet (Chicago Faucets #928-317SAM). This system shall be a US Water Systems 5-Stage RO with 2-Stage DI Water System. All piping, tubing, and accessories, including pre-filters with membrane, tank and tank stand, angle stop feed valve, tank valve system, RO module, DI module, and monitor, shall be provided by the same manufacturer (US Water Systems).

1.03 SUBMITTALS:

A. Shop drawing submittals shall include, but not be limited to, the following:

1. Cut sheets for the RO tank, RO manifold, flow restrictor, DI system, drain saddle, DI-approved distribution valve, treated water pipe, valves, faucets, fittings, and all other required accessories. These cut sheets shall clearly indicate all features, options, materials, and dimensions.
2. Additional information as required in Appendix A.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Delivery: Treated water piping system components shall be delivered in factory-fabricated, water-resistant packaging.
B. Handling: Treated water piping system components shall be handled carefully to prevent damage to materials, components, enclosures, and finishes.
C. Storage: Treated water piping system components shall be stored in a clean, dry location protected from the weather.

PART 2 - PRODUCTS

2.01 System Components:

A. This system includes the following components:

1. RO Module
2. DI Module and Monitor
3. Tubing Bundle

4. Filter Wrench
5. 1/4" Drain Saddle Valve (3/8" if using an air gap faucet)
6. Tank Valve
7. Angle Stop Feed Valve
8. Tank and Side Mount Tank Stand
9. Pre-Filters (Sediment and Activated Carbon)
10. Reverse Osmosis Membrane

2.02 Component Overview:

1. Pre-Filters:
    a. Sediment Filter: Removes larger particles (sand, silt, rust, scale).
    b. Activated Carbon Filters: Remove chlorine and chloramine.
2. DI Cartridge: Treats water to DI quality.
3. Reverse Osmosis Membrane: Reduces dissolved minerals, metals, and salts.
4. RO Module: Houses pre-filters and membrane; includes mounting bracket.
5. DI Module: Houses DI cartridges; includes conductivity meter.
6. Storage Tank: Stores filtered water.
7. Automatic Shut-Off Valve (ASO): Stops water supply when tank is full.
8. Feed Water Angle Stop Valve: Connects to cold water line.
9. Waste Water Saddle Valve: Connects to drain line (1/4" standard, 3/8" for air gap faucet).
10. Tubing: Supplies feed and reject water.
11. Fittings: For hose connections.

2.03 Installation Tools

A. Tools Needed May vary depending on installation

1. 3/8" Drill and 1/4" Drill Bit
2. Faucet Drill Bit (7/16" standard faucet, 7/8"-1 1/8" air gap faucet)
3. Phillips Head and Flat Blade Screwdrivers
4. Adjustable Wrench
5. Teflon Tape
6. Plastic Tube Cutter

2.04 Quick Connect Fittings

1. This RO system utilizes quick connect fittings for ease of installation and superior performance. Proper use of these push-in fittings is crucial. High-quality tubing, cut square with a plastic tube cutter or sharp razor, is required.
2. Connecting Tubing:
    a. Prepare the Tube: Cut the tube square, ensuring the outside diameter is free from score marks, burrs, and sharp edges. For soft, thin-walled tubing, tube inserts are recommended.
    b. Insert the Tube: Push the tubing fully into the fitting until it reaches the tube stop. The fitting will grip the tube before a seal is formed.
    c. Secure the Connection: The collet (gripper) with stainless steel teeth will hold the tubing firmly. The O-ring creates a permanent, leak-proof seal.
    d. Verify Connection: Pull on the tubing to check that it is secure. Test the system before leaving the site and/or before use.
3. Disconnecting Tubing:
    a. Depressurize the System: Ensure the system is depressurized before disconnecting the tubing.
    b. Release the Collet: Push the collet squarely against the fitting face.

c. Remove the Tube: While holding the collet in this position, remove the tube. The fitting can be reused.

4. Leak Troubleshooting:

a. Leaks at fittings are typically caused by defective tubing. To fix a leak:
b. Relieve pressure.
c. Release the tubing.
d. Cut at least 1/4" off the end of the tubing (square cut).
e. Reattach the tubing.
f. Verify the connection is leak-free.
g. It is advisable to cut off 1/4" from the tubing end each time a new connection is made.

PART 3 - INSTALLATION

3.01 Installation Location

A. The RO system can be installed under a sink, in a basement, or other suitable location with adequate space. Do not install the unit where temperatures may fall below freezing, as damage may occur.
B. Storage Tank: Locate the tank within 10 feet of the RO module, ideally under the sink or in a nearby cabinet. Ensure the chosen location can support the weight of a full tank (over 30 lbs).
C. RO Module: Mount the module on either side of the sink, in a cabinet, or in a heated basement with access to a potable cold water line and a sanitary drain.
D. DI Module: Mount the DI module near the RO module and storage tank.
E. Feed Water Connection: Connect to a potable cold water supply line only, using an angle stop feed water valve installed between the sink's cold water shutoff valve and the faucet tubing. NOTE: Softened water is preferred since it will extend the life of your RO mem-brane.
F. Drain Connection: Use a waste water saddle valve designed for 1-1/2" OD drain pipe. Install the valve above (before) the trap, on the vertical or horizontal tailpiece. Do not install near a garbage disposal. If discharging into a utility sink or standpipe, an air gap may be required (1" or greater above the floor or pipe rim). Do not connect the RO drain line to the dishwasher drain line. Back pressure may cause the air gap to overflow.

3.02 Installation: Feed Water Angle Stop Valve and Tubing

A. Isolate Water Supply: Turn off the cold water supply valve for the sink faucet. Open the cold water faucet to relieve pressure in the line.
B. Install Angle Stop Valve: Disconnect the sink faucet "whip hose" or tubing from the shutoff valve (be prepared for residual water spillage). Install the angle stop valve onto the sink faucet shutoff valve and tighten securely using two wrenches. The angle stop valve can be swiveled and positioned later.
C. Reconnect Faucet Supply: Reconnect the "whip hose" or tubing to the angle stop valve and tighten securely.
D. Test for Leaks: Ensure the angle stop valve's blue handle is closed. Open the sink shutoff valve and check all connections for leaks. Repair any leaks immediately.
E. Connect RO Supply Tubing: If no leaks are present, connect the orange tubing to the angle

stop valve. Leave the other end of this tubing unconnected until later in the installation process.

3.03 Drain Saddle Valve Installation

A. Before installing the drain saddle valve, inspect the drain pipe to ensure it is in good condition and not thin or frail. Drain saddle valves are designed for standard 1-1/2" OD drain pipes. Install the valve above the trap (between the sink and trap) on the vertical or horizontal tailpiece. Do not install near a garbage disposal outlet, as this may cause clogging.

    1. Mark the Opening: Position the port side of the drain saddle valve at the desired location and mark the opening. Never position the opening on the bottom of the pipe. A side or top position is recommended. Install the rubber gasket on this half of the saddle, ensuring the gasket hole aligns with the port hole.
    2. Drill the Hole: Drill a 1/4" hole (3/8" if using an air gap faucet) at the marked location. Do not drill through both sides of the pipe.
    3. Install the Saddle Valve: Position both halves of the drain saddle on the drain pipe, aligning the quick connect opening with the drilled hole. Use a screwdriver to maintain alignment while tightening.
    4. Secure the saddle clamp with the provided nuts and bolts. Do not overtighten. Ensure equal spacing between the saddle halves on each side.
    5. Connect the Drain Line: Connect the black drain line to the port on the drain saddle. If using an air gap faucet, connect the 3/8" black line from the larger brass barb to the drain saddle.

3.04 Tank Installation

A. Prepare the Tank Outlet: Apply 3-4 wraps of Teflon tape to the tank outlet threads.
B. Install the Tank Valve: Install the tank valve by turning it clockwise. Hand-tightening is usually sufficient, but additional tightening may be required.
C. Connect Tubing: Connect the green 3/8" tubing to the tank valve. Leave the other end of the tubing unconnected for now. It will be connected later.
   Note: Tanks are pre-pressurized to 7 psi. Check and adjust the pressure as needed before installation to ensure it maintains 7 psi.

3.05 Initial Tubing Considerations: It is recommended to leave excess tubing during initial connections. This provides space to pull the unit out of the cabinet for filter changes without disconnecting all the tubing. While securing the system and cutting the tubing to fit is acceptable, it may require system removal for filter changes or make in-cabinet filter changes more difficult.

3.06 RO Filter Installation

A. Install First Filter: Remove the first sump (far right when facing the unit) and install the sediment filter.
B. Secure First Sump: Tighten the sump hand-tight, then use the filter wrench to tighten an additional 1/4 to 1/2 turn.
C. Install Carbon Filter: Remove the center sump and install the carbon filter. Ensure the rubber gasket is correctly placed on both sides of the carbon filter.
D. Secure Carbon Sump: Tighten the center sump hand-tight, then use the filter wrench to tighten an additional 1/4 to 1/2 turn.

E. Install Second Carbon Filter: Repeat steps 3 and 4 for the far left sump and the final chloramine carbon block filter.

3.07 Membrane Installation

A. Disconnect Tubing: Remove the 1/4" tubing from the membrane housing cap by pressing the collet on the elbow fitting towards the fitting. When the collet is flush, the tubing will pull out easily. (See previous section for quick connect fitting removal instructions.)
B. Open Housing: Grip the membrane housing with both hands and remove the cap by turning it counterclockwise.
C. Install Membrane: Remove the membrane from its packaging and install it in the housing. Lightly lubricate the two O-rings on one end of the membrane with the supplied silicone grease.
D. Seat Membrane: Ensure the membrane is fully seated in the housing. When fully seated, it will be approximately 1/8" - 1/4" inset from being flush with the housing.
E. Secure Housing: Lubricate the O-ring on the membrane housing cap and install the cap hand tight. Tighten an additional 1/8 - 1/4 turn.
F. Reconnect Tubing: Push the 1/4" tubing back into the elbow fitting until it is fully seated. It should not be able to be pulled out with a light tug. Ensure proper seating to prevent leaks.

3.08 RO Unit Installation

A. The RO unit is typically mounted to the sink cabinet sidewall, positioning it based on the storage tank location (usually at the rear of the cabinet). The unit is generally installed at the front of the cabinet.
B. To mount the unit:

1. Elevate the unit at least 2" off the floor.
2. Level the unit.
3. Mark the mounting hole locations.
4. Drill the mounting holes.
5. Install the mounting screws, allowing the mounting bracket slots to slip over them.

Note: If the cabinet sidewalls are not solid, the unit may be placed on the floor and secured with screws to prevent tipping. While wall mounting is recommended, it is not required. If the unit is not wall mounted and the tubing is not cut short, the module can be easily removed from the cabinet for filter changes.

3.09 Final Tubing Connections

A. With all components installed, make the final tubing connections, following these guidelines:

1. Route tubing along cabinet contours.
2. Cut tubing to the desired length with square cuts using a proper cutting tool.
3. Avoid sharp bends in the tubing.

B. Final Tubing Connections

1. Connect black tubing to the RO unit's 1/4" x 3/8" adapter on the membrane permeate line.
2. Ensure the storage tank shutoff valve is closed. Connect the open end of the green tank tubing to the provided 3/8" tee. Connect the black tubing from the 1/4" x 3/8" reducing coupling to the tee. Connect another piece of black tubing to the remaining open port on

the 3/8" tee. This tubing will be connected in Step 7.

3. Connect orange tubing from the angle stop supply valve to the RO unit's sediment filter inlet fitting.
4. Connect the tubing from the drain saddle to the RO unit's flow restrictor on the membrane.
5. Mount the dual DI system to the wall.
6. Connect the outlet tee fitting to the "OUT" probe of the EC-2 monitor. Attach the tee to the "OUT" stem fitting on the dual DI system. This is the system outlet and connects to the customer-supplied dispensing system/faucet.
7. Connect the inlet tee fitting to the "IN" probe of the EC-2 monitor. Attach the tee to the "IN" stem fitting on the dual DI system. Connect the black tubing from the tank tee to the inlet port on the dual DI system's inlet tee.
8. Do not install the DI cartridges yet. The system must be flushed before installing the DI cartridges.

PART 4 - SYSTEM START-UP

4.01 Pre-Start-Up Checks:

A. Verify all connections are secure.
B. Turn on the feed water valve and check for leaks. Turn off the valve and correct any leaks before proceeding.
C. Initial Fill and Air Purge: Close the storage tank valve. Open the faucet/dispensing system until a steady stream of water flows (approximately 1/8" diameter). Water will also flow to the drain.
D. Close the faucet/dispensing system and wait five minutes to check for leaks. The initial water may be discolored (this is normal).
   Important Note: A steady stream (not drips) is essential before closing the faucet. Otherwise, trapped air may prevent proper tank filling and waste water.
E. If no leaks are present, open the storage tank valve and allow the system to fill. This typically takes about 2 hours. The system is full when water flow to the drain stops. Check for leaks with a full tank and repair as needed.
   Air Gap Faucet Note: Intermittent spurting from the air gap opening is normal during initial start-up as air is purged from the system.
   Caution: Ensure feed water pressure does not exceed 75 PSI to avoid system damage.

4.02 Flushing and Operation Check:

A. To verify proper RO system operation:

1. Drain the tank completely through the faucet/dispensing system (initial water will be discolored).
2. Close the faucet/dispensing system and allow the system to refill.
3. Let the system run for 2-3 hours until the tank is nearly full.
4. Drain the tank completely again through the faucet/dispensing system. Do not use this water.
5. Allow the tank to refill for another 2-3 hours.

4.03 Air Purging

A. If the tank does not fill during initial start-up, air may be trapped in the tank tubing. While the standard start-up procedure is usually sufficient, additional air purging may be necessary due to water temperature or pressure.

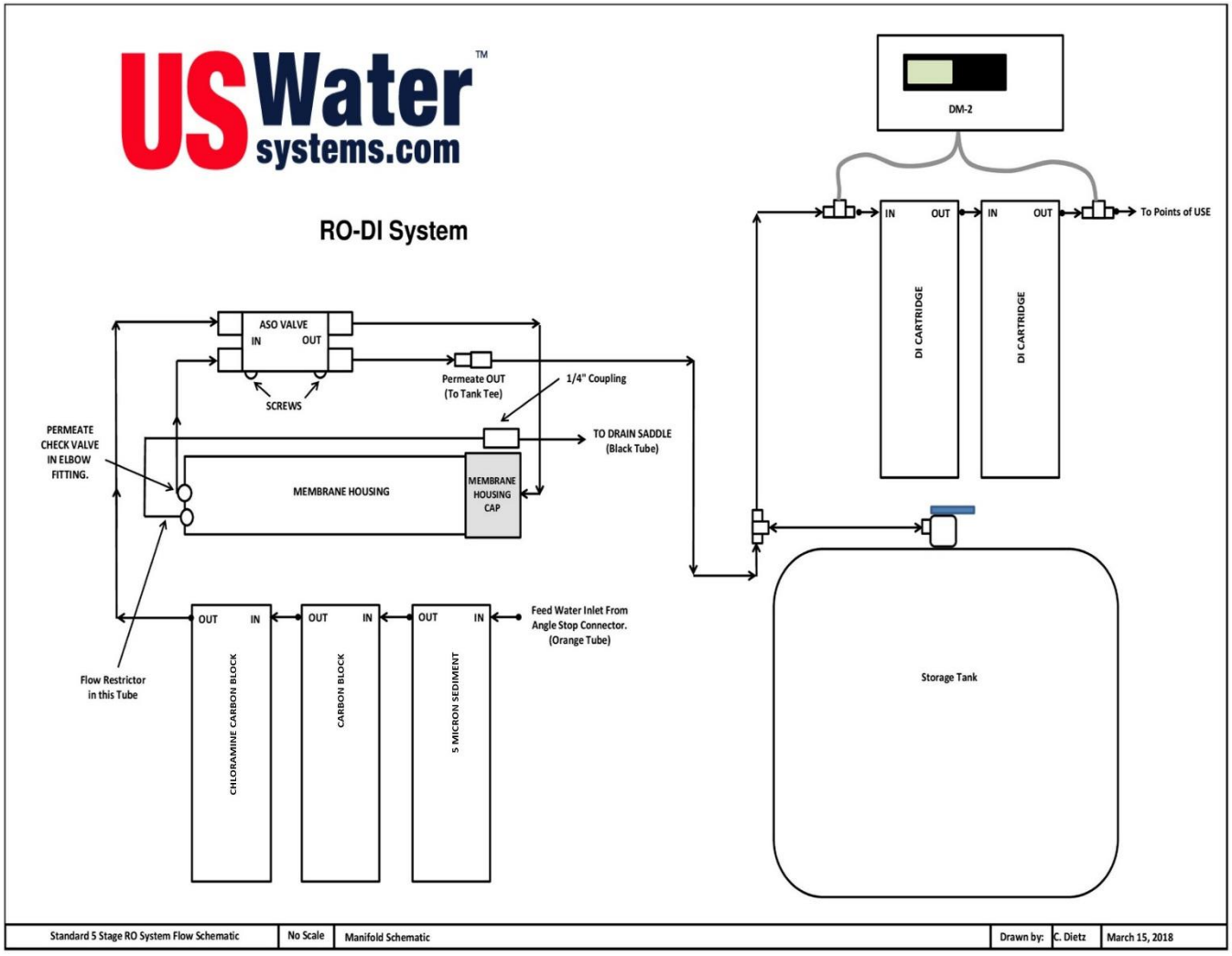
1. Close the tank valve and feed water valve. Open the faucet/dispensing system to relieve pressure.
2. Remove the tank tubing from the tank valve and hold it over a bucket or pan.
3. Open the feed water valve and the faucet/dispensing system.
4. Allow water to flow from the tank tubing until a steady stream is achieved.
5. Reinsert the tank tubing fully into the tank valve. Ensure it is completely seated to prevent leaks.
6. Open the tank valve and allow water to flow from the faucet/dispensing system until a steady stream is achieved. Close the faucet/dispensing system and allow the tank to fill.

4.04 DI Cartridge Installation

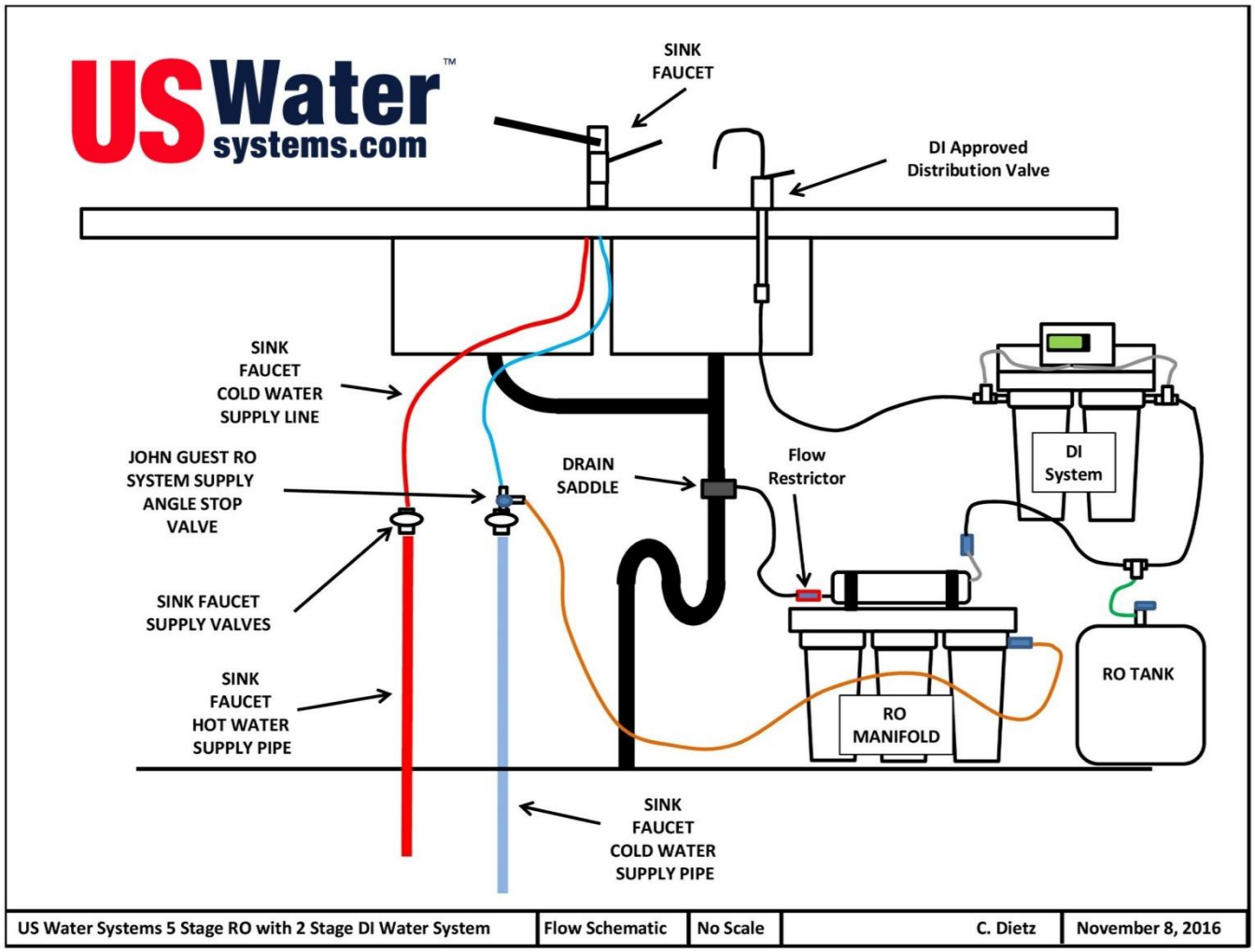
A. After the system is purged of air and fully operational, install the DI cartridges.

1. Close the water supply valve and tank valve. Open the faucet/dispensing system to release pressure.
2. Remove the DI filter sumps.
3. Prepare the Cartridges: Remove the plastic wrapper from each DI cartridge and ensure the upper rubber gasket is in place.
4. Install the Cartridges: Install the cartridges in the housings, ensuring the sump O-ring and rubber washer are correctly positioned.
5. Secure the Sumps: Install the sumps and tighten hand-tight, then snug an additional 1/4 turn with the filter wrench.
6. Flush the System: Open the water supply valve and tank valve. Allow the system to fill and flush the DI cartridges until water quality stabilizes (3-5 minutes). Water stored in the DI sumps may lose quality; flushing is recommended each time the system is used.

4.05 STANDARD FLOW DIAGRAM



4.06 SYSTEM OVERVIEW



PART 5 - MAINTENANCE

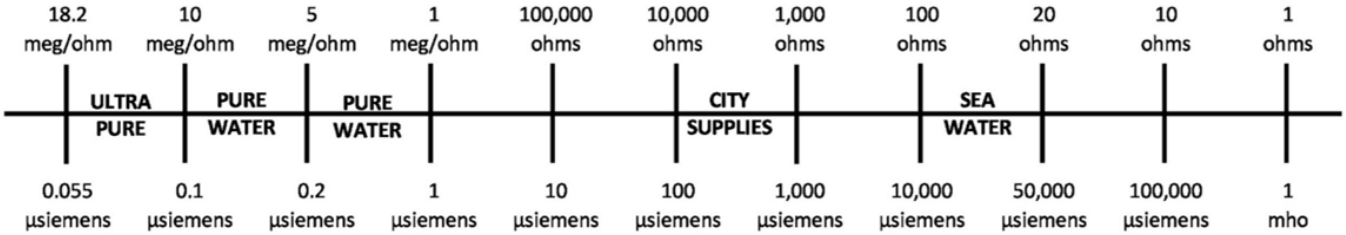
5.01 The RO system contains filters and membranes which must be replaced periodically for proper operation.

Replacement Part	Frequency
507-USWCB-2510-10 (Carbon Pre-Filter)	Every 6-12 Months
507-USWCB-2510-CL (Chloramine Pre-Filter)	Every 6-12 Months
551-USWS-2510-05 (Sediment Pre-Filter)	Every 6 - 12 Months
255-208338 (50 GPD Membrane) 255-208339 (75 GPD Membrane) 255-208340 (100 GPD Membrane) 255-208341 (150 GPD Membrane)	Every 3-5 Years
507-USWF-2510-MB (DI Cartridges)	As needed to maintain quality

NOTE: Filter change frequencies may be amended, depending on source water conditions.

PART 6 - EXECUTION

6.01 CAPACITY CALCULATION



6.02 RO-DI System Warranty

A. US WATER SYSTEMS, INC. warrants this 50-150 GPD RO-DI System as follows:

1. Three-Year Coverage: For three (3) years from the original residential installation date, US WATER SYSTEMS, INC. will replace or repair the storage tank, filter housings, and membrane housing, free of charge (excluding transportation and labor), if found defective due to faulty materials or workmanship.
2. One-Year Coverage: For one (1) year from the installation date, US WATER SYSTEMS, INC. will replace any part not listed above, free of charge (excluding transportation and labor), except for pre-filters, post-filters, and the reverse osmosis membrane.

B. General Provisions:

1. This warranty does not apply to commercial or industrial installations, or any part of the system subjected to misuse, neglect, alteration, accident, damage from external causes (fire, flood, freezing, etc.), or if original serial numbers have been removed. Fouling or damage to the membrane or filters caused by specific contaminants (iron, sulfur, bacterial iron, silt, sand, tannins, organics, bacteria, hot water, or chlorine) voids the membrane warranty.
2. These warranties are in lieu of all other warranties, expressed or implied. US WATER SYSTEMS, INC. does not authorize any person to assume other obligations. No responsibility is assumed for delays or failures due to circumstances beyond the control of US WATER SYSTEMS, INC.

To obtain warranty service, contact:

US WATER SYSTEMS, INC.
1209 Country Club Road
Indianapolis, IN 46234
(317) 209-0889 or 800-608-8792

C. Limitations:

1. Implied warranties of fitness or merchantability are limited to the terms of this expressed warranty. US WATER SYSTEMS, INC. shall not be liable for incidental or consequential damages. Some states may not allow these exclusions or limitations. This warranty provides specific legal rights, and you may have other rights that vary by state.

D. Transferability: This warranty may be transferred to a subsequent owner with written approval from US WATER SYSTEMS, INC. and payment of a standard transfer fee.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

1.02 DEFINITIONS

A. AABC: Associated Air Balance Council.
B. TAB: Testing, adjusting, and balancing.
C. TABB: Testing, Adjusting, and Balancing Bureau.
D. TAB Subcontractor: An entity engaged by the Contractor to perform TAB Work.

1.03 SUBMITTALS

A. 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.
B. Contract Documents Examination Report: Within 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
C. 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.
D. Certified TAB reports.
E. Sample report forms.
F. 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.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with ASHRAE Standard 202, Guideline 0 and Title 24.
B. TAB Contractor Qualifications: Engage a TAB entity certified by AABC.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB technician.

C. TAB Conference: Meet with University's Representative 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 plans.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

D. 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.

E. TAB Report Forms: Use standard TAB contractor's forms approved by University's Representative.
F. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.05 PROJECT CONDITIONS

A. Full Occupancy: University will occupy the site and existing building during entire TAB period. Cooperate with University's Representative during TAB operations to minimize conflicts with University's operations.
B. Partial Occupancy: University may occupy completed areas of building before Substantial Completion. Cooperate with University's Representative during TAB operations to minimize conflicts with University's operations.

1.06 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

3.01 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 as specified in Division 23 Section "Metal Ducts" and 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.

3.02 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.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2010, 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. 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.

3.04 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. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
D. 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.
E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.
H. Check for airflow blockages.
I. Check condensate drains for proper connections and functioning.
J. Check for proper sealing of air-handling-unit components.
K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.05 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 Architect 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.

3.06 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.

3.07 REPORTING

A. Contract Documents Examination 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.

3.08 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, and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
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, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
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 o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Entering-water temperature in deg F.
i. Leaving-water temperature in deg F.
j. Refrigerant expansion valve and refrigerant types.
k. Refrigerant suction pressure in psig.
l. Refrigerant suction temperature in deg F.

G. 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, and bore.
h. Center-to-center dimensions of sheave, and number of adjustments in inches.

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, and bore.
f. Center-to-center dimensions of sheave, and number of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round 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.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.
l. Seal type.

I. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.09 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 room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
c. Verify that balancing devices are marked with final balance position.
d. 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 University's Representative.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of University's Representative.
3. University's Representative 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, University 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.

3.10 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

SECTION 23 33 10
HVAC AIR-DISTRIBUTION SYSTEM CLEANING & SEALING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.02 DEFINITIONS

A. ASCS: Air systems cleaning specialist.
B. NADCA: National Air Duct Cleaners Association.
C. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible
D. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams, and connections to an acceptable minimum.
E. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes
F. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
G. Exposed Duct: Exposed to view in a finished room or exposed to weather.

1.03 SUBMITTALS

A. Qualification Data: For an ASCS.
B. Strategies and procedures plan.
C. Cleanliness verification report.

1.04 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA.

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
2. Supervisor Qualifications: Certified as an ASCS by NADCA.

B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.
C. Cleaning Conference: Conduct conference at Project site.

1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS

2.01 DUCT MATERIALS AND SEALANTS

A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
B. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.
C. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards.

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread, and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally, provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
3. Gaskets in Flanged Joints: Soft neoprene.

D. Approved factory-made joints may be used.

2.02 DUCT LINER (Where REQUIRED)

A. Duct liner is only permitted to be used for supply and return ducts. Duct liner is not permitted for outside air ducts.
B. Rectangular Duct or Casing Liner: ASTM C1071, Type I (flexible), or Type II (board), 25 mm (one inch) minimum thickness, applied with mechanical fasteners and 100 percent coverage of adhesive in conformance with SMACNA, Duct Liner Application Standard.
C. Round Liner: Factory fabricated double-walled with one inch-thick thru two inch-thick sound insulation liner. Construction shall comply with flame and smoke rating required by NFPA 90A. Assemblies shall be complete with continuous sheet Mylar liner, 2 mil thickness, between the perforated liner and the insulation to prevent erosion of the insulation. Provide liner couplings/spacer for metal liner. At the end of insulated sections, provide insulation end fittings to reduce outer shell to liner size. Provide liner spacing/concentricity leaving airway unobstructed

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2021.
C. Prepare written report listing conditions detrimental to performance of the Work.
D. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

E. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards
F. Proceed with work only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:

1. Supervisor contact information.
2. Work schedule including location, times, and impact on occupied areas.
3. Methods and materials planned for each HVAC component type.
4. Required support from other trades.
5. Equipment and material storage requirements.
6. Exhaust equipment setup locations.

B. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
C. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
D. Comply with NADCA ACR 2021, "Guidelines for Constructing Service Openings in HVAC Systems" Section.
E. CLEANING
F. Comply with NADCA ACR 2021.
G. Remove visible surface contaminants and deposits from within the HVAC system.
H. Systems and Components to Be Cleaned:

1. Air devices for supply and return air.
2. Air-terminal units.
3. Ductwork:

a. Supply-air ducts, including turning vanes, to the air-handling unit.
b. Return-air ducts to the air-handling unit.
c. Exhaust-air ducts.

I. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
J. Particulate Collection:

1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,

K. Control odors and mist vapors during the cleaning and restoration process.

L. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
M. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
N. Clean all air-distribution devices, registers, grilles, and diffusers.
O. Clean visible surface contamination deposits according to NADCA ACR 2021 and the following:

    1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
    2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
    3. Clean evaporator coils, reheat coils, and other airstream components.

P. Duct Systems:

    1. Create service openings in the HVAC system as necessary to accommodate cleaning.
    2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems can pass the HVAC System Cleanliness Tests (see NADCA ACR 2021).

Q. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
R. Mechanical Cleaning Methodology:

    1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

        a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
        b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

    2. Cleaning Mineral-Fiber Insulation Components:

        a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2021.
        b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2021).
        c. Fibrous materials that become wet shall be discarded and replaced.

S. All existing ductwork served by fans and all AHU (all areas served by the AHU units) shall be Inspected and cleaned. Ducts are in service for a long-extended period with heavy buildup of dirt & deterioration of internal fiber glass liner from light to moderate conditions. This scope shall include thoroughly cleaning the fiberglass duct liner using brushes and vacuums, repair and replace any small rips or tears encountered and then fully encapsulate it with design

polymerics dp-2510. The coating shall completely seal the fiberglass and help prevent the release of loose fiberglass fibers into air flow. Any extensive damaged or loose liners shall be replaced with new. This shall be field verified and confirmed.

T. Some of the ductwork may be wrapped with insulation on the exterior, all ducts shall be cleaned by thoroughly brushing and vacuuming all interior surfaces. This shall be done using HEPA filtered collection vacuums. This method of cleaning shall ensure that all dust and dirt is removed, the HEPA filtered vacuums shall prevent any of the contaminants in the systems from being blown into the building spaces during cleaning process.

U. Access points shall be cut into the rigid metal ducts as necessary to completely access the interior for cleaning.

V. All access holes made in metal ducts shall be sealed with galvanized sheet metal panels of the same gauge as the ducts. Panels shall be installed using duct sealer and self-tapping screws placed a maximum of four inches apart around the entire perimeter. The panel shall overlap the access opening by at least one inch on all edges. Caulking shall be neat and continuous around the perimeter. All surfaces to be caulked shall be clean of any dirt, rust, etc., that would affect sealing.

W. Access panels installed in lined metal duct shall have reflectix insulation attached with adhesive and/or pins. All raw edges shall be sealed to prevent fiber liberation.

X. All interior dampers and turning vanes shall be thoroughly cleaned with a stiff-bristled brush and vacuuming. All manual dampers shall have their setting marked before cleaning by HVAC contractor and shall be reset to original setting after cleaning. Any broken/damaged dampers shall be replaced with new.

Y. All work shall be supervised by a foreman having thorough knowledge and experience in cleaning air conditioning systems. The work shall be performed by experienced and qualified personnel in accordance with standards and guidelines as set by the national air duct cleaners association (NADCA) and CAL/OSHA.

Z. Labor and materials: contractor shall furnish all labor, materials, supplies, tools, equipment, supervision, transportation and any other services or items necessary to accomplish the work

AA. Existing services: the existing heating, ventilating and air conditioning systems shall be maintained to all occupied areas during the normal working week, this shall be coordinated with HVAC contractor & College.

BB. Cleaning of premises: contractor shall keep the job site clean of all surplus materials and debris and shall dispose of all debris and leave area broom clean at the end of each work shift. Work shall be done at hours convenient to the district (day & night shift/afterhours/weekends/holidays) so as not to interfere with existing operation.

CC. As necessary, furnishings and equipment shall be protected with plastic tarps where work is being performed.

DD. Upon completion of cleaning, every interior surface shall be cleaned to a point where it is visibly free of accumulated debris and dust. Provide certification of duct cleaning, duct sealing and leakage tests. Submit a post-project report outlining scope of work, and which will include photographic documentation of the work that was performed.

EE. The work while in progress will be subject to inspections by a representative of the College to

confirm and ensure that the work is being done according to specifications and requirements.

FF. Any mechanical problems discovered during cleaning shall be reported in writing to College representative.

GG. Antimicrobial Agents, Coatings, and Sanitizers:

1. Apply antimicrobial agents, coatings, and sanitizers if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments, coatings, and sanitizers shall be applied after the system is rendered clean.
3. Apply antimicrobial agents, coatings, and sanitizers directly onto surfaces of interior ductwork. Fogging is prohibited.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.03 CLEANLINESS VERIFICATION

A. Verify cleanliness according to NADCA ACR 2021, "Verification of HVAC System Cleanliness" Section.

B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents, coatings, and sanitizers.

C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

D. Prepare a written cleanliness verification report. At a minimum, include the following:

1. Written documentation of the success of the cleaning.
2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
3. Surface comparison test results if required.
4. Gravimetric analysis (nonporous surfaces only).
5. System areas found to be damaged.

E. Photographic Documentation: Provide photos of cleaned ducts.

3.04 RESTORATION

A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2021, "Restoration and Repair of Mechanical Systems" Section.

B. Restore service openings capable of future reopening.

C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing.

D. Replace damaged insulation with new to match existing.

E. Ensure that closures do not hinder or alter airflow.

F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

3.05 DUCT LEAKAGE TESTS AND REPAIR

A. Ductwork leakage testing shall be performed by the Testing and Balancing (TAB) Contractor directly contracted by the General Contractor.
B. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust, and relief ductwork), section by section, including fans, coils, and filter sections. Based upon satisfactory initial duct leakage test results, the scope of the testing may be reduced by the Campus on ductwork constructed to the static pressure of 500 Pa (2" WG) duct pressure classification. In no case shall the leakage testing of ductwork constructed above the static pressure of 500 Pa (2" WG) duct pressure classification or ductwork located in shafts or other inaccessible areas be eliminated.
C. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
E. All tests shall be performed in the presence of the Campus authorized representative and the Test and Balance contractor. The Test and Balance agency shall measure and record duct leakage and report to the Campus and identify leakage source with excessive leakage.
F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the IOR.
G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

END OF SECTION

SECTION 23 33 46
FLEXIBLE DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Flexible ducts, insulated.
2. Flexible duct connectors.

1.02 ACTION SUBMITTALS

A. Product data.
B. Product Data Submittals: For each type of product.
C. Shop Drawings: For flexible ducts.

1. Include plans showing locations, mounting details, and attachment details.

1.03 INFORMATIONAL SUBMITTALS

A. 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.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A and NFPA 90B.
B. 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 must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
C. Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."
D. Comply with ASTM E96/E96M.

2.02 FLEXIBLE DUCTS, INSULATED

A. Standard: Product is to be UL 181 listed and bearing the UL label.
B. Flexible Ducts, Insulated - Class 1, Two-Ply Vinyl Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
C. Flexible Ducts, Insulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Heli

cally Wound, Spring-Steel Wire; Fibrous-Glass Insulation:

PART 3 - EXECUTION

3.01 INSTALLATION OF FLEXIBLE DUCTS

A. Install flexible ducts in accordance with applicable details in the following publications:

1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
2. NAIMA AH116.
3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.

C. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.
6. Install in accordance with ADC instructions.

D. Supporting Flexible Ducts:

1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft. (1.2 m). Provide sufficient support so that maximum centerline sag is 1/2 in. per ft. (42 mm per meter) between supports. A connection to rigid duct or equipment may be considered a support joint.
2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.
4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches (1800 mm) o.c.

END OF SECTION

SECTION 26 00 10
ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE

Electrical General Requirements specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements. Work includes but is not necessarily limited to the following:

A. Definitions, guarantees, submittals, clean-up, "As-Builts" and all other applicable requirements of Division 0 and Division 1 apply to the work of this section.
B. Examine all other sections for work related to those sections which are required to be provided as work under this Division & Sections.
C. Coordinate all work in this Division with related trades.
D. Furnish and install the following:

1. Incidental items not indicated on the drawings nor mentioned in the Specifications that belong to the work described, or are required to provide complete operable systems, as though called out here in every detail.
2. All construction power and lighting and all power for testing of equipment and systems through final acceptance tests.
3. All equipment and facilities required to provide temporary and permanent services.
4. Electrical distribution systems, including, electrical service, feeders, pull boxes, panel boards, branch circuit wiring, and circuit control and disconnect devices.
5. All electrical work for the mechanical systems, except as referred to be furnished or installed as part of other sections/divisions of the specifications.
6. All distribution material for and connection of the mechanical equipment, as required by the specific equipment furnished so that a complete and operable system results.
7. Conduits, outlets and cabinets or terminal boards. Work related to the mechanical trade as listed below shall be included in this Division of the work. Refer to control drawings and mechanical drawings for exact requirements of work in this scope. Furnish and install the following:

    a. All conduits, outlets, line voltage wiring, and control devices required for the specified operation of the equipment.

8. Furnishing and installation of all hangers, anchors, sleeves, chases and supports, for all electrical materials and equipment.
9. Connect all motors and electrical line voltage control equipment.
10. Cleaning, patching, repairing, and painting.

1.02 APPLICABLE PUBLICATIONS AND STANDARDS

The following publications form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. American National Standards Institute, Inc. (ANSI) Publications
B. State of California Administrative Codes
C. National Electrical Manufacturers Association (NEMA) Publication

D. National Fire Protection Association (NFPA) Publications
E. Underwriters Laboratories, Inc. (UL) Publications.
F. All current codes and regulations enforced by Division of State Architects. (DSA)

1.03 REFERENCES

All work and materials shall conform to all applicable Federal, State and local codes and regulations governing the installation, including but not limited: **California code of regulations (C.C. R).** Applicable Codes As of January 1, 2023

1.01 WORK SEQUENCE

A. Install work in phases to accommodate District's occupancy requirements. During the construction period, coordinate Architectural, electrical and mechanical schedule and operations with District's and other trades. Refer to Division 1 - General Requirements.

1.02 DEFINITIONS

A. The words "work" or "electrical work" herein include products, labor, equipment, tools, appliances, transportation and all related items, directly or indirectly required to complete the specified and indicated electrical installation.
B. The word "concealed" shall mean that the installation will not be visible when all permanent or removable elements of the construction are in place. The word "exposed" shall mean that the installation is visible when all permanent or removable elements of the construction are in place.
C. The word "code" shall mean any and all regulations and requirements of regulatory agencies, public and private, having jurisdiction over the work involved.
D. The word "product" used in Division 16 means all material, equipment, machinery, and/or appliances directly or indirectly required to complete the specified and/or indicated electrical work.
E. The words "standard product" shall mean a manufactured product, illustrated and/or described in catalogs or brochures, which are in general distribution prior to the date of issue of construction documents for bidding. Products will generally be identified by means of a specific catalog number and manufacturer's name.
F. The word "provide shall mean furnish and install and where applicable shall also mean connect, complete installation and test.
G. The words "powered equipment", as used in Division 16, shall mean a complex product converting and electrical energy source to:

    1. Heat energy.
    2. Mechanical power.

H. Refer to Division 1, General Requirements, for additional definitions of words and phrases used to describe Division 16, Electrical Work.

1.03 DISCREPANCIES

A. Where a conflict in requirements occurs between the specifications and drawings, or in the specifications or on the drawings, and a resolution is not obtained from the District/Engineer before the bidding date, the more expensive alternate will become the contractual requirements.
B. Omissions from the drawings or specifications or the miss-description of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or miss-described details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.
C. The Contractor shall check all drawings furnished to him immediately upon their receipt and shall promptly notify the Engineer of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

1.04 CHANGES

A. The Contractor shall be responsible to make and obtain approval for all necessary adjustments in circuiting as required to accommodate the relocations of equipment and/or devices which are affected by any approved authorized changes. All changes shall be clearly indicated on the "As-Built" drawings. A copy of the progress “As-Built” drawings shall be kept at job site for review by Inspector of Record/Engineer/District.

1.05 SUBMITTALS

A. Submit shop drawings, manufacturer's data certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review. Include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval. Contractor shall be responsible for reviewing and certifying submittals as conforming to the drawings and specifications prior to submittal and shall verify conformance of equipment as delivered with final shop submittals, specifications and plans. Contractor shall report to Engineer any deviations prior to initiation of construction. Contractor is responsible for promptly reporting to District any news of late equipment delivery which is likely or certain to delay installation.
B. Submit under provisions of Division 1.
C. Proposed Products List: Include Products specified in Division 26, 27 & 28 & Appendix “A”:
D. Submit shop drawings and product data grouped and referenced by the technical Section numbers.
E. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt

of shop drawings returned from the Engineer bearing the electrical engineer's stamp of “Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Engineer without additional compensation.

F. Shop Drawings: Drawings shall be a minimum of 8.1/2 inches by 11 inches in size with a minimum scale of 1/8-inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, duct work, and other items that must be shown to assure a coordinated installation. In wiring diagrams, identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.

G. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.

H. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or Underwriters' Laboratories (UL), submit proof of such conformance to the Engineer for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the District. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

I. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.

J. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

1.06 REGULATORY REQUIREMENTS

A. Electrical: Conform to NFPA 70, ANSI C2, and CAC Title 24, NFPA 101 and all other state and local codes.

B. The requirements of authorities shall be the minimum acceptable requirements for the work, and nothing described in these Specifications or indicated on the drawings shall be construed to permit work not conforming to the most stringent of the applicable codes and regulations. When drawings or specifications call for materials or construction of better quality of larger

size than required by codes, laws, rules and regulations, the drawings and specifications shall take precedence.

C. Equipment not complying with applicable codes shall be removed and replaced with approved equipment at Contractor's expense. UL listing labels, where applicable, shall be installed prior to shipment from factory.
D. Obtain permits, and request inspections from authority having jurisdiction.

1.07 PRODUCT ALTERNATES OR SUBSTITUTIONS

A. Where a manufacturer's product is specified, the design intent is to establish definite quality, construction, and performance characteristics. The manufacturer's latest published catalog data for the product shall become part of this specification as though stated herein to the extent that such data establishes quality desired, testing procedures, safety features, life expectancy, performance characteristics and, in the case of finish material, the general appearance. Substitute products, where permitted, will be required to equal or exceed these various requirements as established by the specified product manufacturer's literature.

1.08 GUARANTEE

A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of Three year (District Standard) from date of acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the District.
B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the District, or their service agency as directed. Furnish manufacturer's warranties in accordance with District General Conditions of this Specification.

1.09 PROJECT/SITE CONDITIONS

A. Install work in locations shown on drawings, unless prevented by project conditions.
B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other Sections. Obtain permission of District before proceeding.

1.10 OPERATION AND MAINTENANCE MANUAL

Submit as required for systems and equipment indicated in the technical sections. Furnish six copies, bound in hardback binders or an approved equivalent. Furnish one complete manual prior to performance of systems or equipment tests and furnish the remaining manuals prior to contract completion. Inscribe the following identification on the cover; the words "OPERATION AND MAINTENANCE MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment. Include a table of contents and assemble the manual to conform to the table of contents, with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include:

A. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.
B. A control sequence describing startup, operation, and shutdown.
C. Description of the function of each principal item of equipment.
D. Installation and maintenance instructions.
E. Safety precautions.
F. Diagrams and illustrations.
G. Testing methods and test equipment required.
H. Performance data.
I. Parts list. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
J. Appendix: List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

1.11 POSTED OPERATING INSTRUCTIONS

Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment.

Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.12 INSTRUCTION TO DISTRICT PERSONNEL

Where indicated in the technical sections, furnish the services of competent instructors to give full instruction to District personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements as required. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Coordinate schedule of instructional class with District during the first regular work week after the equipment or system has been accepted and turned over to District for regular operation.

1.13 CATALOGED PRODUCTS/SERVICE AVAILABILITY

Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for 3 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The 3 - year period shall be

satisfactorily completed by a product for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 3 - year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.14 MANUFACTURER'S RECOMMENDATIONS

Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.15 DELIVERY AND STORAGE

Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.16 ELECTRICAL REQUIREMENTS

Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Power wiring and conduit shall conform to the requirements of Section 16050 "Basic Materials and Methods."

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to District. All work shall conform to the requirements of NFPA 70, Title 24, California Code of Regulations (CCR).

3.02 WORK RESPONSIBILITIES

A. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgement must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions. The contractor is responsible for the correct placing of his work and the proper location and connection of his work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.

B. Locations shown on architectural ceiling plan or on wall elevations shall take precedence over electrical plan locations but where a major conflict is evident, notify the Engineer for instructions.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or

equipment, such changes shall be made without extra cost, providing the change is ordered before the conduit runs, etc. and work directly connected to same is installed and no extra materials are required.

D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
E. Lighting fixtures in mechanical spaces are shown in their approximate locations only. Do not install light outlets or fixtures until mechanical piping and duct work is installed; then lights shall be installed in locations best suited for equipment arrangement or as directed by the Engineer.
F. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the shop drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
G. Should any changes to the work indicated on the drawings or described in the specifications be necessary to comply with the above requirements, notify the Engineer immediately and cease work on all parts of the contract which are affected until approval for any required modifications to the construction has been obtained from the Engineer.
H. Be responsible for any cooperative work which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Architect and shall be made to his satisfaction.
I. Perform all work with competent and skilled personnel.
J. All work, including aesthetic as well as electrical and mechanical aspects of the work, shall be of the highest quality consistent with the best practices of the trade.
K. Replace or repair, without additional compensation, and any work which, in the opinion of the Architect, does not comply with these requirements.

3.03 PAINTING OF EQUIPMENT

A. Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
B. Field Applied: Paint electrical equipment as required to touch up, to match finish on other equipment in adjacent spaces or to meet safety criteria.
C. When not covered under the painting section of the specifications, all electrical work exposed to view shall be painted in accordance with the painting section of the specifications to match surroundings. Work to be painted shall include conduit, hangars, outlet boxes, pull boxes, surface raceway and similar items.

END OF SECTION

SECTION 26 00 60
ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. Environmental Protection Agency (EPA) Regulations:

1. 40 CFR 261 Regulations Identifying Hazardous Waste
2. 40 CFR 262 Regulations for Hazardous Waste Generators
3. CFR 263 Regulations for Hazardous Waste Transporters
4. 40 CFR 264 Regulations for Owners and Operators of Permitted Hazardous Waste Facilities

B. State of California Administrative Codes:

1. Title 22, Division 4, Chapter 30 Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes

C. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Regulation:

1. 29 CFR 1910.94 Subpart G, Occupational Health and Environmental Control

D. Department of Transportation (DOT):

1. 49 CFR 178 Regulations for Shipping Container Specifications

1.03 SUBMITTALS:

A. Disposal Permit for Hazardous Waste: Submit a copy of the applicable EPA and state permits or licenses for transportation, treatment, storage, and disposal of hazardous waste by permitted facilities.
B. Insurance: Provide evidence of reliable insurance coverage and assets to fully indemnify against long-term liabilities and/or catastrophic occurrences. Upon contract award, original Certificates of Insurance must be submitted to the District, indicating all required coverage's and endorsements as requested and required by District.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.
B. Verify that abandoned wiring and equipment serve only abandoned facilities.
C. Demolition drawings are based on casual field observation and existing record documents. Report discrepancies to Engineer before disturbing existing installation.
D. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
B. Coordinate electrical outages with District.
C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.
D. Existing Electrical Service: Maintain existing system in service until building modules are abandoned by the District and turned over to the Contractor for construction or new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from District at least 14 days before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of this Section and as indicated on the drawings.
B. Remove, relocate, and extend existing installations to accommodate new construction.
C. Remove abandoned/demoed devices & equipment wiring to source of supply unless otherwise indicated.
D. Remove exposed abandoned/demoed conduit. Cut conduit flush with walls and floors, and patch surfaces.
E. Disconnect abandoned/demoed outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
F. Disconnect and remove abandoned electrical distribution equipment (electrical panels & replace with new as indicated on the drawings).
G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
H. Disconnect and remove all ceiling luminaires, where new ceiling is installed. Remove, relocate or provide brackets, hangers, and other accessories as required.
I. Repair adjacent construction and finishes damaged during demolition and extension work.
J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods as specified in Section 16050, “Materials and Methods."
L. Maintain electrical continuity of existing electrical systems which may extend to outside of the renovation areas.
M. Salvage, protect and provide new extension boxes as required to re - install existing devices which will remain in place on new furred walls and reconnect existing devices.
N. Salvage existing branch circuit wiring to re utilize for new ceiling fixtures and provide new seismic attachments for recessed T – Bar Ceiling fixtures in compliance with CA T 24 requirements.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.
B. Panelboards: Replace existing branch circuit panel boards with new as shown on the electrical drawings. Reconnect existing feeders from existing distribution equipment & branch circuit wiring which will remain after demolition, extend conduit & wiring to accommodate new panel(s). Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION

SECTION 26 05 13
WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Boxes, enclosures, keys and locks.
2. Receptacles and switches.
3. Identifications and signs.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 26 – Electrical.
3. Division 27 & 28 – Communications. (District Standards)

PART 2 - PRODUCTS

2.01 BOXES, ENCLOSURES, KEYS AND LOCKS

A. Outlet Boxes and Fittings:

1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated, or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for fittings installed.
5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.
6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
7. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.
8. In existing or new drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws in each plaster ear screw hole. Boxes fastened to gypsum board shall be Raco, Appleton, Cooper, Bowers, or equal.
9. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.
10. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.

B. Junction and Pull boxes:

1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.
2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.
3. Covers shall be fastened to box with a sufficient number of machine screws to ensure

continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pull-box or junction box cover.

4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:
   a. The cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.
   b. Surface or semi-flush mounting pull and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.
   c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.
5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.

C. Keys and Locks:

1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to District.
2. Locks shall be keyed to Corbin No. 60 keys for access to operating equipment and Corbin 70 keys for service access. Special keys and locks shall only be provided where specified.

2.02 RECEPTACLES AND SWITCHES:

A. Receptacles:

General: The receptacle face shall be white/ivory/Black as selected by Architect, and Coordinate prior to submittals. All cover plates shall be 302 stainless steel to match device installed.

1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back, and side wired with internal screw pressure plates. The mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be PVC impact resistant nylon. Receptacles shall have triple wipe brass power contacts.

NEMA #	Leviton
(20 amps) NEMA 5-20	5362-X
(20 amps) NEMA 5-20 (with Type A & Type C USB ports):	T5634/T5834

2. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

NEMA #	Leviton
NEMA 5-20R (installed at all Lab benches/stations)	7899-X
(20 amps) NEMA 5-20(with Type A & Type C USB ports: To be Installed at all Perimeter walls).	GUAC1W/GUAC2W

3. HDMI Feed through Quickport Connector: Leviton 40834-00X with cover plate.
4. HDMI Cable: Monoprice 8K Certified 24 AWG, HDR, VRR, CL2 in wall -rated Ultra High

Speed HDMI Cable, length as required

5. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats.
6. Receptacles within 6 feet of water fountains, counter tops, or any sources of water shall be GFCI type.

B. Switches:

1. Local Switches:
   a. Provide local switches, high strength thermoplastic toggle, specification industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation. Provide switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles.

	Leviton
Single pole	1221-2I
Double pole	1222-2I
Three-way	1223-2I
Four-way	1224-2I

   b. Provide lock type switches, as manufactured by Leviton 1221-2L specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch-long forks, 5/32-inch spacing between forks and 5/16-inch width overall.
2. Lighting Switches: nLight wireless programmable switches, see lighting drawings.

2.03 COVER PLATES

   a. All cover plates shall be 302 stainless steel to match device installed.

2.04 IDENTIFICATION AND SIGNS

A. Identification Plates:

1. Provide identification plates for the following unless otherwise specified, for switchboards, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.
2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate panel designation, voltage, and phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.
3. Identification plates shall be black-and-white nameplate stock of Bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.

B. Markings:

1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type

stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self-adhesive plastic, or Brother P-Touch self-sticking laminated plastic labels may be installed.

PART 3 - EXECUTION

3.01 INSTALLATION AND SUPPORT OF BOXES

A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.

B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8-inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or equal nut and a Tomic No. 711-B Adapta-Stud, or equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2-inch locknut on stud and a 3/8-inch 16 hex nut locking stud to rod.

C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:

1. Install wall-mounted telephones, light switches, and other switches, 48 inches above the finished floor. Refer to other Division 26, 27 and 28 Sections.
2. Outlet boxes for fire alarm pull stations shall be mounted at 45 inches above finished floor to ensure that the operating handle of the initiating device is no higher than 48 inches at finished floor. Under no circumstances shall the operating handle of the device exceed 48 inches above finished floor regardless of indicated height on drawing.
3. Wall mounted fire alarm strobe or horn/strobe devices shall be mounted such that the entire lens is not less than 80 inches above finished floor. If ceiling heights allow, wall mounted appliances shall have bottom of lens a minimum of 80 inches but not more than 96 inches to the top of lens.
4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or equal protective covers for devices when required.
5. Voice evacuation speakers mounted indoors shall be mounted in ceiling space or if mounted on wall shall not be less than 10 feet to center above finished floor.
6. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.
7. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
8. The use of extension boxes shall be limited to not more than 1 times the original depth of the junction box.

3.02 COVER PLATES

A. Provide a plate on each switch, plug, pilot light, data and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.

B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless-steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.

C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:

1. Three-gang and larger gang switches in locations other than classrooms.
2. Lock switches.
3. Pilot switches.
4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.
5. Switches not in the same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.
6. Receptacles operating at other than 120 V shall be identified with the operating voltage.
7. Where indicated on Drawings.

D. Designations shall be as indicated on Drawings or as specified by Architect.
E. Standard GFI cover plates shall be Leviton, Raco 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.03 IDENTIFICATION OF CIRCUITS AND EQUIPMENT

A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters, pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.
B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.
C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.
D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of a metal frame retaining a clear plastic cover permanently attached to the inside of panel door. A list of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit, area and connected load.
E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.04 PROTECTION

A. Protect Work of this section until Substantial Completion.

3.05 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Product Schedule: Indicate type, use, location, and termination locations.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated, and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. 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. Cerro Wire LLC.
2. General Cable Technologies Corporation.
3. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 AND ASTM B 496 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2: Comply with UL 44.

2.02 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
B. 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. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. Ideal Industries, Inc.
4. ILSCO.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc diecast with set screws, designed to connect conductors specified in this Section.
D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One/Two hole with standard]/long barrels.
3. Termination: Compression/Crimp.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Feeders: THHN/THWN Copper for feeders. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway; Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway; Type XHHW-2, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.
D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway; Type XHHW-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
B. It is the intent of the District and the Engineer that no splices shall be made in the run and shall be terminated only at equipment terminals, if this is impractical it will be reviewed and approved on a case-by-case basis.
C. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with UL requirements and Specification Section 26 05 44 and 27 05 28 "PUSD – Pathways for Communications Systems."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to UL Listing.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Provide details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Data: Certificates, for hangers and support for electrical equipment and systems, accessories, and components, from manufacturer.

1.04 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M/ AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Hangers and support shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the specified seismic forces and the supported equipment and systems will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.

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. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Select for applicable load criteria 1-5/8 inches minimum.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   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) Hilti, Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   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) Hilti, Inc.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F 3125M, Grade A325 (Grade A325M).
5. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as [required by] [scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in] NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT/GRC/IMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lbs.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69, Spring-tension clamps].
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Type EMT - FJMX.
2. Type IMC raceways.
3. Type LFMC raceways.
4. Type PVC raceways and fittings.
5. Fittings for conduit, tubing, and cable.
6. Threaded metal joint compound.
7. Solvent cements.
8. Metallic outlet boxes, device boxes, rings, and covers.
9. Termination boxes.
10. Cabinets, cutout boxes, junction boxes, and pull boxes.
11. Cover plates for device boxes.
12. Hoods for outlet boxes.

1.02 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cabinets and cutout boxes.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details. Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness at location where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

PART 2 - PRODUCTS

A. TYPE EMT-S RACEWAYS AND ELBOWS
B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2. General Characteristics: UL 797 and UL Category Control Number FJMX.

C. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; Atkore International.
b. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
c. Western Tube; Zekelman Industries.
d. Wheatland Tube; Zekelman Industries.

2. Material: Steel.

a. Exterior Coating: Zinc/Alternate corrosion-resistant coating.
b. Interior Coating: Zinc with organic top coating/Zinc/Organic coating.
c. Minimum Trade Size: trade size 3/4).
d. Colors: Manufactured to comply with UL 797, ANSI C80.3, NEMA RN2, NEC/CEC Article 250 -118
e. Black- Dark Colored Areas (3/4" – 2" sizes)
f. Orange – Fiber Optic systems (3/4" – 2" sizes)
g. Green – Critical (Hospital/healthcare use (3/4" – 2" sizes)
h. Purple – Security Systems/ Specialty Wiring Systems (3/4" – 2" sizes)
i. Red – Emergency Circuits/Fire Alarm systems (3/4" – 4" sizes)
j. Yellow – Caution areas/Specialty Equipment (3/4" – 2" sizes)
k. Blue – Low Voltage wiring/data communication/video/Network Security. (3/4" – 2" sizes)
l. White – Light Colored areas (3/4" – 2" sizes)
m. Low friction ID Coating (E -Z Pull).

D. PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. Bluesteel Services LLC.
c. Calbond; Atkore International.
d. KorKap; Robroy Industries.
e. Perma-Cote; Robroy Industries.
f. Plasti-Bond; Robroy Industries.

2. Options:

a. Exterior Coating: PVC complying with NEMA RN 1 and marked ETL Verified PVC-001.
b. Exterior Coating: Zinc/Alternate corrosion-resistant coating.
c. Interior Coating: Zinc with organic top coating/Zinc/Organic coating.
d. Minimum Trade Size: trade size 3/4.
e. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
f. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.02 TYPE FMC-S AND TYPE FMC-A RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1 and UL Category Control Number DXUZ.

B. Steel Flexible Metal Conduit (FMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. Electri-Flex Company.

2. Material: Steel.
3. Options:

a. Minimum Trade Size: trade size 3/4.

2.03 TYPE IMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1242 and UL Category Control Number DYBY.

B. Steel Electrical Intermediate Metal Conduit (IMC):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. Allied Tube & Conduit; Atkore International.
c. Calconduit; Atkore International.
d. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
e. Western Tube; Zekelman Industries.
f. Wheatland Tube; Zekelman Industries.

2. Options:

a. Exterior Coating: Zinc/Alternative corrosion-resistant coating.
b. Interior Coating: Zinc with organic top coating/Zinc/Organic coating.
c. Minimum Trade Size: trade size 3/4.

2.04 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquid-tight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. Anaconda Sealtite; Anamet Electrical, Inc.
c. Electri-Flex Company.
d. International Metal Hose Co.

2. Material: Steel.

a. Minimum Trade Size: trade size 3/4.

C. Stainless Steel Liquid-tight Flexible Metal Conduit (LFMC-SS):

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Electri-Flex Company.

2. Material: Stainless steel.
3. Options:

a. Minimum Trade Size: trade size 3/4.

2.05 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type IMC, Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. Crouse-Hinds; Eaton, Electrical Sector.
c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
d. Konkore Fittings; Atkore International.
e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
f. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
g. Southwire Company.

2. General Characteristics: UL 514B and UL Category Control Number DWTT.

3. Options:

    a. Material: Steel/Die cast.
    b. Coupling Method: Compression coupling/Raintight compression coupling with distinctive color gland nut. Setscrew couplings & fittings not permitted.
    c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
    d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type EMT Raceways with compression fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB, Electrification Products Division.
    b. Allied Tube & Conduit; Atkore International.
    c. Calconduit; Atkore International.
    d. Crouse-Hinds; Eaton, Electrical Sector.
    e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    f. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
    g. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
    h. Southwire Company.

2. General Characteristics: UL 514B and UL Category Control Number FKAV.
3. Options:

    a. Material: Steel/Die cast.
    b. Coupling Method: Compression coupling/Raintight compression coupling with distinctive color gland nut. Setscrew couplings & fittings not permitted.
    c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
    d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

D. Fittings for Type FMC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Fittings Corp. (AMFICO).
    b. Liquid Tight Connector Co.
    c. Southwire Company.

2. General Characteristics: UL 514B and UL Category Control Number ILNR.

E. Fittings for Type LFMC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Liquid Tight Connector Co.

2. General Characteristics: UL 514B and UL Category Control Number DXAS.

2.06 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 2419 and UL Category Control Number FOIZ.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ABB, Electrification Products Division.

2.07 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:

1. Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. Crouse-Hinds; Eaton, Electrical Sector.
c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
d. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
e. Killark; Hubbell Incorporated, Construction and Energy.
f. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
g. Pass & Seymour; Legrand North America, LLC.
h. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

3. Options:

a. Material: Sheet steel/Cast metal.
b. Sheet Metal Depth: as required per NFPA 70, Table 314.16(A) for permitted conductor quantities.
c. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lbs.
d. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lbs.

C. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB, Electrification Products Division.
    b. Crouse-Hinds; Eaton, Electrical Sector.
    c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    d. Killark; Hubbell Incorporated, Construction and Energy.
    e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
    f. Pass & Seymour; Legrand North America, LLC.
    g. Plasti-Bond; Robroy Industries.
    h. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

D. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB, Electrification Products Division.
    b. Arlington Industries, Inc.
    c. Crouse-Hinds; Eaton, Electrical Sector.
    d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    e. Hubbell Premise Wiring; Hubbell Incorporated, Commercial, and Industrial.
    f. Killark; Hubbell Incorporated, Construction and Energy.
    g. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
    h. Plasti-Bond; Robroy Industries.
    i. Raco Taymac Bell; Hubbell Incorporated, Commercial, and Industrial.
    j. Wiring Device-Kellems; Hubbell Incorporated, Commercial, and Industrial.

3. Options:

    a. Material: Sheet steel/Cast metal depth as required per NFPA 70, Table 314.16(A) for permitted conductor quantities for each size box.
    b. Cast-Metal Depth: minimum 2.4 inch.

2.08 TERMINATION BOXES

A. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.
B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1773 and UL Category Control Number XCKT.

C. Termination Boxes and Termination Bases for Installation online Side of Service Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ABB, Electrification Products Division.
   b. B-line; Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Hoffman; nVent.
   e. Metron; Hubbell Incorporated, Commercial and Industrial.
   f. Milbank Manufacturing Co.

2. Additional Characteristics: Listed and labeled for installation online side of service equipment.

D. Termination Boxes and Termination Bases for Installation on Load Side of Service Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ABB, Electrification Products Division.
   b. B-line; Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Erickson Electrical Equipment Company.
   e. Hoffman; nVent.
   f. Metron; Hubbell Incorporated, Commercial and Industrial.
   g. Milbank Manufacturing Co.

2. Additional Characteristics: Listed and labeled for installation on load side of service equipment.

2.09 CABINETS, CUTOUT BOXES, JUNCTION BOXES, AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

   a. Non-Environmental Characteristics: UL 50.
   b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ABB, Electrification Products Division.
   b. B-line; Eaton, Electrical Sector.
   c. Crouse-Hinds; Eaton, Electrical Sector.

d. FSR Inc.
e. Hoffman; nVent.
f. Killark; Hubbell Incorporated, Construction and Energy.
g. Milbank Manufacturing Co.
h. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
i. Robroy Enclosures; Robroy Industries.

3. Additional Characteristics: UL Category Control Number CYIV.
4. Options:

a. Degree of Protection: Type 1/Type 3R/Type 4/Type 12 as applicable due to environment where located unless otherwise indicated.
b. Indoor Sheet Metal Cutout Boxes:

5. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.
6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. B-line; Eaton, Electrical Sector.
c. Crouse-Hinds; Eaton, Electrical Sector.
d. FSR Inc.
e. Hoffman; nVent.
f. Killark; Hubbell Incorporated, Construction and Energy.
g. Milbank Manufacturing Co.
h. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
i. Robroy Enclosures; Robroy Industries.

7. Additional Characteristics: UL Category Control Number CYIV.
8. Options:

a. Type 1/Type 3R/Type 4/Type 12 as applicable due to environment where located unless otherwise indicated.

C. Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. B-line; Eaton, Electrical Sector.
b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
c. FSR Inc.
d. Hoffman; nVent.
e. Hubbell Industrial Controls; Hubbell Incorporated, Commercial and Industrial.
f. Milbank Manufacturing Co.
g. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
h. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

3. Additional Characteristics: UL Category Control Number BGUZ.
4. Options:

a. Degree of Protection: Type 1/Type 3R/Type 4/Type 12 as applicable due to environment where located unless otherwise indicated.
b. Indoor Cast-Metal Junction and Pull Boxes:

5. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crouse-Hinds; Eaton, Electrical Sector.
b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
c. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.

7. Additional Characteristics: UL Category Control Number BGUZ.
8. Options:

a. Degree of Protection: Type 1/Type 3R/Type 4/Type 12 as applicable due to environment where located unless otherwise indicated.

D. Outdoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. B-line; Eaton, Electrical Sector.
c. Crouse-Hinds; Eaton, Electrical Sector.
d. Erickson Electrical Equipment Company.
e. FSR Inc.
f. Hoffman; nVent.
g. Killark; Hubbell Incorporated, Construction and Energy.
h. Milbank Manufacturing Co.
i. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
j. Robroy Enclosures; Robroy Industries.

3. Additional Characteristics: UL Category Control Number CYIV.

a. Options:
b. Degree of Protection: Type 3R/Type 4X as applicable due to environment where located unless otherwise indicated.

c.

E. Outdoor Sheet Metal Cutout Boxes:

1. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Products Division.
b. B-line; Eaton, Electrical Sector.
c. Crouse-Hinds; Eaton, Electrical Sector.
d. Erickson Electrical Equipment Company.
e. FSR Inc.
f. Hoffman; nVent.
g. Killark; Hubbell Incorporated, Construction and Energy.
h. Milbank Manufacturing Co.
i. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
j. Robroy Enclosures; Robroy Industries.

3. Additional Characteristics: UL Category Control Number CYIV.

a. Options:
b. Degree of Protection: Type 3R /Type 4X as applicable due to environment where located unless otherwise indicated.

F. Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. B-line; Eaton, Electrical Sector.
b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
c. FSR Inc.
d. Hoffman; nVent.
e. Hubbell Industrial Controls; Hubbell Incorporated, Commercial and Industrial.
f. Milbank Manufacturing Co.
g. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
h. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

3. Additional Characteristics: UL Category Control Number BGUZ.

a. Options:
b. Degree of Protection: Type 3R /Type 4X as applicable due to environment where located unless otherwise indicated.

G. Outdoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of

raceway or cable.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Crouse-Hinds; Eaton, Electrical Sector.
    b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    c. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.

3. Additional Characteristics: UL Category Control Number BGUZ.
4. Options:

    a. Degree of Protection: Type 3R /Type 4X as applicable due to environment where located unless otherwise indicated.

2.10 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

    a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
    b. Wall plate-Securing Screws: Metal with head color to match wall plate finish.

B. Metallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
    b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    c. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
    d. Leviton Manufacturing Co., Inc.
    e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
    f. Pass & Seymour; Legrand North America, LLC.
    g. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

2. Options:

    a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
    b. Wall plate Material: Type 302/304 non-magnetic stainless steel with brushed finish.

2.11 HOODS FOR OUTLET BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2. General Characteristics:

    a. Reference Standards:

        1) UL 514D and UL Category Control Numbers QCIT and QCMZ.
        2) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.

3. Mounts to box using fasteners different from wiring device.

B. Retractable or Re-attachable Hoods for Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB, Electrification Products Division.
    b. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

2. Options:

    a. Provides Gray, weatherproof, "while-in-use" cover.

C. Extra-Duty, While-in-Use Hoods for Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB, Electrification Products Division.
    b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
    c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    d. Leviton Manufacturing Co., Inc.
    e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

2. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
3. Options:

    a. Provides gray, weatherproof, "while-in-use" cover.
    b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION

3.01 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
B. Outdoors:

1. Exposed and Subject to Severe Physical Damage: IMC.

2. Exposed and Subject to Physical Damage: IMC.
3. Exposed and Not Subject to Physical Damage: IMC.
4. Concealed Aboveground: IMC
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:

1. Hazardous Classified Locations: IMC.
2. Exposed and Subject to Severe Physical Damage: IMC. Subject to severe physical damage includes the following locations:

    a. Loading docks.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

3. Exposed and Subject to Physical Damage: IMC. Subject to physical damage includes the following locations:

    a. Locations less than 2.5 m above finished floor.
    b. Stub-ups to above suspended ceilings.

4. Exposed and Not Subject to Physical Damage: EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT
6. Damp or Wet Locations: IMC.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC/FMC.

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines (No Set Screw Z Fittings).

1. IMC: Provide threaded type fittings unless otherwise indicated.

3.02 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
B. Degree of Protection:

1. Outdoors:

    a. Type 3R/Type 4 unless otherwise indicated.
    b. Locations Exposed to Hosed own: Type 4X.

c. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.

2. Indoors:

a. Type 1 unless otherwise indicated.
b. Damp or Dusty Locations: Type 4.
c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flying's: Type 4.
f. Locations Exposed to Hose down: Type 4X.
g. Locations Exposed to Corrosive Agents: Type 4X.
h. Locations Exposed to Spraying Oil or Coolants: Type 13.

C. Exposed Boxes Installed Less Than 8 ft. Above Floor:

1. Provide cast-metal boxes. Boxes with knockouts or unprotected openings are prohibited.
2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.03 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Comply with NECA NEIS 102 for installation of aluminum raceways.
6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to trade size 1-1/4 and insulated throat metal bushings on trade size 1-1/2 and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
9. Raceway Terminations at Locations Subject to Moisture or Vibration:

a. Provide insulating bushings to protect conductors, including conductors smaller than

No. 4 AWG. Install insulated throat metal grounding bushings on service conduits.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch of enclosures to which attached.
7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:

    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    b. Where an underground service raceway enters a building or structure.
    c. Conduit extending from interior to exterior of building.
    d. Conduit extending into pressurized duct and equipment.
    e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    f. Where otherwise required by NFPA 70.

9. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
10. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
11. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
12. Cut conduit perpendicular to the length. For conduits trade size 2 and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.

13. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lbs tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types EMT-A, ERMC-A, and FMC-A:
2. Types ERMC and IMC:

    a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

3. Types FMC and LFMC:

    a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

4. Type PVC:

    a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F (Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
    b. Comply with manufacturer's written instructions for solvent welding and fittings.

D. Stub-ups to Above Recessed Ceilings:

1. Provide EMT, IMC for raceways.
2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

E. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
2. EMT: Provide compression/steel/cast-metal fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

F. Expansion-Joint Fittings:

1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install

in runs of aboveground IMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft .

2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

G. Raceways Penetrating Rooms or Walls with Acoustical Requirements:

    1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.04 INSTALLATION OF SURFACE RACEWAYS

A. Install surface raceways only where indicated on Drawings.
B. Install surface raceway with a minimum 2-inch radius control at bend points.
C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.05 INSTALLATION OF BOXES AND ENCLOSURES

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box,

whether installed indoors or outdoors.

D. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
E. Locate boxes so that cover or plate will not span different building finishes.
F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
I. Set metal floor boxes level and flush with finished floor surface.
J. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
K. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
M. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

    1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    2. Provide gaskets for wall plates and covers.

3.06 FIRESTOPPING

A. Install UL Listed firestopping materials at penetrations of fire-rated floor and wall assemblies.

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

    1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
    2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.08 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wall plates, covers, and hoods.

END OF SECTION

SECTION 26 05 44
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, LLC.
b. CCI Piping Systems.
c. Flexicraft Industries.
d. GPT; an EnPro Industries company.

2. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral water stop.

B. Pipe Sleeves, PVC:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CCI Piping Systems.
b. GPT; an EnPro Industries company.
c. Metraflex Company (The).

C. Sheet Metal Sleeves, Galvanized Steel, Round:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Benefast.
b. Specified Technologies, Inc.

2. Description: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.02 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Abesco Fire LLC.
b. Specified Technologies, Inc.
c. Wiremold; Legrand North America, LLC.

2. Description:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16-inch, thickness must be 0.052 inch.
2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16-inch, thickness must be 0.138 inch.

2.03 SLEEVE SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, LLC.
2. CALPICO, Inc.
3. GPT; a division of EnPRO Industries.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM/Nitrile (Buna N rubber 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.

2.04 GROUT

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. W.R. Meadows, Inc.

B. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
C. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
D. Design Mix: 5000 psi, 28-day compressive strength.
E. Packaging: Premixed and factory packaged.

2.05 POURABLE SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle SynTec Incorporated.
2. GAF.
3. Johns Manville; a Berkshire Hathaway company.

B. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.06 FOAM SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Innovative Chemical Products (Building Solutions Group).
2. The Dow Chemical Company.

B. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.01 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves provide **1/2 inch** annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed **or seismic criteria require different clearance**.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors **2 inches** above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
E. Underground, Exterior-Wall and Floor Penetrations:

    1. Install steel pipe sleeves with integral water-stops. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
    2. Install steel pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.02 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
B. Install conduits and cable with no crossings within the sleeve.
C. Fill opening around conduits and cables with expanding foam without leaving voids.
D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.03 INSTALLATION OF SLEEVE SEAL SYSTEMS

A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Panel Board Directories.
5. Engraved Device cover plates
6. Miscellaneous identification products.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1and IEEE C2. for minimum size of letters for legend and for minimum length
B. of color field for each raceway size.
C. Comply with NFPA 70.

D. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

E. Comply with ANSI Z535.4 for safety signs and labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Warning labels and signs shall include, but are not limited to, the following legends:

1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES. This labels shall be installed at all new panels installed.
2. Provide warning signs or labels for arc flash and voltages, and others.

2.03 LABELS

A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible labels lami

nated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Champion America.
    c. emedco.
    d. LEM Products Inc.
    e. Panduit Corp.

B. Self-Adhesive Labels:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. emedco.
    c. Ideal Industries, Inc.
    d. LEM Products Inc.
    e. Panduit Corp.

2. Preprinted, 3-mil- thick, polyester/vinyl flexible label with acrylic pressure-sensitive adhesive.

3. Polyester/Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

    a. Nominal Size: 3.5-by-5-inch.

2.04 TAPES AND STENCILS:

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlton Industries, LP.
    b. Champion America.
    c. Ideal Industries, Inc.
    d. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. Emedco.

C. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Seton Identification Products.

D. Underground-Line Warning Tape

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Ideal Industries, Inc.
c. LEM Products Inc.
d. Marking Services, Inc.
e. Seton Identification Products.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, , COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

4. Tag: Type I:

a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches.
c. Thickness: 4 mils. Weight: 18.5 lb/1000 sq. ft..
d. Tensile according to ASTM D 882: 30 lbf and 2500 psi.

5. Tag: Type ID:

a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches.
c. Overall Thickness: 5 mils.
d. Foil Core Thickness: 0.35 mil.
e. Weight: 28 lb/1000 sq. ft.
f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

6. Tag: Type IID:

a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches
c. Overall Thickness: 8 mils.
d. Foil Core Thickness: 0.35 mil
e. Weight: 34 lb/1000 sq. ft.
f. Tensile according to ASTM D 882: 300 lbf and 12,500 psi.

2.05 Tags

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. Emedco.
d. Seton Identification Products.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. Emedco.
d. LEM Products Inc.
e. Panduit Corp.

C. Write-On Tags:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. LEM Products Inc.
c. Seton Identification Products.

2. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to raceway, conductor, or cable.

3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.06 Signs

A. Baked-Enamel Signs:

1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Champion America.
c. Emedco.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Champion America.
    c. Emedco.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:

    a. For signs up to 20 sq. inches, minimum 1/16-inch-.
    b. For signs larger than 20 sq. inches, 1/8 inch thick.
    c. Engraved legend with black letters on white face.
    d. Punched or drilled for mechanical fasteners.
    e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. Emedco.

2.07 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ideal Industries, Inc.
2. Marking Services, Inc.
3. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch
2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F
5. Color: Black.

2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
B. Apply identification devices to surfaces that require finish after completing finish work.
C. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
D. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
E. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

F. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.02 IDENTIFICATION SCHEDULE

A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits, more 120 V to Ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 10-foot maximum intervals.
B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "POWER."

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and hand holes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase- and Voltage-Level identification, 600 V or Less: Use industry standard colors for ungrounded service feeders and branch-circuit conductors.

a. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Nameplate Installation:

1. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
2. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
3. Secure nameplate to equipment as recommended by the manufacturer.
4. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
5. Install nameplates for the following with source, end destination, feeder #, voltage, ampacity, feeder wire size for all low voltage (600 volts & below) equipment, locate equipment labels where accessible and visible:
   a. Panelboards & Distribution boards.
   b. All other equipment installed as part of this project.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, pull boxes and handholes, use self-adhesive, self-laminating polyester labels/self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive, self-laminating polyester labels/self-adhesive vinyl labels with the conductor designation.

G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
   a. Power-transfer switches.
   b. Controls with external control power connections.

L. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.

1. Comply with NFPA 70E and ANSI Z535.4.

M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for emergency operations.

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine plastic label, punched or drilled for mechanical fasteners. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label 4 inches high.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION

SECTION 26 06 30
ELECTRICAL ACCEPTANCE TESTING

PART 1 - GENERAL

1.01 SECTION INCLUDES: Acceptance testing requirements for electrical power systems.

1.02 APPLICABLE CODES AND PUBLICATIONS: The following publications form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Use latest applicable codes adopted and enforced by Authorities Having Jurisdiction (AHJ).

APPLICABLE PUBLICATIONS: The following publications form a part of this specification to the extent mentioned. The publications are referred to in the text by the basic designation only.

A. American National Standards Institute, Inc. (ANSI) Publication:

1. C2-93 National Electrical Safety Code
2. C37.16-88 Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements and Application Recommendations

B. International Electrical Testing Association Inc. (NETA) Publication:

1. ATS-1999 Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

C. Institute of Electrical and Electronic Engineers (IEEE) Publications:

1. 141-86 Recommended Practice for Electric Power Distribution for Industrial Plants
2. 242-86 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. 399-90 Recommended Practice for Industrial and Commercial Power System Analysis
4. 446-87 Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications

D. National Fire Protection Association (NFPA) Publication:

1. 70-2017 National Electrical Code (NEC) with latest 2022 California Electrical Code (CEC) amendments.

1.03 SUBMITTALS

A. Submit under provisions of Division 1 & Division 26.
B. Qualifications: Provide for:

1. Designated project safety representative.
2. Certified Engineering Technician(s) engaged by contractor to be assigned to the project.

C. Acceptance Test Procedures: Provide for:

1. Panel Boards.
2. Low voltage circuit breakers (>100A)
3. Grounding systems.
4. Conductors and Cables, including megger testing of cables.
5. Torque testing of all terminated cables at each equipment to comply with manufacturer's torquing requirements.

6. Installation and acceptance testing for all installed electrical systems.
7. GFI outlets Operation & testing

D. Certified Test Reports: The final report shall be signed by an NETA Certified Technician employed by Contractor and shall include the following information: Summary of the project, description of the equipment tested, visual inspection report, description of the tests, test results, conclusions and recommendations, appendix including appropriate test forms, and identification of the test equipment used. Provide bound copies for:

1. Panel Boards.
2. Low voltage circuit breakers (>100A)
3. Grounding systems
4. Conductors and Cables.
5. GFI outlets Operation & testing

1.04 QUALIFICATIONS

A. The contractor shall engage the services of qualified NETA Certified technician personnel to provide final inspection, testing, calibration, and adjusting on the electrical distribution system as defined in this Section. The testing personnel shall have been engaged in full practice for a minimum of five years.
B. The testing personnel shall have a calibration program with accuracy traceable every six months, and in an unbroken chain, to the National Institute of Standards and Technology (N.I.S.T.).
C. The testing personnel shall have a designated safety representative on the project. The safety standards shall include OSHA and NFPA 70E.
D. Testing and inspection (engaged by the contractor) shall be performed by an Engineering Technician, certified by a National organization, with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution equipment, systems, and devices. Information on the qualifications of the Certified Engineering Technician shall be submitted to the Engineer for approval prior to the start of work.
E. The qualifications of the testing personnel shall be submitted to the Architect/District for approval minimum 30 days prior to the start of testing.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 ALL INSPECTIONS SHALL BE PERFORMED in accordance with applicable codes and standards including NEC, CEC, ANSI, IEEE, NEMA and OSHA.

A. The testing technician personnel shall provide all materials, equipment, labor, and technical supervision to perform the inspections and tests & witnessed by I.O.R.

3.02 INSPECTION

A. A visual inspection of the installed equipment shall be performed by the independent testing

organization to verify that the distribution equipment installed and to be tested is the equipment denoted on the approved shop drawings. The inspection shall check the equipment designations, device characteristics, special installation requirements, applicable codes, and standards.

B. After completion of the visual inspection, a report shall be developed stating any discrepancies that may have been found.

3.03 TESTING, CALIBRATION AND ADJUSTMENT

A. The testing organization shall perform tests on each item of distribution equipment identified in accordance with the latest edition of the International Electrical Testing Association's (NETA) Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.

B. Field acceptance testing shall be accomplished on each item of electrical distribution equipment installed or connected as part of this contract. This shall include:

1. Panel Boards.
2. Low voltage circuit breakers
3. Grounding systems
4. GFI outlets Operation & testing
5. Conductors and Cables, including Megger testing of IR Values.

C. Systems shall be energized or otherwise placed in service only after completion of all required tests and an evaluation of the test results has been completed.

3.04 CORRECTION OF DEFICIENCIES: Any deficiencies found shall be rectified, and work affected by such deficiencies shall be completely re-tested at the Contractor's expense. Final acceptance of the electrical power system is contingent upon satisfactory completion of the acceptance and system function tests.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Lighting and appliance branch-circuit panel boards.

1.02 SCOPE

1. Replace existing recessed obsolete Zinsco Panels with new as specified and indicated on panel schedules. Re connect all existing feeders and branch circuit wiring including contactors & time clocks. All reconnected feeder & branch circuit wiring shall be tested and verified per 2017 NETA standards (ANSI/NETA ATS) requirements. Maintain work space clearances per CEC and DIR sub chapter 5 – Electrical Safety Orders and Article 4 – Requirements for electrical Installations OSHA 1910.303 All walls shall be patched and restored to original conditions including painting, panel anchorages as required.

1.03 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

1.04 REFERENCES

The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

A. NEMA PB 1 - Panelboards
B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
C. NEMA AB 1 - Molded Case Circuit Breakers
D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
E. UL 50 - Enclosures for Electrical Equipment
F. UL 67 - Panelboards
G. UL 98 - Enclosed and Dead-front Switches
H. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
I. Federal Specification W-P-115C - Type I Class 1
J. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit And Service.
K. NFPA 70 - National Electrical Code (NEC)
L. 2022 California Electrical Code (CFC)
M. ASTM - American Society of Testing Materials
N. IBC – International Building Code – Seismic compliance requirements
O. NFPA 5000 – NFPA Building Code – Seismic compliance requirements.
P. ASCE 7 – American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures – Seismic compliance requirements
Q. ICC ES AC156 – International Code Council Evaluation Services Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems – seismic testing protocol.
R. Manufacturer’s Instruction Bulletin and installation Manual

1.05 ACTION SUBMITTALS

A. Product Data: For each type of panel board.
B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types include mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panel boards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Provide rating of overcurrent protective device included in panel boards to match existing.

1.06 INFORMATIONAL SUBMITTALS

A. Panel board schedules for installation in panel boards.

1.07 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.08 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures not exceeding 104º F
2. Altitude not exceeding 3300 feet.

1.09 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panel boards that fail in materials or workmanship within specified warranty period.

1. The manufacturer shall warrant specified equipment to be free from defects in materials and workmanship for Thirty-six (36) months of service from the date of completion.

PART 2 - PRODUCTS

2.01 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panel boards according to IEEE 344 to withstand seismic forces defined in 2022 CBC."
B. 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.
C. Comply with NEMA PB 1.
D. Comply with NFPA 70.
E. Enclosures: Flush and Surface - mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2. Height: 84 inches maximum with operating device height of 6’7” maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

F. Incoming Mains Location: Convertible between top and bottom.

G. Phase, Neutral, and Ground Buses Hard-drawn copper, 98 percent conductivity.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panel board.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panel board.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Sub feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

I. NRTL Label: Panel boards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panel boards shall have meter enclosures, wiring, connections, and other provisions for digital metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panel boards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

K. Panel board Short-Circuit Current Rating: Series and Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panel boards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and 2022 CBC.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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. Square D - by Schneider Electric NF & NQOD Type or approved equal by Eaton.
    a. Interior
        1) Shall be type NQ or NQOD panelboard rated for 240 Vac maximum. Continuous main current ratings, as indicated on associated schedules on drawings, not to exceed 225 amperes maximum.
        2) Minimum short circuit current rating: As indicated on the drawings and or match existing system in rms symmetrical amperes at 240 Vac.& 600 Vac
        3) Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
        4) All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
        5) A solidly bonded copper equipment ground bar shall be provided.
        6) Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length.
        7) Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have filler plates covering unused mounting spaces.
        8) Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
        9) Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 100A interiors shall be horizontally/vertically mounted. Main circuit breakers over 100A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.
        10) Interior phase bus shall be pre-drilled to accommodate field installable options (NQ only), i.e., Sub-Feed Lugs, Sub-Feed Breakers, Thru-Feed Lugs.

2. Main Circuit Breaker:
    a. Shall be Square D type circuit breakers or equal by Eaton.
    b. Main circuit breakers shall have an over-center, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.
    c. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.
    d. The breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.
    e. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.

f. Lugs shall be CSA and UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. The lug body shall be bolted in place; snap-in designs are not acceptable.
g. The circuit breakers shall be CSA and UL Listed for use with the Mechanical Lug Kits.

3. Branch Circuit Breakers

a. Shall be Square D type circuit breakers. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the associated schedules on drawings.
b. Molded case branch circuit breakers shall have bolt-on type bus connectors.
c. Circuit breakers shall have an over-center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
d. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP® indicator appearing in the clear window of the circuit breaker housing.
e. The exposed faceplates of all branch circuit breakers shall be flush with one another.
f. Lugs shall be UL Listed to accept solid or stranded [copper and aluminum conductors] [copper conductors only. The legs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per CEC Table 310-16. Branch circuit breakers rated 30 amperes and below shall be UL Listed to accept 60° C rated wire.
g. Breakers shall be UL Listed.

4. Enclosures

a. Type 1 Boxes

1) Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvannealed steel is not acceptable.
2) Boxes shall have removable end walls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
3) Box width shall be 20” wide maximum.

b. Type 1 Fronts

1) Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
2) Fronts shall be hinged 1-piece with door. Mounting shall be flush/surface as indicated on associated schedules and drawings.
3) Panelboards shall have MONO-FLAT fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
4) The front shall have cylindrical tumbler type lock with catch and spring-loaded stainless-steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.

2.04 IDENTIFICATION

A. Panel board Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panel board door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
C. Circuit Directory: Directory card inside panel board door, mounted in metal frame with transparent protective cover.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Install panel boards and accessories according to NECA 407/NEMA PB 1.1.

C. Comply with mounting and anchoring requirements specified in 2022 CBC.

D. Mount top of trim 90 inches above finished floor unless otherwise indicated.

E. Mount panel board cabinet plumb and rigid without distortion of box.
F. Mount recessed panel boards with fronts uniformly flush with wall finish and mating with back box.
G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
I. Install filler plates in unused spaces.

J. Stub four 1-inch empty conduits from panel board into accessible ceiling space or space designated to be ceiling space in the future. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.02 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements per standard codes.
B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installation. Handwritten directories are not acceptable. Install directory inside panel board door.
C. Panel board Nameplates: Label each panel board with a nameplate complying with requirements for identification.

D. Device Nameplates: Label each branch circuit device in power panel boards with a nameplate complying with requirements for identification.

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panel board bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace them with new units and retest.

D. Panel boards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panel boards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

SECTION 26 72 20
ASSISTIVE LISTENING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. The work includes the provision of Assistive Listening System (ALS) for the science labs

1.02 SCOPE OF WORK

A. The work shall consist of the provision, testing, and documentation of a complete and fully functional ALS. The instructions in this section are specific to the ALS installations and should be read in conjunction with other contract documents as applicable. The system provided shall be provided in compliance with CBC 11B.219 and 11B.706.

1.03 Approvals

A. The system shall maintain the following listings and/or approvals from the following agencies:

1. (UL) Underwriter's Laboratories
2. FCC Federal Communications Commission

1.04 DELIVERABLES

A. Prior to ordering materials or commencing any construction activities, the contractor shall provide the Owner with a complete bill of materials, including all quantities of components, devices, equipment, and wiring required to complete this work.

PART 2 - PRODUCTS

2.01 ASSISTIVE LISTENING SYSTEM

A. Furnish an FM wireless assistive listening system for use by the hearing-impaired. The assistive listening system (ALS) shall be capable of broadcasting on 57 channels and be frequency agile. The ALS system shall have 80dB SNR or greater, end-to-end. Receivers shall be frequency agile and frequency set with a "seek" button. The receiver will incorporate a stereo headset jack that allows the user to plug in either a mono or stereo headset and listen to audio normally. The portable receivers and transmitters shall incorporate automatic battery charging circuitry for recharging of Ni-MH batteries. Sound Mate Telex products with system carrying case are specified.

B. Refer to CA Building Code as quoted below;

1. 2-202 ASSEMBLY AREA. [DSA-AC] A building or facility, or portion thereof, used for the purpose of entertainment, educational or civic gatherings, or similar purposes. For the purposes of these requirements, assembly areas include, but are not limited to, classrooms, lecture halls, courtrooms, public meeting rooms, public hearing rooms, legislative chambers, motion picture houses, auditoria, theaters, playhouses, dinner theaters, concert halls, centers for the performing arts, amphitheaters, arenas, stadiums, grandstands or convention centers.
2. 2-202 Assistive Listening System (ALS). An amplification system utilizing transmitters, receivers, and coupling devices to bypass the acoustical space between a sound source and a listener by means of induction loop, radio frequency, infrared, or direct-wired equipment.

3. 11B-216.10 Assistive listening systems. Each assembly area required by Section 11B-219 to provide assistive listening systems shall provide signs informing patrons of the availability of the assistive listening system. The sign shall include wording that states "Assistive -Listening System Available" and shall be posted in a prominent place at or near the assembly area entrance. Assistive listening signs shall comply with Section 11B-703.5 and shall include the international Symbol of Access for Hearing Loss complying with Section 11B-703.7.2.4. Refer to plans for locations.
4. 11B-219.2 Required systems. An assistive listening system shall be provided in assembly areas, including conference and meeting rooms. Refer to plans for locations.
5. 11B-219.3 Receivers. The minimum number of receivers to be provided shall be equal to 4 percent of the total number of seals, but in no case less than two. Twenty-five percent minimum of receivers provided, but no fewer than two, shall be hearing-aid compatible in accordance with Section 11B-706.3.
6. 11B-219.5 Portable systems. Portable assistive-listening systems are used for conference or meeting rooms, the system may serve more than one room. An adequate number of electrical outlets or other supplementary wiring necessary to support a portable assistive-listening system shall be provided.
7. 11B-703.7.2.4 Assistive listening systems. Assistive listening systems shall be identified by the International Symbol of Access for Hearing Loss complying with Figure II B-703.7.2.4.
8. 11B-706 Assistive listening systems
9. 11B-706.1 General. Assistive listening systems required in assembly areas. conference and meeting rooms shall comply with Section 11B-706. Refer to plans for locations.
10. 11B-706.2 Receiver jacks. Receivers required for use with an assistive listening system shall include a 1/8 inch (3.2 mm) standard mono jack.
11. 11B-706.3 Receiver hearing-aid compatibility. Receivers required to be hearing aid compatible shall interface with telecoils in hearing aids through the provision of neck loops.
12. 11B-706.4 Sound pressure level. Assistive listening systems shall be capable of providing a sound pressure level of 110dB minimum and 118 dB maximum with a dynamic range on the volume control of 50 dB.
13. 11B-706.5 Signal-to-noise ratio. The signal-to-.noise ratio for internally generated noise in assistive listening systems shall be 18 dB minimum.
14. 11B-706.6 Peak clipping level. Peak clipping shall not exceed 18 dB of clipping relative to the peaks of speech.

C. Furnish and install the following with system carrying case and user manual:

1. Telex PST 170 – 17 channel transmitters with OLM -10 Microphone, Portable belt Pack Transmitter (Qty: 4)
2. Telex SR 400 17 channel portable receivers with backlit LCD display (Qty: 4 each). Multi-purpose room with 50 or more seats shall receive a quantity of ALS receivers that equals at least 4% of the number of seats in the room (rounding up to the nearest integer), Required quantities indicated is per Occupant load of the room.
3. Telex HED-2 Collapsible Light weight Headphones (Qty: 4)
4. Telex HM-2 Head worn Microphone (Qty: 4)
5. NiMH rechargeable AA batteries. (Qty: 4)
6. Telex BC-100 –Battery Charger for SR 400 & PST-170 (Qty:4)
7. ADA Access/Compliance signage kit. (See plans and details for locations.)

PART 3 - EXECUTION

3.01 General

A. All Work described in this specifying document and on the Project, drawings shall be performed in accordance with the acknowledged Professional and Industry standards and practices. All installed equipment shall meet and/or exceed the specified manufacture's regulations.

B. Furnish and install all materials, devices, components and equipment required for a complete and operational system.

C. It is the contractor's obligation to inform the Architect and/or the District's Representative of any and all conflict's, between the project documents and the onsite conditions.

D. It is the Contractor's responsibility and obligation to coordinate with all necessary trades to ensure the integrity and compliance of the Manufacture and Industry standards are met during the duration of the installation.

3.02 Equipment Installation

A. Portable Assistive Listening receivers shall be provided to the district with all components:

B. Equipment to be installed in accordance with manufacturer's instructions and demonstrate use of equipment to District personnel.

3.03 Programming

A. The contractor shall provide all necessary programming to provide a complete operating system.

3.04 Testing

A. The completed systems shall be physically inspected by the District's representative to assure that all equipment is installed in a neat and professional manner, and in accordance with these Specifications.

B. The final system testing and commissioning shall be performed after all installation and initial testing has been completed by the Installer, but prior to any use of the systems.

C. The Contractor, prior to requesting systems testing and demonstration to the District's representative, shall ensure that all systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive hum and noise, RF interference, or instability of any form.

3.05 Training

A. The contractor shall provide no less than one (1) two (2) hour training sessions.

1. The first training session will be "Train the Trainer". The District will appoint their representative to be provided extensive training so that he/she will be able to provide additional support once the project has been completed.
2. The additional training session will be provided as a general overview of the system operation for large groups, or several smaller groups as designated by the owner. Usually, these additional training events will coincide with a school function when the sound system will be used.
3. Provide sign-in sheets for all training events. Deliver to architect in the close out documents.

3.06 Warranty

A. Contractor will provide a minimum of a 3-year Workmanship Warranty that includes Parts and Labor.

B. All equipment provided under this specification shall be warranted to be free from defects in materials and workmanship for a period of 36 months from the notice of completion.

3.07 System Documentation

A. Upon completion of the installation, the contractor shall provide four copies (one hardcopy and three electronic copies) of Project Close-Out Documents to the Owner. Documentation shall include the items detailed in the sub-sections below:

1. Maintenance and Operation Manuals

B. The As-Built drawings are to include Equipment Layout and System Single Line Drawings.

END OF SECTION

Division 27 – Communications

SECTION 27 00 00 – COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section provides general requirements and guidelines for communications systems, including but not limited to:

A. Structured cabling systems.
B. Communications pathways and spaces.
C. Network and telecommunications equipment.
D. Testing and certification requirements.

1.1.2 The specific requirements found in other sections of Division 27 or Division 28 shall supersede the general requirements listed in this section when more specific direction is provided. Where conflicts arise between Division 27 and other Divisions (e.g., Division 26), the requirements of Division 27 shall govern all communications, structured cabling, and low-voltage system installations unless otherwise approved in writing by the District ITS Project Manager.

1.1.3 The work covered under this section applies to all Division 27 specifications and associated drawings for the project.

1.1.4 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.2 RELATED REQUIREMENTS:

1.2.1 Refer to individual Division 27 sections for specific system components, materials, and execution requirements. The list of Division 27 section specifications includes, but is not limited to, the following:

A. SECTION 27 00 00 – COMMUNICATIONS
B. SECTION 27 05 26 - GROUNDING & BONDING FOR TELECOMMUNICATIONS SYSTEMS
C. SECTION 27 05 28 – PATHWAYS FOR COMMUNICATIONS SYSTEMS
D. SECTION 27 05 43 - UNDERGROUND DUCTS & RACEWAYS FOR COMMUNICATIONS SYSTEMS
E. SECTION 27 05 50 – COMMUNICATIONS DOCUMENTATION & SUBMITTALS
F. SECTION 27 05 53 – IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
G. SECTION 27 05 86 – TESTING & CERTIFICATION OF STRUCTURED CABLING
H. SECTION 27 06 50 – COMMUNICATIONS EQUIPMENT & MATERIALS SCHEDULE
I. SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS
J. SECTION 27 11 16 – COMMUNICATIONS RACKS, CABINETS, AND ENCLOSURES
K. SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING
L. SECTION 27 13 13 - COMMUNICATIONS COPPER BACKBONE CABLING
M. SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING
N. SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING
O. SECTION 27 15 01.15 - ACCESS CONTROL COMMUNICATIONS CONDUCTORS AND CABLES
P. SECTION 27 15 01.17 - INTRUSION DETECTION COMMUNICATIONS CONDUCTORS AND CABLES
Q. SECTION 27 15 01.46 - PAGING COMMUNICATIONS HORIZONTAL CABLING
R. SECTION 27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING
S. SECTION 27 15 23 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

T. SECTION 27 20 00 - DATA COMMUNICATION
U. SECTION 27 30 00 - VOICE COMMUNICATIONS
V. SECTION 27 40 00 - AUDIO-VIDEO COMMUNICATIONS – GENERAL REQUIREMENTS
W. SECTION 27 40 01 - AUDIO-VIDEO SYSTEMS – STANDARD CLASSROOMS AND MEETING ROOMS
X. SECTION 27 40 02 - AUDIO-VIDEO SYSTEMS – ENHANCED CLASSROOMS AND COLLABORATION SPACES
Y. SECTION 27 40 03 - AUDIO-VIDEO SYSTEMS – NETWORKED, DISTRIBUTED, AND MULTI-ZONE ENVIRONMENTS
Z. SECTION 27 51 00 - DISTRIBUTED AUDIO-VIDEO COMMUNICATIONS SYSTEMS

1.2.2 Other Division Coordination:

A. Division 26 – Electrical: Power and grounding.
B. Division 28 – Electronic Safety and Security: Security system integration.

1.3 DEFINITIONS & RESPONSIBILITIES

For the purposes of this specification, the following terms shall have the meanings defined below.

1.3.1 Contractor

A. The term Contractor refers to the Prime Contractor or any entity that holds a direct contractual agreement with the District for the execution of work under this specification. The Contractor is responsible for compliance with all contract documents, specifications, applicable codes, and coordination of work, whether self-performed or subcontracted.
B. Prime Contractor
   1. The Prime Contractor is the entity contractually responsible for the entire scope of work, including managing all subcontractors. The Prime Contractor may be a General Contractor, Electrical Contractor, or other entity as designated in the contract. Responsibilities include:
C. Ensuring all work meets contract documents, applicable codes, and specifications.
D. Coordinating all subcontractors to ensure compliance with pathway sizing, fill ratios, and infrastructure requirements.
E. Reporting any discrepancies in pathway availability, conduit sizing, or other conflicts to the District ITS Project Manager and Facilities Project Manager for resolution before proceeding.
F. Delivering final project completion and ensuring work is accepted per contract requirements.

1.3.2 District

A. Refers to Pomona Unified School District (PUSD), the governing entity overseeing all construction and technology infrastructure projects.

1.3.3 General Contractor (GC)

A. The General Contractor (GC) is a licensed contractor responsible for overall construction management, which may include site preparation, structural work, and coordination of multiple trades. The GC may also serve as the Prime Contractor if contractually designated.

1.3.4 ITS

A. Refers to the District's Information Technology Services (ITS) Department, responsible for managing telecommunications, networking, and low-voltage infrastructure.

1.3.5 ITS Project Manager

A. The ITS Project Manager is the District's representative responsible for overseeing all telecommunications, networking, and low-voltage infrastructure work and is appointed by the Director of Information and Technology Services or their designee. Responsibilities include:

1. Reviewing and approving all submittals pertaining to Division 27 work.
2. Reviewing and approving any variances Division 27 specifications and industry standards.
3. Verifying compliance with Division 27 specifications and industry standards.
4. Coordinating with the Facilities Project Manager to ensure low-voltage infrastructure aligns with overall project execution.

1.3.6 Owner

A. Synonymous with the Pomona Unified School District (PUSD), as the entity funding and authorizing the project.

1.3.7 Project Manager

A. The Project Manager is the District's representative responsible for oversight of all construction, scheduling, and contract compliance. This individual ensures project execution aligns with the District's goals, coordinates inspections, and serves as the point of contact for construction matters.
   1. The Project Manager is responsible for coordinating communication between the Contractor and the ITS Project Manager to ensure Division 27 work is properly integrated into the overall construction schedule and project scope.
   2. Facilitates resolution of conflicts between construction and ITS infrastructure requirements.
   3. Ensures Division 27 work is completed in alignment with the project's construction milestones.

1.3.8 PUSD

A. Synonymous with the Pomona Unified School District (PUSD), as the entity funding and authorizing the project.

1.3.9 Subcontractor

A. A Subcontractor is any entity or trade working under the Prime Contractor to perform a specialized scope of work. Examples include:
   1. Electrical Subcontractor – Responsible for power and conduit installation.
   2. Low-Voltage Subcontractor – Responsible for structured cabling and telecommunications pathways.
   3. Other Specialty Subcontractors – Includes security, audiovisual, and other trades.
B. All Subcontractors report to the Prime Contractor, who is responsible for their compliance with contract requirements.

1.4 TERMS & ABBREVIATIONS

1.4.1 For the purposes of this specification, the following terms and abbreviations shall apply to all Division 27 sections:

1.4.2 Backbone Cabling Terms:

A. Backbone Cabling: Structured cabling that interconnects MDFs, BDFs, and IDFs within and between buildings
B. BDF (Backbone Distribution Frame): A secondary telecommunications room within a campus that connects to the MDF and multiple IDFs, supporting backbone cabling and network distribution.
C. IDF (Intermediate Distribution Frame): A localized distribution point within a building for network connectivity, typically serving a specific floor or area.
D. MDF (Main Distribution Frame): The primary telecommunications room where external service provider connections terminate and the main backbone cabling originates.
E. MPoE (Minimum Point of Entry): The designated location where telecommunications services enter the building, often housing the MDF and serving as the primary demarcation point.

1.4.3 Communications Systems & Devices:

A. Access Control Panel: A device that manages and monitors access control systems, including door sensors, card readers, and electronic locks.

B. Alarm Panel: The central unit that monitors and controls security and intrusion detection systems, often interfacing with cameras, sensors, and alarm devices.
C. Camera: A device used for video surveillance, including IP cameras, CCTV, and other visual monitoring equipment.
D. WAP (Wireless Access Point): A device that enables wireless devices to connect to a wired network using Wi-Fi or related standards.
E. Vape Sensor: A device designed to detect the presence of vapor emissions, often used in schools and public buildings for safety monitoring.
F. Public Address (PA) System: Audio system used for broadcasting voice announcements and emergency notifications.

1.4.4 Cabling & Infrastructure Components:

A. Cat6 (Category 6): A twisted pair cable standard supporting Gigabit Ethernet and 10 Gigabit Ethernet over short distances.
B. Cat6A (Augmented Category 6): An enhanced twisted pair cable that supports 10 Gigabit Ethernet over the full 100 meters.
C. Cat5e (Enhanced Category 5): A twisted pair cable supporting Gigabit Ethernet, used in legacy installations.
D. Cat3 (Category 3): An older twisted pair cable standard used for telephone wiring.
E. Fiber: Refers to fiber optic cables, which transmit data using light, supporting high-speed communication over long distances, including single-mode and multimode fibers.
F. CMP (Plenum): Cable rated for use in air-handling spaces with low smoke and flame spread characteristics.
G. CMR (Riser): Cable rated for use in vertical shafts and riser spaces between floors.
H. OSP (Outside Plant): Cable designed for outdoor use, including buried, aerial, and conduit installations.
I. OSP-CMP: Hybrid cable suitable for transitioning directly from outdoor to indoor plenum spaces.
J. TCO (Telecommunications Outlet): A fixed connection point where horizontal cabling terminates, typically providing a network or communication connection via an RJ45 or similar connector.
K. U Space: Refers to rack unit space in equipment racks (1U = 1.75 inches in height), used to define the size and capacity of network racks and cabinets.
L. CCA (Copper-Clad Aluminum): Cable with an aluminum core and copper coating, **prohibited for use in this specification.**

1.4.5 Documentation & Standards:

A. CAD (Computer-Aided Design): Digital drawings and plans created using design software
B. PDF (Portable Document Format): A universal file format used for submitting digital documentation, including as-built drawings, specifications, and reports.

1.4.6 Measurement & Compliance:

A. GIS (Geographic Information System): Technology used for mapping and documenting locations,
B. RFI (Request for Information): A formal request submitted by the Contractor to clarify specifications, address conflicts, or propose alternative solutions.

1.4.7 Safety & Regulatory:

A. NEC (National Electrical Code): A set of standards for safe electrical design, installation, and inspection to protect people and property from electrical hazards.
B. CEC (2025 California Electrical Code): Regulatory code governing electrical installations in California, aligning with the NEC and state-specific safety requirements.
C. AHJ (Authority Having Jurisdiction): The entity responsible for enforcing codes, approving installations, and ensuring compliance with regulatory requirements, including building, safety, and fire codes.

1.5 COORDINATION WITH DISTRICT ITS DEPARTMENT

1.5.1 Project Coordination and Communication

A. The contractor shall coordinate with the District's ITS Department Project Manager and designated personnel prior to the start of any work.

1.5.2 The District ITS Department reserves the right to reassign or change the ITS Project Manager at any time.

1. Any change in Project Manager designation shall be communicated to the Contractor in writing by the District ITS Department.

2. Upon receiving notification of a change, the Contractor shall direct all future correspondence, coordination, and approvals to the newly assigned ITS Project Manager.

3. If a transition period is required, the outgoing ITS Project Manager shall facilitate a handover meeting to ensure continuity of project oversight.

1.5.3 Pre-Installation and Ongoing Coordination

B. The Contractor must schedule and attend a pre-installation coordination meeting with the District ITS Department to review project scope, site conditions, and any special requirements prior to the start of any work.

C. Ongoing communication with the District ITS Project Manager is required throughout the duration of the project to ensure compliance with District standards and integration with existing systems.

D. The **Contractor must provide advance notice of any planned service interruptions, testing, or major installations to allow for proper coordination and approval by the District ITS Department.**

1.5.4 Contract Documents and Interpretation:

1.6 COMPLIANCE WITH STANDARDS AND REGULATIONS

All work must be performed in accordance with the latest District ITS standards, industry best practices, and applicable codes.

1.6.1 Codes and Regulations

A. All materials, installation, and workmanship shall comply with the most recent editions of the following codes and regulations, including addenda and technical service bulletins (TSB), in effect at the time of bid submission:

1. National Electrical Manufacturers Association (NEMA).
2. 2025 California Electrical Code (CEC).
3. National Electrical Safety Code (NESC).
4. FCC Rules and Regulations.
5. Local, county, state, and federal regulations and codes.

1.6.2 Industry Standards Compliance

A. All materials, installation, and workmanship shall conform to the latest editions of applicable industry standards, best practices, and regulatory requirements, including but not limited to:

6. ANSI/TIA-568 – Structured Cabling Standards.
7. ANSI/TIA-569 – Telecommunications Pathways and Spaces.
8. ANSI/TIA-606 – Administration of Telecommunications Infrastructure.
9. ANSI/TIA-607 – Grounding and Bonding for Telecommunications.
10. ANSI/TIA-758 – Customer-Owned Outside Plant Telecommunications Infrastructure.
11. BICSI - Telecommunications Distribution Methods Manual (TDMM).
12. BICSI - Outside Plant Design Reference Manual (OSPDRM).
13. BICSI - Information Technology Systems Installation Methods Manual (ITSIMM).
14. All materials and products shall be Underwriters Laboratories (UL) listed or tested by a nationally recognized testing laboratory (NRTL) acceptable to the District, and shall meet or exceed applicable industry safety and performance standards.

1.6.3 District ITS Standards Compliance

A. The contractor must ensure that all installations meet the latest District ITS Standards and Design Guidelines.

1.6.4 Handling Non-Compliant Systems, Installations, and Pathways

A. If existing systems, installations, or pathways do not comply with current standards, the contractor shall:
15. Install new systems and pathways separately to prevent integration with non-compliant legacy infrastructure.
16. Retrofit existing installations and pathways where required to bring them into compliance with current standards.
17. Replace or properly abandon any obsolete or non-compliant conduit, raceways, or cable pathways that cannot be upgraded.

B. Expanding upon or reusing a non-compliant legacy system, installation, or pathway is strictly prohibited and must be corrected before new work proceeds.

C. The contractor shall:
18. Identify, document, and report all discovered non-compliant conditions, including pathways, conduits, cabling, and equipment.

19. Submit a corrective action plan for approval by the District ITS Project Manager before proceeding with work.

1.7 CONTRACT DOCUMENTS & INTERPRETATION

1.7.1 In the event of a conflict between the Division 27 specifications, industry standards and the drawings, the **Division 27 specifications shall take precedence**, unless otherwise approved in writing by the **District ITS Project Manager**.

1.7.2 All **requests for deviations** from Division 27 specifications must be submitted **in writing** to the District ITS Project Manager for **review and written approval** before implementation.

1.7.3 If discrepancies arise between Division 27 and other divisions (e.g., Division 26 – Electrical, Division 28 – Security), the ITS Project Manager shall provide the final determination for all work governed by Division 27.

1.8 COORDINATION & COMPLIANCE

1.8.1 General Responsibility

A. Prime Contractor Responsibilities:
1. Shall ensure all conduits and pathways meet required fill ratios before any cable installation begins.
2. Shall coordinate between subcontractors, including Electrical and Low-Voltage Subcontractors, to verify that all conduits are sized appropriately for the intended cable load.
3. If the drawings or specifications indicate a conduit size that does not meet the fill ratio requirements, the contractor shall:
- Notify the District ITS Project Manager immediately.
- Propose a revised conduit size or alternative solution to maintain compliance.
- Obtain written approval before proceeding with installation.

B. Low-Voltage Subcontractor Responsibilities:
1. Shall review all planned cable routes and verify that pathway sizing meets project requirements prior to installation.
2. Before pulling cables, shall verify that the existing fill ratio complies with Section 1.7.2 - Fill Ratio Requirements.

C. Discrepancy Management:
1. If a discrepancy is identified before or during installation, the responsible party must immediately notify the Prime Contractor and District ITS Project Manager.
2. Failure to comply with fill ratio requirements or address issues prior to installation will necessitate corrective action at no additional cost to the District.

1.8.2 Deficiency Identification/Resolution RFI:

A. The contractor shall submit an RFI for any issues or deficiencies identified, including, but not limited to:
   1. Fill ratio non-compliance, as outlined in Section 27 00 00 Part **Error! Reference source not found. Error! Reference source not found.**.
   2. Inability to meet installation requirements or design intent.
   3. Non-viable pathways, such as obstructed conduits, damaged sleeves, or overfilled raceways.
   4. Conflicts with other building systems, including mechanical, plumbing, or electrical installations.
B. RFI Submission Requirements:
   1. Description of the discrepancy or issue, including location details and impact on the project.
   2. Proposed alternative solutions with supporting documentation, such as photos, drawings, and specifications.
   3. Impact analysis on project timelines, system performance, and compliance with standards.
   4. Recommended temporary measures, if applicable, to maintain safety and system functionality until a permanent resolution is approved.
C. RFI Approval Process
   1. Submit the RFI to the District ITS Project Manager within 3 business days of identifying the issue.
   2. Contractor will obtain written approval from the District ITS Project Manager before proceeding with any modifications.
   3. If the approved RFI necessitates changes to the as-built documentation, the contractor shall update all affected documents as part of the final submittals per Section 27 05 50 - Communications Submittals.

1.9 PATHWAY FILL RATIO REQUIREMENTS

1.9.1 General:

A. All communication pathways, including conduits, cable trays, J-hooks, and raceways, shall adhere to the maximum fill ratios outlined in this section. In addition, all pathways must comply with manufacturer-specified fill ratios, the NEC, and any applicable requirements of the AHJ. When determining the maximum allowable fill, the most restrictive (i.e., lowest) value between this standard, the manufacturer's specification, the NEC, and AHJ requirements shall apply.
B. Newly installed pathways shall maintain at least 25% spare capacity to support future growth. Existing pathways may utilize the full maximum fill ratio as outlined in TABLE 27 00 00 - 1: Pathway fill ratios.
C. Fill ratios are calculated based on the internal cross-sectional area of the pathway, following NEC Chapter 9, Table 1 and ANSI/TIA-569-D standards.
D. If pathway fill exceeds allowable limits, the contractor shall:
   1. Increase pathway size, or
   2. Provide additional pathways to meet the project requirements.
E. When manufacturer specifications differ from calculated fill ratios, the more restrictive value shall apply.
F. Any pathway identified as full shall not be used for additional cabling unless reconfigured or expanded.
G. Contractors shall not exceed maximum fill ratios, as outlined in TABLE 27 00 00 - 1: Pathway fill ratios, without prior approval in writing from the ITS Department Project Manager.

1.9.2 Maximum Pathway Fill Ratios:

TABLE 27 00 00 - 1: PATHWAY FILL RATIOS

Pathway Type	Max Fill - Existing (%)	Max Fill - New (%)
Straight Pathways (<2 feet)	60%	45%
Pathways (<100 feet)	40%	30%
Long Pathways (>100 feet)	28%	21%
J-Hooks & Non-Continuous Supports	50%	37.5%
Cable Trays & Baskets	40%	37.5%
HDPE Pathways (Subject to Approval)	28%	21%
Surface Mounted Raceway with Devices Brackets	20%	15%
Surface Mounted Raceway without Devices Brackets	40%	30%

1.9.3 Full Pathway Procedure:

A. Full pathways must be accurately documented and identified on as-built submittals.
B. Ensure that pathway status is communicated during coordination meetings, especially if additional cables might be needed for future phases.

1.10 SAFETY REQUIREMENTS

1.10.1 General Safety Requirements

A. The Contractor shall comply with all applicable safety codes, including:
   1. OSHA regulations (e.g., 29 CFR 1926 for construction safety).
   2. National Electrical Code (NEC), especially regarding electrical safety.
   3. Local Authority Having Jurisdiction (AHJ) requirements.
B. Personal Protective Equipment (PPE):
   1. All workers must wear appropriate PPE
C. Job Site Safety:
   1. Maintain clear access to emergency exits and fire equipment at all times.
   2. Store materials safely, avoiding obstructions in walkways and access points.
   3. Secure all tools and equipment when not in use, especially in occupied areas.
D. Additional Safety Requirements:
   1. Individual sections within Division 27 may include additional safety requirements specific to their section.
   2. Contractors are responsible for complying with all safety requirements, including those found in specific sections.

1.10.2 Contractor Responsibilities

A. The Contractor is responsible for:
   1. Providing all necessary safety equipment and ensuring it is in good working order.
   2. Conducting regular safety briefings with work crews, especially when job conditions change.
   3. Reporting any safety incidents or near misses to the District ITS Project Manager within 24 hours.
B. Pre-Work Safety Assessment:
   1. Highly recommend taking photos of work areas before starting work to document existing conditions.
   2. Report any pre-existing hazards or damage to the District ITS Project Manager before work begins.

1.10.3 Safety for Underground Structures

A. Barrier & Safety Measures:
   1. When working in underground structures, the Contractor shall ensure the safety of personnel and prevent unauthorized access by:
      - Caution taping off the area with high-visibility tape.
      - Installing physical barriers, such as cones, safety fencing, or portable barricades, around the open pull point.
      - Posting warning signs indicating "Open Trench", "Work in Progress", or "Do Not Enter".
B. Monitoring Requirements:
   1. Open pull points may not be left unattended at any time.
   2. The Contractor shall assign a dedicated spotter or safety monitor to remain at the pull point whenever the cover is removed.
   3. The safety monitor must:
      - Maintain visual contact with the open pull point.
      - Direct pedestrians and other workers away from the hazard area.
C. Unattended Pull Points:
   1. If the pull point must be left unattended, the Contractor shall securely replace the cover and ensure it is locked or bolted if applicable.
   2. Temporary covers, such as weighted steel plates, may be used only if they are:
      - Rated for the load requirements of the area (e.g., vehicular traffic, pedestrian use).
      - Properly labeled with warning signage and taped off until permanent covers are reinstalled.

D. Inspection Before Leaving Site:
   1. At the end of each workday, the Contractor shall conduct a final safety check to ensure:
      - All pull points are properly covered and secured.
      - No barriers or safety equipment remain in walkways or roadways, unless approved by the ITS Department Project Manger
      - The work area is free of hazards, including tripping hazards and exposed cables.

1.10.4 Safety Measures for Overhead Work in Occupied Spaces

A. When performing overhead work in spaces that may be occupied during business hours, the Contractor shall:
   1. Establish a safe work zone around the overhead work area.
   2. Use barriers, such as caution tape, safety cones, or portable barricades, to prevent access to the hazard area.
   3. Post clear signage, including "Overhead Work in Progress", "Keep Clear", and "Authorized Personnel Only" as needed.
B. Protection Measures:
   1. Ensure the work zone is large enough to protect people from:
      - Falling objects, such as tools, hardware, or debris.
      - Overhead hazards, including lifts, scaffolding, and open ceiling tiles.
C. When working in hallways, classrooms, or shared spaces:
   1. Restrict access to the area directly below and adjacent to the work area.
   2. Provide alternative routes if hallways or entrances are blocked.
   3. Ensure emergency exits and fire egress paths are not obstructed.

1.11 SITE SECURITY REQUIREMENTS

1.11.1 General Security Responsibilities

A. The Contractor is responsible for maintaining the security of the job site, including:
   1. Securing all access points, doors, windows, and gates at the end of each workday.
   2. Ensuring that all keys, badges, and access credentials are accounted for and returned as required.
   3. Reporting any security incidents or access control issues to the District ITS Project Manager and School Security immediately.
B. Preventing Unauthorized Access:
   1. Close and lock doors when moving between rooms, preventing unauthorized access
   2. If working in sensitive areas, such as server rooms or secure spaces, ensure:
      - The area is never left unsecured.
      - Only authorized personnel are allowed entry.
C. Photo Documentation:
   1. Highly recommend taking photos of work areas before starting work, particularly in:
      - Classrooms, offices, and sensitive locations.
      - Areas with pre-existing damage or security concerns.
   2. Existing damage must be reported to the District ITS Project Manager before work begins to avoid liability.
D. Incident Reporting:
   1. If the Contractor cannot secure an area, they must:
      - Notify the District ITS Project Manager and School Security immediately.
      - Document the issue in the daily security log.
      - Take temporary measures to reduce risks.

1.11.2 School Security Information

A. School Security Phone Number:
   1. After Hours: 909-629-7797
   2. During Business Hours: 909-397-4800
B. Emergency Contact Protocols:

1. If a security emergency occurs, contact School Security immediately, then notify the District ITS Project Manager.
2. Keep a record of all communications with School Security, including call times, personnel contacted, and instructions provided.

1.11.3 Check-In Procedures:

A. Scheduling & Approval:
   1. All site work must be scheduled a minimum of 48 hours in advance with the District ITS Project Manager.
   2. Failure to schedule with District ITS Project Manager may result in contractor being denied entry and turned away.
B. Business hours work
   1. Before starting work each day, the Contractor shall:
      - Check in at the school office.
      - Sign in and obtain a visitor badge.
      - Provide work details, including:
        ◊ Locations being accessed.
        ◊ Expected duration of work.
   2. After-hours or weekend work
      - The Contractor must contact School Security at the start work before entering the campus and provide:
        ◊ Name of Company
        ◊ Expected work hours.
        ◊ Work location, including site and areas
      - Failure to notify School Security may result in a police response.
C. If unable to check in, immediately notify the District ITS Project Manager.

1.11.4 Check-Out Procedures:

A. Business hours work
   1. Check-out with office before leaving campus.
   2. Verify that all areas and equipment accessed during work are properly locked and secured.
   3. Tools, materials, and equipment are secured and stored safely.
B. After hours/weekends work
   1. Contact School Security before leaving campus.
   2. Verify that all areas and equipment accessed during work are properly locked and secured.
   3. Verify that the campus perimeter is secured, including all exterior doors and gates.
   4. Restore all intrusion alarm systems to their normal operating state before leaving the site.
   5. Perform a final walkthrough to ensure all exterior doors and gates are securely locked.
   6. Notify School Security immediately if there are area that are unable to be secure, do not leave site until direct to do so by School Security.

1.11.5 Key & Access Control Management

A. Key Management:
   1. The Contractor shall maintain strict control of all District-provided keys.
   2. Return keys daily, unless overnight access is pre-approved.
   3. Report lost or damaged keys to the District ITS Project Manager and School Security immediately.
   4. Contractor responsible for all cost associated remediation of lost or solen keys
B. Access Control Systems:
   1. Restore all access control systems to their normal operating state before leaving the site.
   2. Restore all intrusion alarm systems to their normal operating state before leaving the site.
   3. Ensure alarm systems are re-armed and security devices are functioning properly.

1.12 QUALITY CONTROL

1.12.1 Contractor Qualifications

A. Licensing Requirements
1. The Contractor shall have a current and valid State of California:
   - C-7 Low Voltage Systems License OR
   - C-10 Electrical Contractor License.

B. General Contractor Requirements
1. Shall have been in business of furnishing and installing communication systems of this type for at least two years
2. Is capable of being bonded to assure the District of performance and satisfactory service during the guarantee period.
3. Shall be a factory authorized installer for the brands of equipment offered and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment located within 100 miles from District.

C. General Training & Certification Requirements
1. The Contractor shall be **trained, certified, and authorized** to install, terminate, and test **all systems covered under Division 27**, including but not limited to:
   - Structured Cabling Systems (Copper & Fiber Optic)
   - Audio-Visual (AV) and Public Address (PA) Systems
   - Access Control Systems
   - Intrusion Alarm Systems
   - Closed-Circuit Television (CCTV) Surveillance Systems

D. Manufacturer-Specific Certification Requirements

Contractor must be a manufacture authorized installer and possess a current manufacture installer certification for all installed products. Including, but not limited to:

1. Structured Cabling Systems (Copper & Fiber Optic)
   - The Contractor must be a Leviton-certified installer and authorized to provide Leviton's Lifetime System Warranty.
2. Audio-Visual (AV) & Public Address (PA) Systems
   - The Contractor must hold current manufacturer certification for the products being installed, including but not limited to:
     - ◊ Crestron, Extron, Biamp, QSC, Shure, or an approved equivalent.
3. CCTV Surveillance Systems (See Division 28 for Full Requirements)
   - The Contractor must be certified and authorized to install, configure, and maintain:
     - ◊ Video Insight Video Management System (VMS), or an approved equivalent.
   - CCTV cameras from approved manufacturers:
     - ◊ Panasonic, Hanwha Vision, Advidia, or an approved equivalent.
4. Access Control Systems (See Division 28 for Full Requirements)
   - The Contractor must be certified and authorized to install, configure, and maintain:
     - ◊ Vanderbilt SMS Enterprise, or an approved equivalent Access Control System.
5. Intrusion Alarm Systems (See Division 28 for Full Requirements)
   - The Contractor must be certified and authorized to install, configure, and maintain:
     - ◊ DMP, or an approved equivalent Intrusion Alarm System.

E. Proof of Certification & Compliance
1. The Contractor must provide proof of all required certifications upon request.
2. Only certified personnel shall perform installation, termination, programming, and testing of applicable systems.
3. If subcontractors are used, they must also meet the same certification requirements.

1.12.2 Abandoned Cabling

A. General Requirements

1. All abandoned cabling shall be removed unless explicitly noted otherwise in the contract documents or directed by the District ITS Project Manager.
2. Abandoned cabling is defined as any cable that:
   - Is no longer in active use or designated for future use per NEC 800.2 and 800.25.
   - Is not terminated on both ends
   - Has been replaced or decommissioned without being fully removed.
3. Removal shall include all abandoned horizontal, backbone, and device cabling.
4. Cables that are known to be abandoned but cannot be removed must be documented in as-built drawings.
5. The removal of abandoned cabling shall comply with:
   - NEC Article 800.2 & 800.25 – Defines abandoned communication cables and mandates removal.
   - CEC Title 24, Part 3 – California-specific electrical code requirements for cabling removal.
   - TIA-569-D – Telecommunications Pathways and Spaces standard addressing abandoned cable management.
   - NFPA 70 & NFPA 75 – Fire protection requirements related to excess cable accumulation.

B. Accessibility & Removal
1. Accessible Pathways:
   - All abandoned cabling in accessible pathways must be removed entirely unless otherwise approved by the District ITS Project Manager.
2. Inaccessible Pathways:
   If a portion of a cable is inaccessible due to crushed conduit, high risk to other systems, or structural barriers:
   - The cable shall be severed 12 inches beyond the point where it exits the inaccessible pathway
   - The remaining inaccessible section of cable may remain in place, but all accessible portions must be fully removed.
   - The cable shall have both ends of the remaining cable shall be labeled with a **2-inch-wide permanent red label** featuring **black text** stating **"ABANDONED."** Labels shall be machine-printed and securely affixed.
   - Contractor shall submit written justification to the District ITS Project Manager for approval before leaving any cable in place.

C. Pathway Considerations
1. Pathways containing abandoned cable shall not be used for new cable installations until all abandoned cables are fully removed.
2. If abandoned cable cannot be fully removed due to inaccessibility, the pathway shall be marked as "FULL" or "OUT OF SERVICE" at all accessible entry points and shall not be used for new cable.
3. If a pathway is partially blocked, it must be evaluated for future use and documented as restricted.
4. If abandoned cable is removed from conduit, the contractor shall install a new pull string per Section 27 05 28.

D. Documentation & Compliance
1. All abandoned cable locations must be noted in as-built documentation.
2. The contractor is responsible for verifying that all removals comply with NEC, CEC, and any applicable state and local codes.
3. Any exceptions to complete removal must be approved in writing by the District ITS Project Manager.

1.13 PROTECTION OF EXISTING EQUIPMENT DURING CONSTRUCTION

1.13.1 Where existing telecommunications or data equipment is located within or adjacent to a construction area, the Contractor shall coordinate with the District ITS Project Manager to ensure uninterrupted service and full protection of active systems throughout the construction phase.

1.13.2 Active equipment shall not be exposed to dust, debris, vibration, or moisture from construction activities. This includes, but is not limited to:

A. Demolition
B. Wall framing or drywall sanding

C. Concrete cutting or core drilling
D. Abatement or hazardous material removal

1.13.3 If early installation or continued operation in an active construction zone is necessary, the Contractor shall:

A. Submit a written justification to the District ITS Project Manager.
B. Provide a detailed protection and cleaning plan for approval, including:
   1. Physical containment or barrier systems
   2. Air filtration and negative pressure measures
   3. Cooling and ventilation provisions to prevent heat buildup around active equipment
   4. Cleaning protocols and materials

1.13.4 The Contractor shall be fully responsible for:

A. Protecting all systems from environmental or physical damage.
B. Restoring any impacted services or equipment.
C. Performing all cleaning and reactivation steps to the satisfaction of the District ITS Project Manager.

1.13.5 Any equipment that fails or is damaged as a result of construction-related conditions or inadequate protection shall be replaced by the Contractor at no cost to the District, including all associated materials, labor, and configuration.

PART 2 - PRODUCTS

2.1 GENERAL COMMUNICATIONS MATERIALS & COMPONENTS

2.1.1 New and from a regularly manufactured line, currently in production at the time of installation, unless otherwise specified in writing by the District ITS Project Manager.

2.1.2 Of the quality specified in the contract documents.

2.1.3 Compliant with all applicable codes, regulations, and standards (see Section 1.6).

2.1.4 All Division 27 systems shall be installed by certified contractors and shall meet all applicable manufacturer warranty requirements.

2.1.5 System-specific product details, including approved manufacturers and performance requirements, are specified in individual Division 27 and Division 28 sections (see Section 1.1.3).

2.2 SUBSTITUTIONS & DEVIATIONS

2.2.1 General Requirements

A. All materials and components shall be selected from the Pre-Approved Materials Schedule in Section 27 05 50 – Communications Documentation & Submittals.
B. Any substitutions or deviations from the Pre-Approved Materials Schedule require prior written approval from the District ITS Project Manager.
C. Substitutions will only be considered if:
   1. The specified item is discontinued or unavailable.
   2. The substitution offers equal or better performance, quality, and warranty at no additional cost to the District.
   3. The substitution is required due to project-specific conditions and is approved in writing by the ITS Project Manager.

2.2.2 Substitution Request Process

A. All substitution requests shall be submitted in writing to the District ITS Project Manager at least 30 days prior to procurement or installation.
B. Each request shall include:
C. A completed Substitution Request Form

D. Manufacturer data sheets and specifications for both the specified item and the proposed substitute.
E. Independent test reports (if applicable) verifying compliance with performance standards.
F. A written statement detailing the reason for the substitution request.

2.2.3 Evaluation & Approval

A. The District reserves the right to request a physical sample of any proposed substitution at no cost to the District for evaluation.
B. The District ITS Project Manager will evaluate substitutions based on:
C. Compliance with District standards and Division 27 performance requirements.
D. Compatibility with existing District systems.
E. Long-term reliability, maintainability, and manufacturer support.
F. Review Timeframe: The District will provide a decision within 10 business days of receiving a complete substitution request. If additional information is required, the timeframe may be extended.

2.2.4 Compatibility & Contractor Responsibility

A. All substituted products must be fully compatible with the District's existing infrastructure.
B. If a substituted product is found to be incompatible, the contractor shall be responsible for replacing all non-compatible equipment at no additional cost to the District.
C. Approval of a substitution does not waive the contractor's responsibility for proper installation, performance, and compliance with contract requirements.

2.3 SYSTEM INFRASTRUCTURE & INTEROPERABILITY

2.3.1 All communications systems shall be designed and installed to ensure full interoperability between Division 27 subsystems, including but not limited to:

A. Structured Cabling Systems (Backbone & Horizontal Cabling).
B. Communications Pathways & Spaces (Racks, Cabinets, Conduits, Cable Trays).
C. Data Communications Network Equipment (Switches, Patch Panels, WAPs).
D. Voice Communications Systems (VOIP, Telephone Backbone).
E. Audio-Visual (AV) & Paging Systems (Distributed AV, Networked Paging).

2.3.2 All cabling and connectivity components shall be fully compatible with the active and passive Division 27 infrastructure, as well as all Division 27 and Division 28 systems, as specified in their respective sections.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 General Workmanship Standards

B. All work shall be performed in a neat, professional, and workmanlike manner accordance with:
1. BICSI Telecommunications Distribution Methods Manual (TDMM).
2. ANSI/TIA and NEC installation standards.
A. Improperly installed or damaged equipment, cabling, or components shall be removed and replaced at no additional cost to the District.
B. All cable runs shall be properly dressed, supported, and routed in accordance with Division 27 pathways and spaces requirements.
C. The contractor shall thoroughly clean all equipment and materials. All exposed parts of the equipment, cabinets, and other equipment shall be left in a clean condition, unblemished and free of all dirt, dust, smudges, spots, fingerprints, etc., The contractor shall remove all debris and rubbish occasioned by the work from the site. The contractor shall thoroughly clean all buildings of any dirt, debris, rubbish, marks, etc., caused by the performance of this work.

3.1.2 Coordination & Integration

A. Contractor shall **coordinate all Division 27 system installations** with electrical, security, and other trades to avoid conflicts.
B. Verify all pathways, power, and grounding provisions before starting work.
C. All equipment shall be fully integrated with active and passive network infrastructure per project requirements.

3.2 LABELING, TESTING & CERTIFICATION

3.2.1 Labeling & Identification

A. All labeling shall comply with ANSI/TIA-606 and Section 27 05 53 – Identification for Communications Systems.
B. Machine-printed labels only; handwritten labels are not permitted.
C. All racks, patch panels, outlets, cables, and equipment shall be labeled in accordance with Section 27 05 53 – Identification for Communications Systems, as well as the labeling requirements specified in the applicable Division 27 and Division 28 sections.

3.2.2 Testing & Certification

A. All Division 27 systems requiring testing and certification shall comply with the requirements specified in their respective sections.
B. All test results shall be submitted to the District ITS Project Manager before system acceptance.

3.3 CLEANUP & RESTORATION REQUIREMENTS

3.3.1 General Cleanup Standards

A. The Contractor shall maintain clean and orderly work areas throughout the project duration, ensuring that tools, materials, and equipment are stored safely and trash is regularly removed.
B. During the course of work, the Contractor shall:
   1. Cover and protect floors, furniture, and sensitive equipment to minimize dust and prevent damage.
   2. Use drop cloths, floor protection, and dust containment methods where needed.
   3. Prevent debris accumulation in hallways, stairwells, and emergency exits, maintaining safe and clear access.
C. Post-Work Daily Cleanup
   1. Daily Cleanup Requirement:
      - At the end of each workday, the Contractor shall perform a full cleanup of all work areas, ensuring:
      - Ceiling tiles are reinstalled, with damaged tiles replaced immediately.
      - Pull box covers, LB fittings, and access panels are secured in place.
      - Tools, materials, and equipment are properly stored or removed from the site.
      - Trash, debris, and waste materials are removed from the job site.
      - Walkways, corridors, and occupied spaces are left in a clean and safe condition.
   2. Nightly Walkthrough:
      - The Contractor shall conduct a self-inspection at the end of each shift to verify compliance with cleanup requirements.
      - Any deficiencies identified must be addressed immediately, ensuring the site is ready for normal use by building occupants the next day.

3.3.2 Post-Work Final Cleanup & Restoration

A. Ceiling Tiles:
   1. Reinstall all ceiling tiles that were removed during work.
   2. Replace broken, damaged, or stained tiles with matching ceiling tiles.
B. Pull Boxes & LB Fittings:
   1. Securely reinstall all pull boxes and LB covers.
   2. Ensure labeling remains visible and legible, as required by Section 27 05 53.
C. Wall & Ceiling Repairs:

1. Patch and repair any damage to walls and ceilings, including holes, scratches, and marks.
2. Repaint surfaces to match existing finishes, using color-matched paint and consistent textures.
3. Remove all markings, including pencil marks, tape residue, and layout lines.

D. Room Condition:
1. Leave work areas free of dust, debris, and trash.
2. Vacuum floors, wipe down surfaces, and dispose of all waste materials offsite.
3. Do not use the District's trash receptacles or dumpsters without prior approval.

E. Final Walkthrough:
1. Conduct a walkthrough with the District ITS Project Manager to verify all cleanup tasks are completed.
2. Address any deficiencies identified during the walkthrough immediately.

3.3.3 Additional Requirements for Occupied Spaces

A. When working in occupied areas, the Contractor shall:
1. Minimize disruption to building occupants, including noise, dust, and access limitations.
2. Coordinate with facility staff to schedule work during non-peak times when possible.
3. Notify the ITS Project Manager if work cannot be completed without impacting building operations, to arrange alternative solutions.

3.3.4 Damage Responsibility & Pre-Work Documentation

A. Contractor's Responsibility for Damages:
1. The Contractor is responsible for repairing or replacing any damage caused by their work, including but not limited to:
- Walls, ceilings, and floor finishes.
- Ceiling tiles, lighting fixtures, and HVAC components.
- Existing equipment, furniture, and building infrastructure.
2. Repairs must restore surfaces to their original condition or as approved by the District ITS Project Manager.

B. Pre-Work Documentation:
1. It is highly recommended that the Contractor document all work areas prior to the start of work.
2. Pre-work documentation should include:
- High-resolution photos of existing conditions.
- Written descriptions of pre-existing damage, if applicable.
- Date-stamped records to support existing condition claims.

C. Reporting Pre-Existing Damage:
1. Any existing damage must be reported to the District ITS Project Manager prior to the start of work.
2. Document all pre-existing conditions with photos and written descriptions, including:
- Ceiling tiles with stains or cracks.
- Walls with holes, scratches, or peeling paint.
- Existing equipment with visible damage or defects.
3. Failure to document pre-existing damage may result in the Contractor being held responsible for repairs.

3.4 FINAL ACCEPTANCE & DOCUMENTATION

3.4.1 **General Requirements**

A. Final acceptance of the project will not be granted until all work has been completed, tested, and reviewed by the District ITS Project Manager.

3.4.2 Closeout Documentation

A. The Contractor shall submit all required closeout documentation per Section 27 05 50 – Communications Documentation & Submittals.

B. All as-built drawings, test results, warranty documentation, and submittals must be provided as outlined in 27 05 50.

C. **Final acceptance will not be granted until all required documentation has been received and approved.**

3.4.3 **System Testing & Certification**

A. All installed systems must pass final testing and certification before acceptance.
   1. Structured cabling systems shall be tested per industry standards, with results submitted in accordance with 27 05 50.
   2. Any system that fails testing must be repaired or replaced at the Contractor's expense before project closeout.

3.4.4 **Final Walkthrough & Punch List Resolution**

A. A final walkthrough will be conducted with the District ITS Project Manager to verify compliance with all specifications.
B. The Contractor shall correct all punch list items before project closeout.
C. Once all issues have been resolved, the ITS Project Manager will issue formal written acceptance of the project.

END OF SECTION

SECTION 27 05 26 - Grounding & Bonding For Telecommunications Systems

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section outlines the baseline standards for grounding and bonding of all for low voltage communications systems. The specific requirements found in related sections supersede requirements listed in this section.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27, and Division 28 sections and requirements in their entirety. For list of all Division 27, and Division 28 sections see section 1.3 of 27 00 00. If section 27 00 00 was not provided contact Districts ITS Department Project Manager to receive complete copy of the Division 27, and Division 28 sections.

1.3 RELATED DOCUMENTS

1.3.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 QUALIFICATIONS

1.4.1 The Installing Electronic Systems Contractor shall hold a valid State of California C-7 or C-10 license for all low voltage installations and a State of California C-10 License for any related high-voltage applications, shall have been in business of furnishing and installing communication systems of this type for at least ten years, and capable of being bonded to assure the District of performance and satisfactory service during the guarantee period.

1.4.2 The Installing Electronic Systems Contractor shall be a factory authorized distributor and warrantee station for the brand of equipment offered and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall maintain a spare set of all major parts for the system at all times.

1.5 DEFINITIONS

1.5.1 BCT: Bonding conductor for telecommunications.

1.5.2 BDF: Building Distribution Frame

1.5.3 BICSI: Building Industry Consulting Service International.

1.5.4 CEC: 2025 California Electrical Code (CCR Title 24, Part 3) based on the National Electrical Code.

1.5.5 EMT: Electrical metallic tubing.

1.5.6 IDF: Intermediate Distribution Frame

1.5.7 MDF: Main Distribution Frame

1.5.8 LAN: Local area network.

1.5.9 RCDD: Registered Communications Distribution Designer.

1.5.10 TGB: Telecommunications grounding busbar.

1.5.11 TMGB: Telecommunications main grounding busbar.

1.6 ACTION SUBMITTALS

1.6.1 Product data for each type of product used.

1.6.2 Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.6.3 Include dimensioned plan and elevation views of telecommunications equipment rooms, labeling each individual component. Show equipment rack assemblies, method of field assembly, workspace requirements, and access for cable connections.

1.6.4 System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by District.

1.6.5 Cabling Administration Drawings.

1.7 INFORMATIONAL SUBMITTALS

1.7.1 As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following: BCT, TMGB, TGBs, and routing of their bonding conductors.

1.7.2 Qualification Data: For Installer.

1.7.3 Qualification Data: For testing agency and testing agency's field supervisor.

1.7.4 Field quality-control reports.

1.7.5 Closeout Submittals

A. Result of the bonding-resistance test at each TMGB/TGB and its nearest grounding electrode.

1.8 QUALITY ASSURANCE

1.8.1 Products, services, and materials provided by the Contractor shall be new and of high quality and free of faults and defects.

1.8.2 Provide products, services, and materials as specified in this document. Substitution of products, services, or materials must receive approval in writing from the Districts ITS Department Project Manager.

1.8.3 Contractor shall warranty all work executed and materials furnished shall be free from defects of material and workmanship for a period of two (2) years from acceptance date of Contract Completion. Immediately upon receipt of written notice from the District, Contractor shall repair or replace at no expense to the District: Any defective material or work which may be discovered before final acceptance or work, or within warranty period; any material or work damaged thereby; and adjacent material or work which may be displaced in repair or replacement.

1.8.4 Examination of or failure to examine work by the District shall not relieve Contractor from these obligations.

1.8.5 If Contractor fails to repair or replace material or work indicated above within 7 days of receiving written notice, the District, with its own personnel or by Contract, may proceed with repair or replacement and assess cost against Contractor, if Contractor does not respond accordingly.

1.8.6 Persons skilled in trade shall install system in accordance with best trade practice. Further, in accordance with all applicable building codes. Contractor and all contractors' employees terminating cable to wiring terminating devices shall be certified by the manufacturer of the wiring device. Copies of certificates shall be provided to the District Representative prior to the start of work.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

2.1.1 Comply with J-STD-607-B.

2.2 CONDUCTORS

2.2.1 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. Harger Lightning and Grounding.
B. Panduit Corp.
C. Tyco Electronics Corp.
D. Comply with UL 486A-486B.

2.2.2 Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

A. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
B. Cable Tray Equipment Grounding Wire shall be No. 6 AWG and not longer than 12 inches (300 mm). The jumper shall be a wire and shall have a crimped grounding lug with two holes and long barrel for two crimps. Attach with grounding screw or connector provided by cable tray manufacturer.

2.2.3 Bare Copper Conductors:

A. Solid Conductors: ASTM B 3.
B. Stranded Conductors: ASTM B 8.
C. Tinned Conductors: ASTM B 33.

2.3 CONNECTORS

2.3.1 Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

2.3.2 Retain "Manufacturers" Paragraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

2.3.3 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. Burndy; Part of Hubbell Electrical Systems.
B. Chatsworth Products, Inc.
C. Harger Lightning and Grounding.
D. Panduit Corp.
E. Tyco Electronics Corp.

2.3.4 Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467. Electroplated tinned copper, C and H shaped.

2.3.5 Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

2.3.6 Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

2.3.7 Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

2.4.1 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. Chatsworth Products, Inc.
B. Harger Lightning and Grounding.
C. Panduit Corp.

2.4.2 TMGB

Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-B.

A. Predrilling shall be with holes for use with lugs specified in this Section.
B. Stand-off brackets must provide a 4-inch (100-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
C. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.4.3 TGB

Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-B.

A. Predrilling shall be with holes for use with lugs specified in this Section.
B. Mounting Hardware: Stand-off brackets that provide at least a 2-inch (50-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.)
C. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.4.4 Rack and Cabinet Grounding Busbars:

Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-B.

A. Predrilling shall be with holes for use with lugs specified in this Section.
B. Cabinet-Mounted Busbar - Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
C. Rack-Mounted Horizontal Busbar - Designed for mounting in 19-inch (483-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.

PART 3 - EXECUTION

3.1 CONDUCTORS

3.1.1 Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

3.1.2 Equipment Grounding Conductor Terminations shall use bolted connectors.

3.1.3 Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).

3.1.4 Grounding and Bonding Conductors:

A. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.

B. Install without splices.
C. Support at not more than 36-inch (900-mm) intervals.
D. Conductors shall not be installed in EMT unless otherwise indicated.

3.2 CONNECTIONS

3.2.1 Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

3.2.2 Stacking of conductors under a single bolt is not permitted when connecting to busbars.

3.2.3 Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

A. Use crimping tool and the die specific to the connector.
B. Pretwist the conductor.
C. Apply an antioxidant compound to all bolted and compression connections.
D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

3.2.4 Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 6 AWG bonding conductors.

3.2.5 Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.

3.2.6 Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.3 IDENTIFICATION

3.3.1 All labeling will comply with Section 27 05 53

3.3.2 Labels shall be preprinted or computer-printed type.

3.3.3 Label each telecommunications conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.4 FIELD QUALITY CONTROL

3.4.1 Testing of system must be completed by qualified testing agency to perform tests and inspections.

3.4.2 Perform tests and inspections.

3.4.3 Tests and Inspections:

A. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
B. Test the bonding connections of the system using an AC earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
C. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
D. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

E. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB. Maximum acceptable AC current level is 1 A.

F. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify District's ITS – Systems Administration department promptly and include recommendations to reduce ground resistance.

3.4.4 Grounding system will be considered defective if it does not pass tests and inspections.

3.4.5 Prepare test and inspection reports.

3.5 WARRANTY

3.5.1 The entire system shall be warranted free of mechanical or electrical defects for a period of one (1) year after final acceptance of the installation. Any material showing mechanical or electrical defects shall be replaced promptly at no expense to the District.

3.5.2 The contractor shall maintain a competent service organization and shall, if requested, submit a service maintenance agreement to the District after the end of the guarantee period.

3.5.3 A typewritten notice shall be posted at the equipment rack which shall indicate the firm, address and telephone number to call when service is necessary. The notice shall be mounted in a neatly finished metal frame with a clear plastic window and securely attached to the inside of the door.

3.5.4 Special Warranty: The contractor shall warrant the cabling system against defects in workmanship for a period of one year from the date of system acceptance. The warranty shall cover all labor and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. All warranty repairs shall be done within fourteen days from being notified in writing by the District. This warranty shall be provided at no additional cost to the District.

END SECTION

SECTION 27 05 28 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section outlines the baseline standards for all above-ground low voltage communications systems pathways and raceways. The specific requirements found in related sections supersede requirements listed in this section.

1.1.2 Installs must comply with NEC/CEC Sections 800.24, 300.4, and 300.11.

1.1.3 All abandoned cables within pathways must be removed unless otherwise directed by the District ITS Project Manager. Pathways shall not be used to store or contain decommissioned or non-operational cables.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27, and Division 28 sections and requirements in their entirety. For list of all Division 27, and Division 28 sections see section 1.3 of 27 00 00. If section 27 00 00 was not provided contact Districts ITS Department Project Manager to receive complete copy of the Division 27, and Division 28 sections.

1.2.2 For underground pathways, including trenching, burial depths, and encasement, refer to Section 27 05 43.

PART 2 - PARTS

2.1 PRE-APPROVED PARTS

2.1.1 Refer to **Section 27 06 50 – Approved Communications Products** for a list of approved materials.

2.2 PROHIBITED PARTS

THE FOLLOWING PATHWAY COMPONENTS ARE STRICTLY PROHIBITED:

A. Split-Y conduit fittings or other conduit intercept methods.
B. Pull elbows in any pathway.
C. Bridle rings for cable support (with or without saddles)

2.3 METALLIC AND NON-METALLIC RACEWAY SYSTEMS

2.3.1 2.5.1 General Requirements

A. All raceways shall be UL-listed and designed for communications cabling.
B. Raceway systems must be compatible with the installed structured cabling system to maintain proper bend radius and fill ratios.

2.3.2 2.5.2 Raceway Color & Aesthetic Considerations

A. Raceway color shall match the décor of the installation space.
B. Part numbers provided in Section 27 06 50 – Approved Communications Products are for ivory-colored components but may be substituted with an appropriate color to match the installation environment.
C. When adding to an existing raceway system, the new components shall match the existing color.
D. If wall color does not match an available raceway color, the raceway shall be painted to match the background.

2.3.3 2.5.3 Approved Raceway Types

The following raceway types are permitted for use:

A. Metallic Surface Raceway (Steel or Aluminum)

1. UL-listed for communications cabling.
2. Used where additional mechanical protection is required.
3. Shall include factory-recommended fittings for bends, junctions, and transitions.

B. Non-Metallic Surface Raceway (PVC or Composite)
1. Permitted for use only when in-wall cabling is not feasible.
2. Must be UL-listed and sized appropriately for bend radius and fill ratio.
3. Multi-channel raceway is preferred for installations requiring both power and data cabling.

2.3.4 Prohibited Raceway Installations

A. The following raceway applications are strictly prohibited:
B. Use of non-UL-listed raceway products.
C. **Modifying raceway systems** (e.g., drilling new knockouts, cutting openings without manufacturer approval).

2.4 J-HOOKS

2.4.1 General Requirements

A. J-hooks shall be UL-listed and designed for use with Category 6 (or higher) and fiber optic cabling.
B. J-hooks must have a smooth, wide-bearing surface to prevent cable damage and signal loss.
C. J-hooks shall have an anti-corrosive finish suitable for the installed environment.

2.4.2 Required Features

A. Retainer Clip: J-hooks must include a built-in retainer clip to prevent cables from slipping.
B. Cable Support Base: J-hooks shall have a minimum 0.5-inch-wide base with smooth, rounded edges.

2.4.3 Prohibited J-Hook Types

The following J-hooks are strictly prohibited:

A. J-hooks without a retainer clip.
B. J-hooks wider than 2 inches internally, unless explicitly approved by the District ITS Project Manager.
C. Wire loop-style J-hooks without a flat support base.
D. Bridle rings (with or without saddles).

2.5 CONDUIT

2.5.1 2.7.1 General Requirements

A. All conduit shall be UL-listed and comply with NEMA, NEC, and CEC requirements for telecommunications pathways.
B. Minimum trade size: 3/4.
C. Maximum trade size: 4 unless otherwise approved by the District ITS Project Manager.
D. Approved Conduit Types:
1. Rigid Metal Conduit (RMC) – Steel or Aluminum.
2. Intermediate Metal Conduit (IMC).
3. Electrical Metallic Tubing (EMT) – Permitted in indoor dry locations only.

2.5.2 Prohibited Conduit Types

The following conduit types are strictly prohibited unless explicitly approved by the District ITS Project Manager for seismic or other special conditions:

A. Flexible Metal Conduit (FMC).
B. Liquidtight Flexible Metal Conduit (LFMC).
C. Electrical Non-Metallic Tubing (ENT) unless used in approved concrete applications.
D. Schedule 40 of Schedule 80 PVC installed above-ground in exposed locations.

2.6 CABLE TRAYS & WIRE BASKETS

2.6.1 General Requirements

A. All cable trays and wire baskets shall be UL-listed and NEMA-rated for use in low-voltage communications systems.
B. Trays shall comply with NEC 392, NEMA VE 1, and ANSI/TIA-569 standards.
C. Cable trays and wire baskets shall be constructed of corrosion-resistant materials suitable for the installed environment.
D. Cable trays must be designed for future expansion, with a minimum of 25% additional capacity beyond initial cable loads.

2.6.2 Approved Types of Cable Trays & Wire Baskets

A. The following cable tray types are approved for installation:
B. Wire Basket Cable Trays:
   1. Minimum 2-inch x 4-inch grid size to allow secure cable support.
   2. Made of zinc-plated, powder-coated, or stainless steel for corrosion resistance.
   3. Shall support communications cables only (power and mixed-use trays are not permitted).
C. Ladder Cable Trays:
   1. Aluminum or steel construction, NEMA 12A, 12B, or 12C rated.
   2. Side rails must have a minimum height of 4 inches.
   3. Rung spacing must not exceed 9 inches on center.

2.6.3 Prohibited Tray & Basket Types

The following cable tray systems are not allowed:
A. Wire baskets without corrosion protection (must be powder-coated, zinc-plated, or stainless steel).
B. Cable trays designed for power wiring (communications cabling must have separate pathways).
C. Trays with rung spacing greater than 9 inches (for ladder trays).

2.6.4 Fittings & Accessories

A. Factory-fabricated bends, T-junctions, and reducers shall be used whenever possible.
B. Splices shall use manufacturer-approved splice kits to maintain structural integrity.
C. Bonding jumpers must be provided for all splices, expansion joints, and tray terminations per NEC 392.60.
D. Trays shall include end caps or cable retainers to prevent unintended cable movement.

2.7 BACK BOXES

2.7.1 All back boxes shall be appropriately sized to support cable bend radius and fill capacity without damage to cables.

2.7.2 Flush Mount

A. New Construction: 2-1/2” Deep 4-11/16” (5S) large capacity box with trade size 3/4, 1 & 1-1/4 knockouts. Use the appropriate mud ring that corresponds to the faceplate being installed.
B. Existing Construction: For flush mount install in existing construction a low voltage old work bracket may be utilized.
C. Use of sectional or gang-able boxes is strictly prohibited.

2.7.3 Indoor Surface Mount:

A. Individual boxes shall be single or double gang, unless otherwise specified.
B. Boxes shall be made of metal or PVC, depending on the application and contract documents.
C. Raceway-mounted boxes shall match the color of the installed raceway for a consistent aesthetic.

2.7.4 Outdoor:

A. Standard weatherproof deep metal back box with trade size 3/4 and 1 knockouts.
B. Must be listed for wet locations

2.8 PULL BOXES. WIREWAYS. GUTTERS, & CONDUIT BODIES

2.8.1 All pull boxes, wireways, gutters, and conduit bodies must be appropriately sized to support cable bend radius and maintain proper fill ratios.

2.8.2 Damp or Wet Locations

A. All boxes, conduit bodies, and fittings in wet locations must be sealed to prevent moisture from entering or accumulating inside.
B. Boxes, conduit bodies, and fittings installed in wet locations must be listed for wet use.
C. Approved drainage openings shall not exceed 6 mm (¼ inch) and must be installed per manufacturer recommendations.
D. Outdoor enclosures shall be constructed of steel and must be NEMA 3R-rated for protection against rain

2.8.3 Conduit Bodies

A. For conduits larger than trade size 3/4, telecommunications conduit bodies (e.g., Southwire SmartLB or equivalent) shall be used to ensure proper bend radius compliance.
B. Standard pull elbows are strictly prohibited due to excessive cable stress and violation of minimum bend radius requirements.

PART 3 - INSTALLATION

3.1 GENERAL INSTALLATION

3.1.1 All exposed conduits, raceways, and boxes shall be painted to match the area behind them unless otherwise noted.

3.1.2 Non-metallic raceways shall match the décor where installed. If not available, default to white or ivory unless otherwise noted.

3.1.3 All exposed conduits, raceways, and boxes shall be installed in an aesthetically pleasing manner at right angles or parallel to the walls or structures, concealing the pathway whenever possible.

3.1.4 Zip ties are prohibited for bundling low-voltage cables. Velcro straps must be used for wire management.

3.1.5 Cables shall be properly supported and must follow an approved pathway.

3.1.6 Pathways exceeding 180° of bends are not permitted.

3.2 PATHWAY FILL RATIOS:

3.2.1 All pathways shall comply with the maximum fill ratios requirements outlined in Section 27 00 00 Part **Error! Reference source not found. Error! Reference source not found.**

3.3 3.1.7 PATHWAY ROUTING REQUIREMENTS

3.3.1 General Routing Guidelines:

A. All conduits, raceways, cable trays, and J-hooks shall be installed parallel or perpendicular to walls, ceilings, and structural elements.
B. Pathways shall run in straight lines whenever possible to minimize complexity and maintain a clean appearance.
C. Diagonal routing of pathways is strictly prohibited, except where structural constraints make it unavoidable.
D. When bends or changes in direction are necessary, use factory-made bends or smooth transitions to maintain pathway integrity.

3.3.2 Aesthetic & Functional Considerations:

A. Pathways installed in visible areas shall be installed neatly, aligned with existing building features such as beams, ceiling grids, or architectural elements.
B. Pathways running on exposed walls should be centered or aligned with existing lines or edges to avoid a cluttered appearance. Group pathways together whenever possible.

3.3.3 Clearance & Accessibility:

A. Maintain clearances outlined in Section 3.5 Clearance Requirements for Pathways.
B. Pathways shall not obstruct access to equipment, panels, or emergency egress routes.
C. Provide adequate space for future installs and maintenance activities.

3.3.4 Backboard Installations:

A. When installing pathways on backboards, all pathways must be vertical or horizontal, avoiding diagonal runs.
B. Pathways on backboards shall only run horizontally at the top or bottom edges of the board, or where specifically indicated in project drawings.
C. Mid-board horizontal pathways runs are not permitted unless explicitly approved by the District ITS Project Manager.
D. Maximize available space on backboards and avoid obstructing other equipment or creating pinch points.

3.4 ABANDONED CABLES IN PATHWAYS:

3.4.1 The term abandoned cable and the corresponding requirements are outlined in 27 00 00 – Communications.

3.4.2 Abandoned cabling shall be removed in accordance with 27 00 00.

3.4.3 Abandoned cables must be removed from the portions of the pathway that are directly impacted by the new work, unless otherwise specifically noted in the contract documents.

3.4.4 Pathways containing abandoned cables shall not be used for new installations unless all abandoned cables in the affected segments have been removed.

3.4.5 If abandoned cables cannot be removed due to inaccessibility, they shall be documented and marked per 27 00 00.

3.4.6 If a pathway with abandoned cable is to remain in use, the Contractor shall provide written justification to the District ITS Project Manager for review and approval.

3.5 CLEARANCE REQUIREMENTS FOR PATHWAYS

3.5.1 Maintain accessibility and prevent obstructions:

A. Maintain 6 inches of vertical clearance above T-bar ceilings.
B. Maintain 12 inches of vertical clearance above cable trays and raceways.
C. Maintain 3 inches of vertical clearance above J-hook pathways.
D. Pathways shall not obstruct ceiling-mounted systems, including HVAC, fire suppression, or lighting.

3.6 SUPPORTING DEVICES

3.6.1 Provide ICC-ES Code Compliant corrosion resistant anchors & fasteners in compliance with ACI, ASTM and CBC as applicable to installed locations. Submit appropriate anchors and fasteners as manufactured by Hilti/DeWalt/Redhead or approved equal with ICC- ES approval.

3.6.2 Install conduit and raceway support and spacing in accordance with CEC.

3.6.3 Install multiple conduit runs on common hangers.

3.7 CONDUIT & RACEWAY

3.7.1 General Requirements

A. Conduits shall be installed per NEC, CEC, CFC, and all local codes.
B. Raceway routing shown on drawings is approximate; adjustments may be required to complete the system.
C. **No more than 180° worth of bends** shall be installed between pull boxes. If additional bends are required, a pull box must be added.
D. Conducts shall not be installed on top of horizontal surfaces located less than 10 feet above finished floor (AFF), including but not limited to walkways, curbs, ramps, mow strips, and floors. Exceptions shall only be permitted when explicitly approved in writing by the District ITS Project Manager prior to construction.
E. Horizontal conduit/raceway over 3' from the floor shall be mounted within 6" of the ceiling, following ceiling lines.
F. Underground conduit installations must comply with Section 27 05 43 – Underground Pathways.
G. Install pull strings in all conduits, except sleeves and nipples.
H. **All conduits must be capped** to prevent the entry of dirt and moisture before cable installation.

3.7.2 Preparation for Use of Existing Conduits

A. General Requirements
1. All existing conduits planned for use as part of this Contract shall be tested, cleaned, and verified before installing any new cables.
2. The contractor shall determine if the conduit is empty or occupied (in-use) before proceeding.
3.
4. If an existing conduit is not suitable for use, the contractor shall notify the District ITS Project Manager for resolution before proceeding with cable installation.

B. Empty Conduits (Previously Occupied or Spare)
1. Testing & Cleaning
- Before installing cables, all empty conduits (whether previously occupied or originally installed as spares) shall be tested using a mandrel and brush test.
- Mandrels shall be at least 12 inches long and 0.25 inches smaller than the conduit's inside diameter at the center, tapering to 0.5 inches smaller at the ends.
- If the mandrel cannot pass, the contractor shall proceed with obstruction removal methods.

2. Obstruction Removal Process
If the conduit is blocked, attempt the following in order:
- Rodding the Raceway – Insert rigid/semi-rigid rods to push through minor obstructions.
- Disassembly if Accessible – If the obstruction cannot be cleared, disassemble accessible conduit sections (e.g., removable fittings, junction boxes) to manually remove the blockage.
- Conduit Replacement – If the obstruction cannot be removed, the contractor shall replace the affected conduit segment per District ITS Project Manager approval.

3. Final Cleaning
- After clearing, pull a mandrel and brush through the entire conduit.
- Use compressed air or a vacuum to remove dust or debris.
- Install a pull string or mule tape in all empty conduits for future use.

C. Occupied (In-Use) Conduits
1. Pre-Installation Inspection
- Visually inspect the conduit where accessible (vaults, pull boxes, terminations).
- Identify cable types and conditions (e.g., fiber optic, copper, damaged insulation).
- Determine available space based on fill ratios per NEC/CEC.

2. Cable Protection During Installation
- If additional cables are to be installed in an occupied conduit, the following precautions apply:
  ◊ Existing cables shall not be displaced, crushed, or over-tightened.
  ◊ Lubricants approved for existing cable types shall be used to minimize friction.
  ◊ Use low-force mechanical pulling methods to prevent damage.

3. Reporting & Verification
    - The contractor shall document and report any:
        - ◊ Existing conduit damage (e.g., crushed, corroded, water infiltration).
        - ◊ Excessive fill that prevents additional cable installation.
        - ◊ Signs of previous cable damage (e.g., insulation cracking, excessive tension).
    - If any issues prevent reuse, notify the District ITS Project Manager for approval before proceeding.

3.7.3 Conduit Types & Restrictions

A. Flexible Metallic Conduit (FMC) & Liquidtight Flexible Metal Conduit (LFMC)
1. Permitted:
    - When required for seismic bracing or vibration isolation.
        - ◊ Lenth not to exceeded 1' foot in length or the minim length allowed by the AHJ, whichever is shorter.
    - With prior approved in writing by the ITS Project Manager.
2. Not Permitted
    - In any other install situation

B. Electrical Metallic Tubing (EMT)
1. Permitted:
    - Indoors, above ceilings and within walls.
    - Outdoors above 10 feet, provided that weatherproof fittings are used.
2. Not Permitted:
    - Outdoors below 10 feet, due to risk of mechanical damage.
    - On rooftops or breezeways if smaller than 2 inches in diameter.
    - In any location subject to severe physical damage.

C. Rigid Metal Conduit (RMC) – Steel or Aluminum
1. Permitted:
    - Anywhere EMT is allowed.
    - Below 10 feet outdoors.
    - Must be used in any areas subject to severe physical damage (e.g., parking lots, mechanical rooms, storage rooms).

D. Rigid Non-Metallic Conduit (PVC) – Schedule 40/80
1. Permitted:
    - Only for underground applications. (Refer to Section 27 05 43 – Underground Pathways.)
    - With prior approved in writing by the ITS Project Manager.
2. Not Permitted:
    - Above ground, unless otherwise specified.

E. Non-Metallic Raceway Systems
1. Permitted:
    - Only indoors, where running cables inside walls is not feasible.
    - Requires approval from the ITS Project Manager.
2. Not Permitted:
    - Outdoors
    - Any place subject to physical damage.

3.7.4 Minimum Conduit Sizing

A. General Minimum Size: All conduits should be at least ¾-inch in diameter.
B. Between Rooms/Buildings: Conduits running between rooms or different buildings must have a minimum diameter of 2 inches.
C. Outdoor Device Connections: For conduits serving a single outdoor device (such as a camera or wireless access point), a ¾-inch minimum is required.

D. MDF, BDF, or IDF Rooms: For conduits connecting Main Distribution Frames (MDF), Base Distribution Frames (BDF), or Intermediate Distribution Frames (IDF), install at least two conduits, each with a minimum diameter of 2 inches.
E. Multi-Outlet Surface Raceways: For conduits that connect to multi-outlet surface raceways, provide at least one 1½-inch conduit for every 18 feet of raceway.
F. New Construction Wall Boxes: In new construction, install a conduit no smaller than 1-1/4 inches from the wall box to the stub-out above the ceiling.

3.7.5 Pathway Routing & Installation

A. All conduits must follow building structural lines and be installed parallel or perpendicular to walls.
B. Raceway installed above ceilings shall follow building structural lines.
C. Underground conduit installation shall comply with Section 27 05 43.
D. Maintain 12-inch clearance between conduit and surfaces exceeding 104°F (e.g., steam pipes, HVAC units).
E. Install factory elbows for bends in metal conduit larger than 2 inches.
F. Use of pull elbows is expressly prohibited.
G. Use of split Y conduit fittings or other conduit intercept methods is expressly forbidden. When joining multiple conduits together, a pull box or vault is required.

3.7.6 Mounting & Support Requirements

A. General Mounting & Support Requirements
   1. Pathways must be securely mounted using the manufacturer's recommended spacing and fastening methods to ensure structural integrity and longevity.
   2. All mounting and support installations shall comply with Division 27 standards and the CEC.
   3. Attachment to structural elements shall follow CEC Article 300.11, ensuring independent support where required.
   4. Fasteners, brackets, and hangers shall be rated for the intended load and environmental conditions.
   5. Seismic bracing shall be installed per CBC & DSA requirements where applicable, and must also comply with manufacturer's seismic installation guidelines.
B. Approved Support & Fastening Methods
   1. All pathways shall be properly supported using ICC-ES code-compliant anchors & fasteners in compliance with ACI, ASTM, and CBC standards.
   2. Pathways shall be grouped together using common supports where feasible, provided it does not exceed load ratings.
C. Cable Tray & Baskets
   1. Cable trays and wire baskets must be securely attached to the building structure using one of the following approved methods:
      - Threaded rod hangers (minimum 3/8") attached to concrete anchors or structural steel.
      - Wall-mounted brackets, beam clamps, or other manufacturer-approved supports.
      - Seismically rated trapeze hangers where required.
      - Install seismic bracing as required in seismic zones per DSA, ASCE 7-16, and NEC 392.18(C).
   2. Support spacing shall not exceed the manufacturer's recommendations and shall be no greater than 5 feet on center.
D. Prohibited Support & Attachment Methods
   1. Pathways shall NOT be supported by wire, zip ties, or perforated straps.
   2. Pathways shall NOT be attached to ceiling support wires, sprinkler pipes, or other non-structural elements.
E. Special Considerations for Wet & Outdoor Locations
   1. Avoid moisture traps; install junction boxes with drain fittings at low points in conduit runs located in wet or outdoor locations.
   2. Outdoor conduit runs shall be mounted to prevent water pooling at low points.

3.7.7 Conduit & Pathway Installation Guidelines

A. Raceways shall be cut square using a saw or pipe cutter. All edges must be de-burred before installation.
B. All conduit connections must be properly secured and brought to the shoulder of the fitting.
C. Stub-outs above ceilings shall extend at least 6 inches above the finished ceiling and be properly capped or oriented to prevent debris entry
D. All conduit and raceway fittings, transitions, and connectors must be manufacturer-approved and rated for the intended environment.
E. In damp or wet locations, use weatherproof fittings and sealing locknuts to prevent moisture intrusion.
F. Install expansion and deflection fittings where raceways cross seismic or building expansion joints.
G. Plastic bushings shall be installed on all conduits before pulling cables to prevent cable damage.

3.7.8 Conduit Installed on Roofs

A. General Requirements
   1. All conduits installed exposed on roofs shall be supported on redwood conduit sleepers to prevent damage to the roof membrane and allow for thermal expansion and contraction.
   2. Conduits shall not block or interfere with:
      - Roof hatches, doors, ventilation openings, dampers
      - Equipment access panels/doors
      - Roof water drainage paths
   3. Conduits shall be installed with appropriate expansion/deflection fittings where required.
B. Conduit Support & Sleeper Requirements
   1. Sleeper Spacing
      - Conduit sleepers shall be placed at a maximum of 5 feet on center along the entire length of the conduit.
      - Additional sleepers shall be installed under conduit expansion/deflection fittings, at each junction box, and within 24 inches of each conduit bend.
   2. Sleeper Construction
      - Fabricated from clear solid redwood, 4 inches by 4 inches (nominal).
      - Minimum sleeper length: 24 inches.
      - Sleeper shall extend a minimum of 9 inches past the conduit attached to it.
   3. C-Channel Support
      - Each sleeper shall have a continuous “C” channel rigidly bolted along its top length.
      - Conduits shall be loosely fastened to the sleeper’s “C” channel with pipe clamps to allow for thermal expansion movement.
C. Sleeper Pad Installation
   1. Pad Requirements
      - Sleeper pads shall be installed under each sleeper to protect the roofing system.
      - Pads shall extend at least 6 inches past each side of the sleeper.
      - The pad shall be semi-rigid mineral surfaced composition board, at least 0.375 inches thick, bituminous-impregnated, and manufactured for the roofing material used.
   2. Installation Method
      - Remove any roofing ballast (gravel) under the sleeper pad before installation.
      - DO NOT puncture or damage the roof membrane during installation.
      - Set sleepers and sleeper pads in non-hardening mastic (minimum 0.25 inches thick), complying with ASTM D1227.
      - Apply continuous uniform coverage of mastic on all surfaces of the sleeper and the contact surface of the sleeper pad with the roof.
D. Drainage Considerations
   1. Conduit sleepers shall be positioned perpendicular to the roof slope to prevent obstruction of drainage flow.

2. If conduit routing prevents perpendicular placement, provide two separate sleeper pads with a minimum 3-inch-wide water drainage gap between the sleepers.
3. Align the water drainage gap with the roof slope to allow unimpeded water flow between the pads.

3.7.9 Raceway System Requirements

A. Raceway systems shall only be installed using manufacturer-approved brackets, transitions, and accessories to ensure system integrity.
B. Field-modified components, homemade supports, or non-approved fasteners are strictly prohibited.
C. All transitions between different raceway types must use manufacturer-specified adapters to maintain proper cable support and prevent sharp edges.
D. Raceways must be securely mounted using the manufacturer's recommended spacing and fastening methods.
E. Raceway covers shall be fully seated and secured to prevent accidental dislodging.

3.8 NON-CONTINUOUS CABLE SUPPORTS (J-HOOKS)

3.8.1 General

A. The portions of cables installed without raceways or cable tray supports shall be installed with J-hook cable supports.
B. Cables shall be loosely bundled in groups not greater than 40 cables.
C. Static load per J-Hook shall not exceeded 20 lbs.
D. **"Bridle rings" with or without saddles are not approved for cable support and are expressly forbidden**
E. Follow manufacturer's recommendations for allowable fill capacity for each size of cable hook.

3.8.2 Attachment Methods

A. Cable supports shall be self-supporting and utilize independent wires, support rods and associated hardware for suspension. At no point shall cable(s) rest on acoustic ceiling grids, T-bars, ceiling support wires, acoustical panels, or other components of the suspended ceiling.
B. **Attaching directly to T-bar grid, concealed spline grid, flexible or rigid ductwork, HVAC registers, sprinkler piping or fixtures, light fixtures or other non-load-bearing elements is prohibited.**
C. J -hooks shall be securely attached to the building structure using one of the following approved methods:
   1. Beam Clamps – For attachment to steel beams or bar joists.
   2. Built-In Wire Mounting (Winged J-Hooks)
      - Support Wire Material: Minimum 12 AWG galvanized steel support wire, securely anchored to the building structure.
      - Structural Attachment:
        ◊ Support wire shall be secured with a minimum of three full twists at the structural attachment point.
        ◊ Support wires must be independently anchored to the building structure and shall NOT be tied to ceiling grids or other non-structural elements, unless explicitly required by the AHJ (Authority Having Jurisdiction) or local code.
      - Wire Extension Below J-Hook:
        ◊ The straight section of the support wire shall extend a minimum of 3 inches below the J-hook.
        ◊ The end of the wire must be bent upward into a closed loop or hook to eliminate sharp edges and reduce injury risk.
        ◊ The loop shall be at least ½ inch in diameter to prevent accidental punctures or snags.
   3. Hanger Rods (Threaded Rod Mounts) – For suspended J-hooks from overhead structures.
   4. Clevis Hangers – For installations requiring additional vertical adjustment.
   5. Flange Clips (Bat Clips) – For attachment to structural flanges.
   6. Smooth Wire Hangers – Minimum 12 AWG galvanized steel support wire, securely anchored to the building structure (e.g., deck, trusses, or beams).
   7. Concrete Anchors – For direct mounting to concrete surfaces.

D. When using spring steel cable hooks the wire shall be capable of supporting a minimum of 30 pounds with a safety factor of 3 where extra strength is required.

3.8.3 Placement

A. J-hooks shall be installed at intervals of 4 - 5 feet apart to effectively support and distribute the cable's weight and be randomly spaced. Randomly spacing cable supports is considered a best practice for all cable systems to reduce harmonics.
B. Distance between J-hooks shall not exceed 60 inches on center along the entire cable length, to insure less than 6 inches of cable sag between adjacent hooks.
C. J-Hooks shall be placed so that cables are not rest directly on ceilings, ceiling hangers, lighting fixtures, air ducts, piping, or equipment.
D. J-hooks shall be installed with the opening facing upward to properly support cables and prevent sagging.
E. J Hooks shall be designed to control bend radius requirements of the cable categories being installed.
F. When installed along turns or bends, the J-hook shall be mounted with the attachment point on the inside bend of the turn to maintain cable support and prevent excess strain.
G. J-hooks shall be installed so that all cables are above fire-sprinkler systems and shall not be attached to the fire-sprinkler system or any ancillary equipment or hardware. The cable support system and hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
H. Refer to the separation requirements listed in Section 27 15 00 – Communications Horizontal Cabling for minimum distances from electrical power and other electromagnetic sources
I. Where aggregate cable bundle supported by ceiling hung cable hooks exceeds either the rated cable or weight load limit of the J-Hook system, provide ceiling basket tray or additional J-Hooks with their own dedicated support system.

3.9 CABLE TRAYS & BASKETS

3.9.1 General Installation Requirements

A. Unless otherwise specified, all cable trays and wire baskets shall be installed above the T-bar ceiling.
B. Cable trays may be installed exposed in limited-access areas such as mechanical rooms, electrical rooms, and telecommunications rooms (MDF, IDF, BDF).
C. Cable trays and wire baskets must be securely supported, properly grounded, and seismically braced per NEC, CEC, and DSA requirements.

3.9.2 Bends & Changes in Direction

A. Factory-fabricated bends (90°, 45°, horizontal, vertical, etc.) should be used whenever possible.
B. Field-fabricated bends shall be smooth and have at least a 12-inch bend radius or maintain the minimum cable bend radius required per ANSI/TIA-568 & manufacturer recommendations, whichever is greater.
C. Bends must be properly supported and must not cause excessive deflection or strain on cables.
D. Where trays turn horizontally or vertically, additional supports shall be installed within 12 inches of the turn to prevent sagging.

3.9.3 Splices & Expansion Joints

A. All cable tray sections must be properly spliced using manufacturer-approved splicing kits.
B. Splices must not obstruct cable pathways and must maintain a smooth transition for cable pulling.
C. For runs exceeding 100 feet or crossing seismic joints, expansion joints must be installed per NEC 392.18 & ASCE 7-16 seismic requirements.

3.9.4 Grounding & Bonding

A. All trays shall be bonded per NEC 392.60 & TIA-607.
B. A #6 AWG copper bonding conductor shall connect all tray sections to the nearest telecom grounding busbar (TGB).
C. Bonding jumpers shall be installed across every tray splice, expansion joint, and termination point.

3.10 SLEEVES

3.10.1 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

3.10.2 Extend sleeves through floors to a height of 6” above finished floor level. Caulk joint between sleeves and floor.

3.10.3 Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

3.10.4 Seal both sides of sleeve with firestopping compound.

3.11 BACK BOXES

3.11.1 General Installation Requirements

A. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
B. Install stamped steel bridges to fasten flush mounting outlet box between studs.
C. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
D. Install adjustable steel channel fasteners for hung ceiling outlet box.
E. Do not fasten boxes to ceiling support wires or other piping systems.
F. Support boxes independently of conduit.
G. Install multi-gang box where more than one device is mounted together.
H. Install multi-gang box with plaster ring for single device outlets.

3.11.2 Location Requirements

A. Install wall mounted boxes at elevations to accommodate mounting heights. If drawings are provided install as indicated on Drawings.
B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
C. Orient boxes to accommodate wiring devices.
D. For inaccessible Ceiling Areas, install outlet and junction boxes no more than 18 inches from ceiling access panel or from removable recessed luminaire.
E. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

3.12 PULL BOXES, WIREWAYS, GUTTERS & CONDUIT BODIES

3.12.1 General Installation Requirements

A. All pull boxes, wireways, gutters, and conduit bodies shall be installed per NEC 314.28 & CEC requirements.
B. Boxes shall be installed in accessible locations and not obstructed by ceiling tiles, ductwork, or structural elements.
C. Boxes shall not be used for splicing unless approved for that purpose and specified in the project drawings.
D. All boxes must be labeled on as-built drawings per Section 27 05 50.

3.12.2 Minimum Size Requirements

A. Sizing shall comply with CEC Section 314.28 (Minimum Size of Pull and Junction Boxes).
B. Due to the size of communications cables and the required minimum bend radius, telecommunications pull boxes shall follow the sizing rules for 4 AWG or larger conductors, regardless of actual cable size.
C. Straight Pulls:
   1. The length of the box or conduit body must be at least 8 times the largest raceway diameter.
D. Angle or U-Pulls:

1. The distance from each raceway entry to the opposite wall must be at least 6 times the largest raceway diameter in that row.
2. If additional raceways are in the same row, increase the required distance by adding the sum of the diameters of all other raceways in that row.
3. Each row shall be calculated individually, and the row requiring the largest distance shall be used.

3.12.3 Location & Mounting Requirements

A. General Location Requirements
   1. All pull boxes, wireways, gutters, and conduit bodies must be installed in accessible locations per NEC 314.29.
   2. Boxes shall not be obstructed by ceiling tiles, ductwork, or structural elements.
   3. Pull boxes shall not be placed in hazardous locations unless specifically designed for such use.
   4. Where possible, pull boxes shall be located in corridors, equipment rooms, or other serviceable areas to prevent disruption to occupied spaces.
B. Ceiling & Wall Mounting Requirements
   1. Above-ceiling pull boxes must be located no more than 10 feet from an accessible ceiling panel.
   2. Pull boxes mounted in drywall or other finished walls must have an accessible cover that is flush with the finished surface.
   3. For surface-mounted installations, boxes shall be mounted parallel to building lines and secured to structural elements.
C. Outdoor & Wet Location Requirements
   1. All outdoor pull boxes shall be NEMA 3R rated steel enclosures (or higher if required by project conditions).
   2. Boxes installed on roofs or under breezeways must be mounted in a manner that prevents water infiltration, following the manufacturer's installation guidelines.
   3. Pull box orientation shall ensure drainage openings are positioned downward and not exposed to direct rain or runoff.
   4. For roof-mounted installations, boxes shall be mounted at least 12 inches above the finished roof surface to prevent water pooling.
   5. Pull boxes shall not be mounted with the conduit entries facing upward unless designed for such an application with proper rain-tight fittings.
   6. Conduits entering outdoor pull boxes shall be sealed with appropriate watertight fittings or duct seal to prevent moisture migration into conduit runs.

3.12.4 Structural & Seismic Considerations

A. Pull boxes and conduit bodies shall be securely fastened to structural elements using approved anchors and supports.
B. In seismic areas, boxes must be seismically braced per local building codes and DSA requirements.
C. Boxes shall not be supported by conduit alone; separate supports must be provided.

3.12.5 Pull Boxes

A. Pull boxes shall be used where required to join multiple conduits and facilitate cable pulling, and prevent excessive strain.
B. Boxes must be securely mounted and supported to avoid movement or strain on conduits.
C. Indoor pull boxes shall have smooth, rounded edges to prevent cable damage.
D. Outdoor pull boxes shall be NEMA 3R rated steel enclosures.

3.12.6 Wireways & Gutters

A. Wireways and gutters shall be installed only where permitted by project specifications and shall not exceed 20% fill ratio.
B. Removable covers must be used to allow easy access for maintenance and future cable additions.
C. Wireways shall be grounded and bonded per NEC 250.96(A).

D. Use of wireways for splicing is prohibited unless specifically designed and rated for that purpose and approved by the District ITS Project Manager

3.12.7 Conduit Bodies

A. Conduit bodies shall be used only when necessary for access or directional changes.
B. **Pull elbows (90° conduit bodies) are strictly prohibited; use junction boxes or sweeping bends instead.**
C. All conduit bodies shall maintain proper cable bend radius per ANSI/TIA-568 & manufacturer specifications.
D. In damp or wet locations, conduit bodies shall be rated for wet conditions and include gasketed covers.

3.13 PULL STRING

3.13.1 When using an existing pull-string to run cables through conduit, a new pull-string will be installed to replace the one being used.

3.13.2 For conduits 1-1/2 inches and larger the pull-string is to be of the polyester tape variety (“mule tape”) rated up to 1200lb

3.13.3 For conduits smaller than 1-1/2 inches the pull string is to be nylon pull-string such as Greenlee Poly Line 430 rated up to 210lb.

3.14 FIRESTOPPING

3.14.1 Install firestopping per the CEC and CFC requirements

3.14.2 Install material at perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

3.14.3 Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

3.14.4 Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

3.14.5 Seal pipe penetrations at telecommunication rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

END SECTION

SECTION 27 05 43 - UNDERGROUND DUCTS & RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section outlines the baseline standards for all underground ducts and pathways for low voltage communications systems. The specific requirements found in related sections supersede requirements listed in this section.

1.1.2 Installs must comply with NEC/CEC Sections 800.24, 300.4, and 300.11.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27, and Division 28 sections and requirements in their entirety. For list of all Division 27, and Division 28 sections see section 1.3 of 27 00 00. If section 27 00 00 was not provided contact Districts ITS Department Project Manager to receive complete copy of the Division 27, and Division 28 sections.

1.2.2 For above ground pathways refer to Section 27 05 28.

1.3 JOB CONDITIONS

1.3.1 Environmental Requirements

A. Contractor shall provide dewatering and drainage as required in accordance with Los Angeles County requirements and State Water Quality Resources.
B. All water discharge must comply with local, state, and federal regulations.
C. Stormwater discharge must comply with NPDES permit regulations.
D. Erosion control plans shall be implemented before trenching begins and maintained for the duration of construction.
    1. Contractor shall provide berms and protective measures to prevent erosion and runoff into trenches.

1.3.2 Weather Protection

A. Contractor shall be responsible for protection and maintenance of all "work areas" during inclement weather, shall maintain existing site drainage in all "non-work areas", and shall not create conditions which would cause any existing portions of site or improvements to be damaged by inclement weather.
B. If excavations become flooded, the contractor shall immediately pump out water and repair any soil destabilization at no additional cost to the District.
C. Construction activity shall not impact existing drainage patterns.

1.3.3 Stormwater & Erosion Control Regulations

A. Contractor shall coordinate with and comply with the National Pollutant Discharge Elimination System (NPDES) requirements, per the California State Water Resources Control Board General Permit for Storm Water Discharge.
B. The contractor shall follow all erosion control measures per project-specific erosion control plans and local jurisdictional requirements.
C. The contractor is responsible for obtaining any required permits related to stormwater discharge.

1.4 EXISTING CONDITIONS

1.4.1 Work Area Limits

A. Grading work and excavation equipment shall be confined to designated work areas.

B. The remainder of the site shall be protected and left undisturbed unless otherwise required by contract documents.
C. Any disturbance outside approved work areas must be restored at no cost to the District.

1.4.2 Protection of Existing Utilities & Infrastructure

A. **The contractor is responsible for protecting in place all known and unknown utilities and infrastructure throughout the project site.**
B. Any damage to utilities, drainage systems, landscape sprinkler lines, retaining walls, curbs, sidewalks, trees, asphalt, turf, or other permanent site features shall be repaired to match original conditions at the contractor's expense.
C. Utility conflicts must be immediately reported to the District ITS Project Manager for further direction before proceeding.
D. All previously undocumented or unknown utilities encountered during excavation shall be documented as part of the as-built submittals per Section 27 05 50.
   1. Pre-Excavation Utility Locating: Any subsurface utilities identified using GPR, electromagnetic detection, or other non-destructive methods must be documented prior to excavation.
   2. Utilities Physically Exposed During Excavation: If additional undocumented utilities are encountered during trenching or digging, the contractor must:
      - Record GIS location, depth, material type, and utility function (if identifiable) per the Districts GIS requirements identified in 27 05 50.
      - Mark all utilities on redlined as-built drawings and submit them to the District ITS Project Manager.
      - If the utility cannot be identified, record its approximate size, composition (metallic, non-metallic), and any visible labels or markings.

1.4.3 Utility Locating & Coordination

A. The contractor is required to contact 811 for public utility locating at least 2 business days prior to excavation and obtain a valid USA Dig Alert ticket.
B. Private utility locating (e.g., ground-penetrating radar (GPR), electromagnetic detection, or other approved methods) is at the contractor's discretion but does not relieve them of their responsibility to protect all known and unknow utilities.
C. The contractor shall pothole and physically verify the exact location and depth of critical underground utilities in areas where conflicts are anticipated or as required by the contract documents.
D. Utility conflicts must be reported to the District ITS Project Manager immediately for resolution before continuing excavation.
E. The contractor is responsible for properly marking all identified utilities and ensuring they remain visible and protected throughout construction.

1.4.4 Contractor Responsibility for Damage

A. All damage to utilities, infrastructure, or site conditions due to contractor activity shall be immediately repaired at the contractor's expense.
B. If unforeseen conditions impact excavation, the contractor shall notify the District ITS Project Manager before continuing work

PART 2 - PARTS

2.1 PRE-APPROVED MATERIALS

2.1.1 Refer to Section 27 06 50 – Approved Communications Products for a list of approved materials.

2.1.2 Any deviations require written approval from the District ITS Project Manager.

2.2 PROHIBITED MATERIALS

THE FOLLOWING PATHWAY COMPONENTS ARE STRICTLY PROHIBITED:

A. Split-Y conduit fittings or other non-approved conduit intercept methods.
B. Non-traffic-rated pull boxes unless specifically approved.
C. Handholes smaller than 12" x 12" unless specifically approved.
D. Unsealed conduit stub-outs or open ends.

2.3 CONDUIT

A. PVC Conduit
   1. PVC conduit shall be Schedule 40 or greater and comply with NEMA, NEC, and UL specifications.
   2. Schedule 80 PVC shall be used for all stub-ups and any locations subject to physical damage.
   3. All PVC conduit joints shall be solvent-welded using manufacturer-recommended cement.
B. High-Density Polyethylene (HDPE) Conduit
   1. HDPE conduit shall be SDR-11 or SDR-13.5, per NEMA TC 7 and UL 651A standards.
   2. HDPE conduit shall be factory-lubricated for low-friction cable pulling.
   3. Joints shall be heat-fused or connected using manufacturer-approved couplers.
   4. Color: Orange for communications unless otherwise noted.
   5. HDPE conduit shall not be used for stub-ups or transitions into buildings.
C. Rigid Galvanized Steel (RGS) Conduit
   1. RGS conduit shall be used for all stub-ups where conduit transitions from underground to above-ground.
   2. All RGS stub-ups shall be wrapped with two layers of 10-mil PVC pipe wrap for corrosion protection.
   3. RGS conduit shall comply with UL 6 and ANSI C80.1.

2.4 DUCT BANK COMPONENTS

2.4.1 Duct Spacers

A. Duct banks with three (3) or more conduits shall use factory-fabricated, non-metallic duct spacers.
B. Spacers shall be designed to maintain a minimum separation of 2 inches between conduits.

2.5 BACKFILL & BEDDING MATERIALS

2.5.1 Native Soil Backfill (Standard Default Option)

A. Compacted native soil, free of debris, large rocks (>3 inches), or organic material.
B. Used unless otherwise specified or required by soil conditions.

2.5.2 Sand Bedding (As Required for Specific Conduit Types)

A. Clean, washed sand, free of clay and other contaminants.
B. Used for HDPE, fiberglass, or sensitive conduit applications.

2.5.3 Slurry Encasement (Only When Approved by District ITS Project Manager)

A. Low-shrinkage concrete mix meeting <5% shrinkage wet to dry.
B. Must be approved in writing by District ITS Project Manager before use as an alternative to compaction requirements.

2.5.4 Concrete Encasement (Only as Specifically Required in Contract Documents)

A. Minimum 2000 PSI strength.
B. Top shall be colored orange for future identification.

2.6 MARKING & LOCATING MATERIALS

2.6.1 Underground Warning Tape

A. Detectable underground warning tape shall be used in all trenches containing conduits.
B. Tape shall be orange, labeled "WARNING - COMMUNICATIONS CABLE BELOW," and installed 12 inches above the highest conduit.

C. Minimum Width: 3 inches

2.6.2 Tracer Wire

A. Tracer wire shall be installed in all underground conduit runs for future locating.
B. Wire shall be orange, minimum 12 AWG solid copper with HDPE insulation.
C. Tracer wire shall terminate in each handhole, vault, or pull box with a minimum 1-foot loop.
D. THHN/THWN electrical wire is not acceptable as tracer wire.

2.7 PULL STRINGS & SEALING MATERIALS

2.7.1 Pull String

A. All conduits shall contain a pull string rated for a minimum of 200 lbs.
B. Conduits 1-1/2” and larger shall use mule tape rated for 1200 lbs.

2.7.2 Duct Plugs & Sealing

A. All empty conduits shall be sealed with watertight, expandable duct plugs.
B. Seal all conduits entering a building to prevent water and gas intrusion.
C. Foam sealant may only be used for temporary seals.

2.8 UNDERGROUND STRUCTURES

2.8.1 General Requirements

A. All underground structures, including handholes, pull boxes, and vaults, shall be traffic-rated to meet AASHTO H-20 or ANSI/SCTE Tier 22, unless otherwise approved in writing by the District ITS Project Manager.
B. All covers shall be permanently labeled per the requirements outlined in 27 05 53 and shall be non-slip rated.
C. All underground structures shall be equipped with bolt-down lids to prevent unauthorized access, displacement, or water infiltration.
D. All structures shall include knockouts or pre-formed conduit entry points sized appropriately for installed conduits.
E. Provide pulling irons, cable racks, sump drains, and bonding points where required.

2.8.2 Handholes

A. Application:
   1. Used for minor distribution points, small pathway access, or low-density lateral connections. Not intended for backbone cabling or high-capacity conduit runs.
   2. May be used to terminate service drops, accommodate minor lateral branches, or provide localized access to communication cabling.
   3. Not permitted for backbone cabling
B. Size Requirements:
   1. Minimum Interior Size: 12" x 17" x 18"
   2. Maximum Conduit Capacity:
      - No more than four (4) Trade Size 2 conduits (2-in / 2-out configuration).
      - Two (2) additional Trade Size 1 conduit may be permitted (e.g., service drop).
   3. Any handhole exceeding this capacity shall be replaced with a vault as defined in 2.8.3.
C. Construction Requirements:
   1. Handholes shall be constructed of polymer concrete, concrete, or fiberglass-reinforced composite rated for underground use.
   2. Covers shall be labeled per Section 27 05 53 and meet H-20 traffic loading requirements.
   3. Bolt-down lids and internal drainage provisions are required unless otherwise noted.

2.8.3 Vaults

A. Application Requirements:
   1. Vaults shall be used for all backbone cabling, major pathway junctions, or conduit groups exceeding handhole capacity limits (as defined in 2.8.2).
   2. Vaults must be sized appropriately to maintain cable bend radius and support long-term accessibility for maintenance and future expansion.

B. Size Requirements:
   1. Minimum interior dimensions: 24" x 36" x 24" (or larger as required by conduit quantity or cable management needs).
   2. Vault shall be sized to accommodate:
      - A minimum of 20% additional conduit capacity beyond initially installed conduits, for future expansion.
      - All service loop slack requirements for fiber and copper cabling, assuming all installed conduits are fully populated with their maximum cable capacity.
      - Proper cable bend radius and clearance for safe pulling, routing, and future maintenance.

C. Construction Requirements:
   1. Constructed of polymer concrete, precast concrete, or polymer composite.
   2. Shall include pre-drilled conduit entry points or field-modifiable knockouts.
   3. Covers must be traffic-rated (H-20 or ANSI/SCTE Tier 22) and labeled per the requirements outlined in 27 05 53.

D. Vaults 30"x48"x36" or larger shall include:
   1. Pulling irons at each end.
   2. Cable racks with arms for fiber optic and copper cable management.
   3. Sump drains for water management where required.
   4. Bonding points for grounding and lightning protection.

2.9 BASE MATERIAL FOR VAULTS, AND HANDHOLES

2.9.1 Crushed Rock Base:

A. Material: ¾-inch minus crushed rock or pea gravel
B. Clean, washed, and free of fines

2.9.2 Concrete Base (If Required by Contract Documents):

A. Minimum 4-inch-thick reinforced concrete slab
B. Concrete Strength: 3,000 PSI minimum
C. Reinforcement: #4 rebar grid at 12-inch on center (O.C.), both directions

PART 3 - INSTALATION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Code Compliance: All underground pathways shall be installed per NEC, CEC, BICSI, and applicable industry standards.

3.1.2 Coordination & Utility Protection:

A. Contractor must coordinate pathway routing with existing and planned utilities.
B. Protect in-place utilities during excavation and backfilling.
C. Any conflicts with existing utilities must be reported immediately to the District ITS Project Manager.

3.1.3 Minimum Burial Depths (Measured to the Top of the Highest Conduit):

A. Non-traffic areas: 18 inches below finished grade.
B. Traffic areas (roads, driveways, parking lots): 30 inches below finished grade.
C. Under roads, driveways, and paved areas: 36 inches below finished grade.

3.1.4 Building Entry Pathways:

A. Conduits entering a building must be sloped away from the building to prevent water infiltration.
B. All building entry conduits must be properly sealed per NEC/CEC requirements to prevent water intrusion and pest entry.

3.1.5 Pathway Verification Before Backfilling:

A. All underground conduits must be inspected and mandrel-tested before backfilling.
B. Any pathway found obstructed or damaged must be cleared or repaired before final burial.

3.1.6 Pathway Bend Limitations:

A. No pathway shall exceed 180° of total bends without an intermediate pull box or vault.
B. Long-radius sweeps shall be used for all underground bends.

3.1.7 Cable Bundling Restrictions:

A. Zip ties are prohibited for bundling low-voltage cables.
B. Only Velcro straps or other District-approved cable management materials may be used.

3.2 ABANDONED CABLES IN PATHWAYS:

3.2.1 The term abandoned cable and the corresponding requirements are outlined in 27 00 00 – Communications.

3.2.2 Abandoned cabling shall be removed in accordance with 27 00 00.

3.2.3 Abandoned cables must be removed from the portions of the pathway that are directly impacted by the new work, unless otherwise specifically noted in the contract documents.

3.2.4 Pathways containing abandoned cables shall not be used for new installations unless all abandoned cables in the affected segments have been removed.

3.2.5 If abandoned cables cannot be removed due to inaccessibility, they shall be documented, marked and identified per 27 00 00.

3.2.6 If a pathway with abandoned cable is to remain in use, the Contractor shall provide written justification to the District ITS Project Manager for review and approval.

3.3 PATHWAY FILL RATIOS:

3.3.1 All pathways shall comply with the maximum fill ratios requirements outlined in Section 27 00 00 Part **Error! Reference source not found. Error! Reference source not found.**.

3.4 PATHWAY DISTANCE LIMITATIONS

3.4.1 General Requirements

A. Maximum conduit distances shall be followed to ensure ease of cable installation and minimize pulling tension.
B. Distances are based on standard low-voltage installations including a mix of fiber optic and copper cables (e.g., 50-pair Cat3, 14/8 PA wire).
C. Any pathway exceeding the listed maximum distances shall require an intermediate pull box or vault.
D. Bends reduce allowable conduit distances and must be considered when designing pathways.
E. Exceptions for fiber-only pathways may be granted upon District ITS Project Manager approval.

3.4.2 Maximum Conduit Distances (Before a Handhold/Pull Box/Vault is Required)

A. No conduit shall exceed 180° in bends without an intermediate pull point.
B. No pathway shall exceed the limits outlined in TABLE 27 05 43 - 1: Maximum Conduit Distance. without prior authorization from the District ITS Project Manager.

C. For all pathways assumes a mix of fiber and copper cables unless otherwise approved by ITS Department Project Manager

TABLE 27 05 43 - 1: MAXIMUM CONDUIT DISTANCE

CONDUIT TYPE & SIZE	RECOMENDED MAX DISTANCE	WITH NO BENDS	WITH STANDARD BENDS (≤180° TOTAL)
1" CONDUIT	125 FT	150 FT	125 FT
1-1/4" CONDUIT	175 FT	200 FT	175 FT
1-1/2" TO 2" CONDUIT	225 FT	275 FT	225 FT
2-1/2" TO 4" CONDUIT	300 FT	350 FT	300 FT
HDPE SDR-11/13.5 *(PRE-LUBRICATED, STRAIGHT RUNS)*	500 FT	600 FT	500 FT

3.4.3 Extended Distance for Fiber-Only Pathways

A. Pathways carrying ONLY fiber optic cables may be approved for extended distances by the District ITS Project Manager on a case-by-case basis.
B. Extended Distance Maximums (Requires ITS Approval):
   1. 4” PVC conduit: Up to 500 ft
   2. HDPE: Up to 750 ft (if conditions allow)
   3. Other sizes: Subject to review

3.4.4 Approval Factors for Distance Extensions:

A. Conduit condition: Must be clean, dry, and smooth-walled.
B. Number of bends: Preferably ≤90° total bends.
C. Cable type & pull calculations: Sidewall pressure must remain within fiber limits.
D. Midpoint assist methods: Fiber jetting or intermediate pull points may be required.

3.4.5 Directional Boring Considerations for HDPE

A. Bores over 500 ft require a midpoint pull box.
B. Bores over 400 ft require pulling tension calculations.
C. Multiple 45° bends reduce max bore distance by 25%+.
D. Directional Boring Installations – Runs installed via directional drilling must account for additional pulling tension, and may require shorter spacing between pull boxes.

3.4.6 Special Considerations

A. Existing Conduits – If existing pathways exceed these limits, pulling tension must be analyzed before reusing the conduit.

3.4.7 Approval Requirements for Variances

A. Any deviation from the listed conduit distances must be approved by the District ITS Project Manager.
B. Engineering calculations or cable tension analysis may be required for approval.

3.5 TRENCHING, SURFACE REMOVAL & RESTORATION

3.5.1 General Requirements:

A. Excavate trenches along straight lines, avoiding unnecessary disturbance.
B. Trenches shall follow approved routing per contract documents.
C. Excavate trenches wide enough to allow proper conduit spacing and compaction.
D. If a more specific trenching, surface removal, or restoration specification exists in the contract documents, it shall take precedence unless otherwise noted.

3.5.2 Asphalt & Concrete Removal:

A. Concrete shall be removed in full panels (flags), not just saw cut along the trench width.
B. Saw cutting is required at control joints to ensure a clean break.
C. No jagged or irregular concrete edges shall be left exposed.
D. Asphalt shall be saw cut to clean straight edges before removal.

3.5.3 Depth Requirements:

A. Trenches shall be deep enough to maintain required burial depths per Section 3.1.3.
B. Over-excavation must be backfilled and compacted to meet grading requirements.

3.5.4 Shoring & Safety:

A. Contractor shall follow OSHA & Cal/OSHA excavation safety standards for trench support.
B. Trenches deeper than 5 feet must comply with trench shoring and shielding regulations.

3.5.5 Trenching Safety & Site Protection

A. A Trenching Safety Plan must be submitted and approved in writing by the District prior to the start of any excavation work.
B. Site protection measures shall be based on the needs and location of the work being performed and must comply with all OSHA, Cal/OSHA, and local jurisdictional safety requirements.
C. Contractor shall install barriers, warning tape, and signage around trenching areas to prevent unauthorized access.
    1. If children are present in or near the work area, or if excavations are near pedestrian walkways, building entrances, or occupied areas, secure fencing (minimum 6' tall), or other approved rigid barrier (e.g., water-filled or concrete barricades) shall be installed. Barriers must be designed to prevent small children from climbing under, over, or through openings.
    2. Trench Cover Requirements shall be determined in the contract documents or at the project kickoff meeting.
    3. If required, steel plates, plywood, or other approved materials shall be used to protect open trenches in traffic areas.
    4. All covers must be secured to prevent movement and clearly marked for safety.
D. Open trenches shall not be left unattended without proper barriers and protection.
E. All site protection and safety measures must be maintained for the duration of the trenching work.

3.5.6 Excess Soil & Spoils Management:

A. All excavated materials shall be properly managed and disposed of per project requirements.
B. Excess soil shall not be left piled on-site unless approved in writing by the District.
C. Contaminated or unsuitable soil must be removed and replaced with approved material.
D. Trench Restoration Requirements

3.5.7 General Restoration Standards:

A. All trenches shall be restored to pre-construction conditions or better.
B. If contract documents specify a more detailed restoration process, those requirements shall take precedence.

3.5.8 Concrete & Hardscape Restoration:

A. Concrete slabs shall be replaced in full panels (flags) to the nearest control joints.
B. If no control joint is available within 24 inches of the trench, dowel bars shall be installed every 18 inches to tie new and existing concrete together.
C. Minimum 3000 PSI concrete shall be used for restoration unless otherwise specified.
D. Finish and texture shall match surrounding areas.
E. Expansion joints and scoring shall be restored to match the original pattern.

3.5.9 Asphalt Restoration:

A. All asphalt surfaces shall be replaced to a minimum depth equal to or greater than the original asphalt.
B. If trenching occurs in traffic areas, asphalt thickness shall comply with local jurisdictional roadway standards.
C. All new asphalt shall be compacted and flush with adjacent surfaces.
D. A tack coat or bonding agent shall be applied to all edges before new asphalt is placed.

3.5.10 Landscaped Area Restoration:

A. Trenches through landscaped areas shall be graded, compacted, and restored to match pre-existing conditions.
B. Topsoil shall be screened and free of debris, with a minimum of 4 inches of fresh topsoil added before reseeding or replanting.
C. Irrigation lines damaged during trenching shall be repaired and tested before final acceptance.

3.6 CONDUTS & DUCTBANKS

3.6.1 General Requirements

A. Conduits shall be installed per NEC, CEC, CFC, and all local codes.
B. Raceway routing shown on drawings is approximate; adjustments may be required to complete the system.
C. **No more than 180° worth of bends shall be installed between pull boxes**. If additional bends are required, a handhold, pull box, or vault must be added.
D. Above-ground conduit installations must comply with Section 27 05 28 – Pathways for Communications Systems
E. All conduits shall include a pull string:
   1. Trade size 1.5 inches and larger: Pull string shall be mule tape with footage markings.
   2. Smaller than Trade size 1.5 inches: Pull string shall be polyester or nylon rated for 200 lbs minimum.
F. **All conduits must be capped or sealed to prevent the entry of dirt and moisture before cable installation.**

3.6.2 Conduit Separation from Electrical Pathways

A. Maintain a minimum 12-inch separation between communications and electrical conduits.
B. If crossing electrical pathways, the conduits shall:
   1. Cross at a 90° angle whenever possible.
   2. Maintain a minimum 3-inch vertical clearance.
      - If conduit separation requirements cannot be maintained, the contractor shall contact the District ITS Project Manager for guidance and approval before proceeding.

3.6.3 Minimum Conduit Sizing & Quantity

A. Minimum Conduit Size
   1. The minimum conduit size shall be trade size 2, unless otherwise noted in contract documents.
   2. Exception: Conduits serving a single light pole may utilize trade size 1 conduit.
B. Required Quantity of Conduits
   1. A minimum of (2) trade size 2 conduits shall be installed in any new trench between underground structures (e.g., pull boxes, vaults) and between buildings.
   2. Backbone pathways shall consist of a minimum of (4) trade size 2 conduits, unless otherwise noted in contract documents.
   3. Additional conduits shall be installed if contract documents specify greater capacity, or as directed by the District ITS Project Manager.
C. Pathway Expansion Considerations
   1. Whenever trenching is performed, additional spare conduits should be installed for future expansion.
   2. If trenching between buildings, at least one conduit must be reserved for future use and capped.

3.6.4 **Conduit Installation by Type**

A. PVC Conduit
   1. All PVC conduit joints shall be solvent-welded using manufacturer-approved cement.
   2. Schedule 80 PVC shall be used for stub-ups and areas exposed to potential damage.
   3. Conduits shall be installed with expansion fittings where temperature variations may cause movement.

B. Rigid Galvanized Steel (RGS) Conduit
   1. RGS conduit shall be used for stub-ups and transitions from underground to above-ground.
   2. All RGS conduit shall be wrapped with two layers of 10-mil PVC pipe wrap for corrosion protection.
   3. Conduits entering buildings shall be properly bonded and grounded.

C. High-Density Polyethylene (HDPE) Conduit
   1. HDPE conduit shall be installed as continuous lengths using heat-fusion or manufacturer-approved couplers.
   2. Direct-buried HDPE conduit shall have a minimum of 6 inches of sand bedding.
   3. HDPE conduit shall not be used for stub-ups or building entry points.

3.6.5 Conduit Spacing & Support

A. Separation Between Conduits in a Duct Bank
   1. Conduits shall maintain a minimum of 2 inches of separation within duct banks.
   2. Duct spacers shall be used at maximum intervals of 5 feet for direct-buried conduits and 8 feet for concrete-encased conduits.

B. B. Direct-Buried Conduits
   1. Direct-buried conduits shall be placed on a 3-inch sand bedding.
   2. Conduit trenches shall be backfilled per Section 3.6 - Backfill & Compaction Requirements.

3.7 BACKFILL & COMPACTION REQUIREMENTS

3.7.1 General Requirements

A. All backfill material shall be clean, compactable, and free of organic matter, debris, or contaminants.

B. Screening Requirement:
   1. Backfill material shall be screened to remove large rocks, debris, or any material greater than 3 inches in diameter.
   2. Within 12 inches above the highest conduit, backfill material shall be screened to ensure no rocks or debris greater than 1 inch in diameter are present.
   3. Construction debris, broken concrete, or asphalt pieces shall not be used as backfill material.

3.7.2 Standard Backfill (Native Soil – Default Method)

A. Conduits shall be covered with a minimum of 12 inches of compacted soil before general backfill is placed.

B. Backfill must be compacted in 6-inch lifts to a minimum of 90% compaction (Modified Proctor, ASTM D1557).

C. Moisture Content Control:
   1. Backfill material must be maintained within -3% to +2% of the optimum moisture content to prevent settlement or instability.
   2. Contractor shall ensure soil is neither too dry (causing inadequate compaction) nor too wet (causing soil pumping or shrinkage upon drying).

3.7.3 Sand Bedding & Backfill (For Certain Conduit Types & HDPE)

A. Where required by contract documents, conduits shall be placed on a 3-inch bed of compacted sand.

B. After conduit installation, an additional 3 inches of sand shall be placed before general backfill is added.

C. Sand shall be clean, washed, and free from clay, organic material, or debris.

D. Compaction Requirement:
   1. Sand shall be compacted in 6-inch lifts to a minimum of 90% Modified Proctor (ASTM D1557).

3.7.4 Duct Bank Backfill & Compaction (For More Than 2 Conduits)

A. Duct banks shall be backfilled using one of the following approved methods:
   1. Sand Backfill (Standard Duct Bank Method – Default)
      - Use clean, washed sand, free from clay, organic material, or debris.
      - Provide a 6-inch bedding layer below the conduits.
      - Install sand in 6-inch lifts and compact to 90% Modified Proctor (ASTM D1557).
      - First 12 inches above the highest conduit shall be screened to remove rocks larger than 1 inch.
      - Final backfill above the screened sand layer may use native soil compacted to 95% Modified Proctor.
      - Compaction Testing for Sand Backfill:
        ◊ One compaction test per 50 linear feet of duct bank.
        ◊ Additional tests at pull boxes, vaults, and intersections.
        ◊ Moisture content testing every 12 inches of depth.
   2. Slurry Encasement (Requires Approval from ITS Project Manager)
      - Use low-strength, flowable slurry (200-500 PSI max).
      - Slurry shall fully encapsulate conduits with a minimum 3-inch cover on all sides.
      - The top 3 inches of the slurry shall be colored orange for future identification.
      - Slurry shall not extend into pull boxes, vaults, or building entry points.
      - Curing Time Requirement:
        ◊ Slurry must cure for a minimum of 24 hours before additional backfill is placed.
        ◊ If structural loading is expected, a minimum 48-hour cure is required.
      - Approval Required:
        ◊ Slurry encasement shall only be used when specifically approved in writing by the District ITS Project Manager.
      - Compaction Testing for Slurry Encasement:
        ◊ Curing Time Verification: Ensure minimum 24-hour cure before proceeding.
        ◊ Strength Testing (If Required by ITS): One test per 100 linear feet to verify compliance.

3.7.5 Concrete Encasement (Where Required in Contract Documents)

A. Where specified, conduits shall be fully encased in 2000-PSI concrete.
B. The top of the encasement shall be colored orange for future identification.
C. Minimum concrete coverage around conduits:
   1. 3 inches on all sides.
   2. 6 inches of cover required under roadways or high-load areas.

3.7.6 Compaction Testing Requirements

A. General Compaction Requirements:
   1. All backfill shall be compacted to a minimum of 90% of the maximum dry density per ASTM D1557 (Modified Proctor).
   2. Compaction lifts shall not exceed 6 inches before mechanical compaction is performed.
   3. Backfill around and between conduits shall be tamped and compacted to maintain proper conduit spacing.
   4. Each lift shall be compacted before additional material is added, ensuring no voids remain around conduits.
B. Testing Frequency:
   1. One compaction test per 100 linear feet of trench.
   2. Testing at every 6-inch lift of backfill.
   3. Additional testing at the discretion of the District ITS Project Manager.
C. Rework Requirements:
   1. If backfill fails to meet compaction requirements, the contractor must remove, rework, and retest the material at no additional cost to the District.

3.7.7 Prohibited Compaction Methods

A. Jetting and/or flooding methods shall NOT be used for compaction.
B. Use of mechanical compactors is required for all lifts except for slurry encasement, which self-compacts.

3.8 MARKING & LOCATING REQUIREMENTS

3.8.1 Tracer Wire Installation

A. General Requirements
1. Tracer wire shall be installed with all underground conduit runs.
2. The wire shall be continuous along the entire conduit run, with no breaks or splices except at vaults, pull boxes, or handholes.
3. Tracer wire shall be orange, minimum 12 AWG solid copper with HDPE insulation.

3.8.2 Installation Methods

A. Tracer wire shall be secured to the conduit using non-metallic ties at intervals not exceeding 10 feet.
B. Termination Requirements:
1. Tracer wire shall terminate inside each vault, or handhole, leaving a 1-foot loop for accessibility.
2. Tracer wire shall be coiled and secured near the top of the pull box for easy access.

3.8.3 Above-Ground Transitions:

A. When transitioning to above ground, tracer wire shall be installed in a parallel conduit and terminate inside the nearest telecom enclosure or junction box.

3.8.4 Underground Warning Tape Installation

A. General Requirements
1. Detectable underground warning tape shall be installed in all trenches containing conduits.
B. Installation Depth
1. Warning tape shall be installed 12 inches above the highest conduit in the trench.
2. If conduits are stacked, tape placement shall still follow the 12-inch-above-highest-conduit rule.

3.9 PREPARATION FOR USE OF EXISTING CONDUITS

3.9.1 General Requirements

A. **All existing conduits planned for use as part of this Contract shall be tested, cleaned, and verified before installing any new cables.**
B. The contractor shall determine if the conduit is empty or occupied (in-use) before proceeding.
C. Any conduits deemed unusable must be documented as part of the As-Build submittals outlined in 27 05 50
D. If an existing conduit is not suitable for use, the contractor shall notify the District ITS Project Manager for resolution before proceeding with cable installation.

3.9.2 Empty Conduits (Previously Occupied or Spare)

A. Testing & Cleaning
1. Before installing cables, all empty conduits (whether previously occupied or originally installed as spares) shall be tested using a mandrel and brush test.
2. Mandrels shall be at least 12 inches long and 0.25 inches smaller than the conduits inside diameter at the center, tapering to 0.5 inches smaller at the ends.
3. If the mandrel cannot pass, the contractor shall proceed with obstruction removal methods.
B. Obstruction Removal Process
1. If the conduit is blocked, attempt the following in order:
- Rodding the Raceway – Insert rigid/semi-rigid rods to push through minor obstructions.
◊ If minor debris or dirt is present, use a brush mandrel or drag line to remove it.

- ◊ If a soft obstruction exists, use a rigid duct rod with a cleaning head to push through the blockage.
- Hydro-Jetting (For PVC & HDPE Conduits)
  - ◊ If the obstruction is soft debris, mud, or silt, a low-pressure hydro-jet system may be used.
  - ◊ Hydro-jetting shall be limited to 1,500 PSI to prevent damage to conduit walls.
  - ◊ Contractor shall use controlled drainage to prevent water intrusion into manholes, vaults, or buildings.
  - ◊ DO NOT use hydro-jetting on conduits that enter occupied buildings without containment and drainage measures.
  - ◊ Protection Measures for Hydro-Jetting:
    - Seal building entry points to prevent water intrusion into telecom rooms.
    - Use vacuum-assisted removal if hydro-jetting is performed near electrical vaults.
    - Ensure proper disposal of flushed debris per environmental regulations.

2. If conduit damage is suspected, stop work immediately and report to the District ITS Project Manager.
3. Final Cleaning
   - After clearing, pull a mandrel and brush through the entire conduit.
   - Use compressed air or a vacuum to remove dust or debris.
   - Install a pull string or mule tape in all empty conduits for future use.

3.9.3 Occupied (In-Use) Conduits

A. Pre-Installation Inspection
1. Visually inspect the conduit where accessible (vaults, pull boxes, terminations).
2. Identify cable types and conditions (e.g., fiber optic, copper, damaged insulation).
3. Determine available space based on fill ratios per NEC/CEC.

B. Cable Protection During Installation
1. If additional cables are to be installed in an occupied conduit, the following precautions apply:
   - Existing cables shall not be displaced, crushed, or over-tightened.
   - Lubricants approved for existing cable types shall be used to minimize friction.
   - Use low-force mechanical pulling methods to prevent damage.

C. Reporting & Verification
1. The contractor shall document and report any:
   - Existing conduit damage (e.g., crushed, corroded, water infiltration).
   - Excessive fill that prevents additional cable installation.
   - Signs of previous cable damage (e.g., insulation cracking, excessive tension).
   - If any issues prevent reuse, notify the District ITS Project Manager for approval before proceeding.

3.10 INSTALLATION REQUIREMENTS FOR UNDERGROUND STRUCTURES

3.10.1 General Requirements

A. All underground structures, including vaults, handholes, and pull boxes, shall be installed per manufacturer specifications, contract documents, and applicable codes.
B. Underground structures shall be placed at locations shown on construction drawings unless adjustments are approved by the District ITS Project Manager.
C. No structure shall be installed in a way that obstructs access to other utilities, walkways, or drainage systems.
D. Installation of pull boxes, vaults, and handholes shall ensure proper alignment with conduit pathways to minimize unnecessary bends or stress on cables.

3.10.2 Placement of Underground Structures

A. Clearance from Curbs & Hardscapes
1. Underground structures shall be placed at least 12 inches from the edge of sidewalks, curbs, or other hardscape boundaries to prevent structural damage.

2. Underground structures may be installed within paved or hardscape areas, such as walkways, parking lots or roadways, if required by design.
3. Where possible, avoid placing structures in the direct path of vehicle traffic. Position them in areas that minimize wear from repetitive vehicle loads.

B. Avoidance of Low-Lying or Flood-Prone Areas
1. Underground structures shall not be installed in locations where water accumulation is likely, unless proper drainage is provided.
2. If placement in a flood-prone area is unavoidable, install drainage sumps, perforated bases, or connect to site drainage systems as required.

C. Accessibility for Maintenance
1. Install structures in open, unobstructed areas for ease of future servicing.
2. Avoid placing underground structures in landscaped areas where tree roots, plant growth, or irrigation may cause interference.
3. Underground structures should be located at least 36 inches from walls, fences, or other obstructions to allow safe worker access.

D. Spacing from Other Utilities
1. Underground structures must be installed at least 12 inches away from other utility structures (e.g., electrical, water, gas).
2. If crossing another utility pathway, maintain required vertical and horizontal clearances per applicable codes.
3. Avoid placing underground structures directly over existing utility lines to prevent future excavation conflicts.

3.10.3 Base & Bedding Requirements

A. Base Material (All Underground Structures Must Be Installed on a Proper Base)
1. Default Base:
- 4 inches of ¾-inch crushed rock or pea gravel
- Compacted to 90% Modified Proctor (ASTM D1557).
2. Concrete Base (As Required by Contract Documents):
- 4-inch-thick reinforced concrete slab with #4 rebar @ 12 inches on center (O.C.), both directions.
- 3,000 PSI concrete minimum strength.

B. The base shall be leveled and compacted before placing the underground structure.

C. Underground structures shall be installed flush with finished grade unless otherwise specified.

3.10.4 Placement & Depth Requirements

A. Handholes
1. Shall be installed flush with finished grade in pedestrian areas.
2. Shall be installed flush with finished grade unless otherwise specified.
3. Minimum Depth (Measured to Bottom of Box):
- Handholes: Minimum 18 inches deep.

B. Vaults
1. Shall be installed flush with finished grade unless otherwise specified.
2. Vaults shall be placed at a depth that allows for conduits to enter at the proper angle without excessive bending.
3. Minimum Depth (Measured to Bottom of Vault):
- Small Vaults (24"x36"x24"): Minimum 24 inches deep.
- Medium Vaults (30"x48"x36"): Minimum 36 inches deep.
- Large Vaults (48"x72"x48"): Minimum 48 inches deep.

3.10.5 Conduit Entry & Sealing

A. All conduits entering underground structures shall be properly aligned and secured using knockout openings or core-drilled entry points.

B. Conduits shall be installed at the bottom third of the vault wall to allow for future expansion.
C. The annular space around all conduit entries shall be sealed using approved watertight duct sealant or expandable foam to prevent debris and water intrusion.
D. Conduit stub-outs must be capped to prevent debris accumulation inside the structure.
E. Excessive conduit bends within underground structures are not permitted; conduits should enter the underground structures as straight as possible.

3.10.6 Drainage & Water Management

A. All underground structures shall include a drain sump unless otherwise specified.
B. If natural drainage is unavailable, the underground structure shall be equipped with a gravel drain field consisting of:
   1. 12 inches of ¾-inch crushed rock beneath the structure.
   2. A perforated drainage pipe leading to a designated drainage area (if required by site conditions).
C. If a solid-bottom box is required (e.g., high water table areas), the structure shall be sealed against groundwater intrusion.
D. Drainage features shall not allow sediment, sand, or debris to clog the structure.

3.10.7 Internal Vault Spacing & Conduit Management

A. Conduit Entry & Spacing
   1. Maintain a minimum 12-inch clearance between the inside walls of the structure and the nearest conduit entry.
   2. Conduits shall enter only at designated knockouts or field-cut openings approved by the District ITS Project Manager.
   3. All field-cut openings shall be sealed and reinforced to prevent moisture intrusion or structural weakness.
B. Conduit Organization Inside Vaults & Pull Boxes
   1. Arrange conduits to prevent unnecessary crossing or tangling of cables.
   2. Multiple conduit banks entering a single structure must be grouped and labeled for easy identification.
   3. Conduit entries should be spaced to allow proper cable routing and pulling access.
   4. Maintain at least 4 inches of spacing between conduits where possible.
   5. Install conduits at opposite ends of the vault when practical to improve cable pull efficiency.
C. Medium and larger vaults shall be equipped with:
   1. Pulling irons at each end to facilitate cable pulling.
   2. Cable racks and arms to support fiber optic and copper cables.
   3. Bonding points for grounding and lightning protection where required.
D. All cable management accessories must be securely attached to vault walls.
E. Cables shall not be left on the vault floor— they must be routed on racks to prevent damage.

3.10.8 Marking & Identification

A. Underground structures shall be clearly labeled on as-built drawings and field maps.
B. Labeling Requirements:
   1. Covers shall be embossed or permanently labeled per requirements outlined in 27 05 50.
C. GIS coordinates shall be recorded for each underground structure and included in as-built documentation per the Districts GIS requirements identified in 27 05 50.

3.10.9 Inspection & Testing

A. The contractor shall notify the District ITS Project Manager for inspection before backfilling any underground structure.
B. The following inspections are required:
   1. Base & Bedding Inspection – Ensure structure is set on the correct base material.
   2. Alignment & Conduit Entry Inspection – Verify conduit positioning, sealing, and structural integrity.
   3. Drainage Inspection – Ensure proper sump installation or waterproofing measures.

C. Any deficiencies must be corrected before backfilling, and the contractor shall bear the cost of any rework.

3.10.10 Prohibited Practices

A. Improper conduit entry:
   1. No non-sealed penetrations – all conduit entries must be watertight.
   2. No excessive conduit bends inside underground structures.
B. Improper installation techniques:
   1. Setting structures on unstable or uncompacted soil.
   2. Backfilling before ITS inspection.
   3. Using handholes in place of vault where larger quantities of cables and conduits are required.

END OF SECTION

SECTION 27 05 50 – Communications Documentation & Submittals

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section outlines the baseline submittal requirements for all low voltage communications systems. The specific requirements found in related sections supersede requirements listed in this section.

1.1.2 Contractor shall comply with all Division 27, and Division 28 sections and requirements in their entirety. For list of all Division 27 sections see section 1.3 of 27 00 00.

1.1.3 If section 27 00 00 was not provided contact Districts ITS Department Project Manager to receive complete copy of the Division 27, and Division 28 sections.

1.1.4 Submittals include pre-installation approvals, as-built documentation, test results, photo documentation, and final warranty/turnover materials.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE. ALL DOCUMENTATION REQUIREMENTS ARE IN PART 3

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

3.1.1 All documentation shall be submitted in electronic, PDF and DWG, formats as required.

3.1.2 All files must be clearly labeled and organized by system type.

3.2 CONSTRUCTION SUBMITTALS (REQUIRED BEFORE INSTALLATION BEGINS)

3.2.1 Shop Drawings & Submittals

A. Product Data Sheets – Manufacturer specifications for all equipment, cabling, racks, terminations, and accessories.
B. Shop Drawings – Scaled drawings showing proposed equipment locations, pathways, MDF/IDF layouts, and elevations.
C. Labeling Plan – Proposed cable and device labeling format per Section 27 05 53.
D. Test Plan – Description of test methods, equipment, and pass/fail criteria per Section 27 08 00.

3.2.2 Sample Submittals (Recommend Approval Before Full Installation)

A. Sample cable and port labels.
B. Example test reports for structured cabling.

3.2.3 Construction Coordination Documents

A. Coordination drawings showing pathways shared with other trades.
B. Power requirements and electrical panel identification for telecom equipment.

3.3 AS-BUILT DOCUMENTATION

3.3.1 General Requirements

A. As-builts must accurately reflect all field changes, deviations, and final installed conditions.
B. Submit complete as-built documentation in both PDF and CAD (DWG) formats, including all required drawings and documentation specified in this section.
C. As-built documentation shall include all approved RFIs that resulted in installation modifications.

D. All Exterior GIS data provided in as-built documentation must have a minimum accuracy of within 1 foot.
E. All interior GIS data in as-built documentation must be accurate to within 3 feet and correctly placed within the designated room.
F. Unless explicitly stated otherwise, all location information provided in as-built drawings shall be approximate, showing the relative position of devices, equipment, and components within the room or building.
G. Any deviations from the 1:1 CAD scale or GIS accuracy requirements must receive prior written approval from the District ITS Project Manager.
H. All as-built documentation, including CAD files, PDF submissions, and photo documentation, must maintain consistency with the requirements outlined in this section and related sections, including 27 00 00, 27 05 53, and 27 08 00

3.3.2 Required As-Built Drawings & Documentation

A. Pathway Drawings & Documentation:
1. Pathway Fill Documentation:
- Submit documentation verifying compliance with the maximum fill ratios as outlined in Section 27 00 00 Part **Error! Reference source not found. Error! Reference source not found.** for all pathways trade size 1-1/4 or larger.
- Include:
  - ◊ Fill ratio calculations
  - ◊ List of all cable types and quantities in pathway
  - ◊ Supporting photos for all Pull Boxes, Conduits, Sleeves & Cable Trays
  - ◊ Identification of full pathways
  - ◊ Documentation of any approved RFIs that impacted pathway fill ratios or installation methods.
  - ◊ Highlight or flag all RFI-related changes in the as-built CAD drawings and documentation to ensure visibility during review.

2. Above Ground / Inwall Pathways Trade size 1-1/4 or larger (Conduits, Sleeves & Cable Trays)
- Size
- Quantity
- Location

3. Under Ground Pathways: (Conduits, Duct Banks)
- Size
- Quantity
- GIS Location For:
  - ◊ Ends of Pathway
  - ◊ Bends in Pathway
  - ◊ Any time pathway depth changes by more than 1 foot.
- Depth
- Encasement type (e.g., concrete, sand, direct burial) type for all pathways.

4. Pull Box/Vaults:
- GIS Location
- Size
- Fill ratios

5. Firestopping
- Locations – All penetrations requiring firestopping.
- Firestopping product utilized
- Date of install

6. Damaged or Unusable Pathways:
- The contractor shall document all pathways that are damaged, obstructed, or otherwise unusable for future cable installations.

- Clearly mark these pathways on as-built drawings and provide a written report detailing the cause of damage and whether repair is feasible.
- If a pathway is permanently unusable, label it as "OUT OF SERVICE" at all accessible entry points.

B. Equipment Documentation:
1. Equipment Racks
   - Locations
   - Rack Type
   - Rack Capacity Report
     ◊ Total U Spaces
     ◊ Total U Spaces Utilized
     ◊ Total U Spaces Available
     ◊ Identification of unused, obsolete, or damaged equipment or components
2. Cross-Connects, Consolidation Points, and Splice Points
   - Location
   - Service Type *(e.g. Voice, Fiber, PA, etc*)
3. Devices and Installed Equipment:
   - Includes all non-cabling devices such as Cameras, PA speakers, IP clocks, Access Control Panels, Alarm Panels, and other installed equipment.
   - Document must include:
     ◊ Location
     ◊ Device Type

C. Cabling Documentation
1. Cable Routing:
   - As-built drawings must show the approximate cabling path for all:
     ◊ Backbone cabling, connecting MDFs, BDFs, and IDFs.
     ◊ Major horizontal distribution, supporting more than 20 cables.
2. Telecommunications Outlet (TCO):
   - All TCOs must be shown on as-built drawings, indicating the approximate location within the room where each TCO is installed.
   - Each TCO must be labeled with its designated identifier, using the labeling scheme outlined in Section 27 05 53.
3. Abandoned Cables:
   - All abandoned cables left in place due to inaccessibility shall be documented on as-built drawings.
   - Provide written justification for why removal was not possible and indicate exact locations where abandoned cable remains.
   - Abandoned cables shall be labeled per Division 27 standards, and all accessible entry points into the pathway shall be marked accordingly.

3.3.3 Additional Required Documentation

A. Electrical Panels & Circuits – Panels/circuits feeding IDF, MDF, BDF, PA, AV, and other telecommunications backbone infrastructure.

3.3.4 CAD Drawing & Layering Requirements

A. General CAD Drawing Standards:
1. All CAD drawings must be created at a 1:1 (full scale) within the model space of the CAD file.
2. Drawings shall use standard architectural or engineering units (e.g., inches, feet) consistently across all layers and views.
3. When external references (Xrefs) are used, ensure they are also at 1:1 scale to maintain consistency.
4. Dimensioning and scaling within paper space viewports should be managed through the viewport scale settings, not by altering the scale of the drawing in model space.

5. CAD files must include a dedicated layer for RFI-driven changes to distinguish approved deviations from standard installations.

B. PDF Output Requirements:
1. The PDF version of all as-built drawings shall be generated directly from the 1:1 CAD files without any scaling adjustments.
2. PDFs do not need to be printed to a specific scale but must maintain relative proportions to the 1:1 CAD file.
3. All PDF drawings must include a graphic scale and key dimensions to verify proportional accuracy when viewed digitally or printed.

C. Scale Verification:
1. The contractor shall verify that all dimensions in the CAD files are accurate and reflect true measurements at 1:1 scale.
2. Any discrepancies between CAD and PDF dimensions must be resolved before submitting as-built documentation.
3. The District ITS Project Manager may request spot checks of dimensions within the CAD file to ensure compliance.

D. All CAD files must use separate layers for each system type.
1. Pathway & Backbone Cabling Layers
2. Pathway – All conduits, trays, sleeves, pull boxes, and vaults.
3. Backbone-Fiber – Fiber optic backbone.
4. Backbone-Copper – Copper backbone (e.g., Cat6A, Cat3, Coax).
5. Backbone-PA – PA backbone (e.g., 70V speaker lines).

E. Horizontal Cabling & Infrastructure Layers
1. DataPorts – Network jack locations.
2. SecurityCabling – Security system wiring.
3. AVCabling – AV cabling.
4. Infrastructure-WAPs – Wireless access points.
5. Infrastructure-AV – Classroom AV (displays, control panels, etc.).
6. Infrastructure-PA – PA system speakers and amplifiers.

F. Corresponding Text & Callout Layers
1. Each system layer must have a corresponding text/callout layer using the “-Text” suffix.
2. Example: Pathway-Text (for conduit sizing, depth, and encasement details).

G. Drawing Legend Requirements
1. A CAD legend must be included, defining all symbols, conduit types, encasement types, and abbreviations.
2. A sample legend must be submitted for approval before final as-built submittals.

3.3.5 GIS Data Requirements

A. General GIS Requirements:
1. GIS data must be provided for all communications infrastructure installed under Division 27 and Division 28.
2. All GIS data must be collected, processed, and submitted using the following Coordinate Reference System:
   - EPSG:6424 – NAD83(2011) / California Zone 5 (ftUS).
3. GIS information shall be:
   - Accurate to within 3 feet for both indoor and outdoor assets.
   - Located to reflect the actual installed position (e.g., a data jack placed at the center of a wall must be reflected as center-of-wall in GIS, not offset into a corner).
4. GIS location data must be captured and submitted for all of the following:
   - All telecommunications equipment racks (MDF, IDF, BDF).
   - All patch panels, LIUs, and consolidation points.

- All telecommunications outlet locations (TCOs) and device ports (data jacks, WAPs, clocks, AV plates, etc.).

5. All backbone cabling pathways (fiber and copper), including:
   - Underground conduit runs
   - Building entrance points
   - Termination points
   - Intermediate pull boxes or vaults
   - All major horizontal pathway infrastructure:
     - ◊ Sleeves
     - ◊ Conduits (trade size 1-1/4" and larger)
     - ◊ Cable trays (for horizontal cable runs supporting more than 20 cables)
     - ◊ Indoor GIS points must be referenced relative to architectural plan locations.

B. Indoor GIS Requirements:
1. Indoor features must achieve positional accuracy of ≤3 feet relative to floor plans and room layouts.
2. Indoor GIS data shall:
   - Reference the building coordinate system aligned with architectural CAD backgrounds.
   - Map each wall plate, equipment rack, and device as accurately as possible to its installed position.

C. Outdoor GIS Accuracy Requirements:
1. Outdoor features (e.g., vaults, manholes, building entry points) must be located using GPS equipment achieving an accuracy of ≤3 feet.
2. GPS equipment used must meet or exceed the sub-meter accuracy class and support WAAS, SBAS, or RTK corrections if needed.
3. All field-collected outdoor data shall include metadata showing the recorded GPS accuracy at time of capture.

D. GIS Data Submission Requirements:
1. GIS data must be submitted in a digital format suitable for direct import into the District's GIS system, specifically:
   - Preferred format: ESRI-compatible shapefile (.shp) or geodatabase (.gdb) format
   - Acceptable alternative: Comma-separated values (.csv) or Excel (.xlsx) spreadsheet with clearly identified fields
2. Each GIS record must include the following minimum attributes:
   - Unique Identifier (matching as-built labels)
   - Equipment Type (e.g., "Data Jack", "Patch Panel", "Fiber Vault", "Pull Box")
   - Cable ID(s) associated (if applicable)
   - Room Name and Room Number (for indoor points)
   - Installation Date
   - Latitude/Longitude (for outdoor points)
   - Accuracy Reported (GPS equipment reported accuracy)
3. GIS data must be submitted along with final as-built drawings at project closeout.
4. GIS submittal must pass a data quality review by the District's ITS Department Project Manager as part of closeout acceptance.

E. Direct GIS System Entry
1. Where directed by the District ITS Department, the Contractor shall enter GIS data directly into the District's GIS system.
2. Contractor shall use a District-supplied login or field application to complete GIS entries as part of standard closeout activities.

3.3.6 Labeling and Identification Standards

A. All labeling, naming, numbering, and identification associated with communications systems — including but not limited to pathways, pull boxes, vaults, cables, equipment, and outlets — shall comply fully with Section 27 05 53 – Identification for Communications Systems.

B. Submittals, as-built drawings, and photo documentation must reflect the final installed labels and identifiers in accordance with the approved 27 05 53 standards.

3.3.7 Photo Documentation Requirements

A. Required Photos for As-Built Documentation
   1. Underground Pathways – Before backfilling, showing conduit entry/exit points, vaults, and terminations.
   2. Firestopping – All penetrations requiring firestop sealant or assemblies.
   3. Major Cable Runs – Backbone and horizontal cabling before ceiling closure or wall installation.
   4. Labeling & Identification – Patch panels, terminations, and pathways labeled per Section 27 05 53.
   5. Pull Boxes & Vaults
   6. Photos must be taken for all pull boxes and vaults that contain conduits 1-1/2" or larger.
   7. Photos must clearly show conduit entry/exit points, conduit size, and final labeling.
   8. Each pull box/vault photo must be named using its assigned label (e.g., "A-PB001.jpg", "V001.jpg").

B. Photo Submission & Format
   1. All photos must be submitted as:
      - High-resolution JPEG or PNG files.
      - Organized in folders by system type (e.g., Pathways, Firestopping, Racks).
      - Labeled to match as-built drawing identifiers.
   2. A compiled PDF report of all photos shall be submitted with as-built documentation.

3.4 CLOSEOUT SUBMITTALS

3.4.1 Final Documentation Requirements

A. General Requirements
   1. The Contractor shall submit a complete As-Built Package as part of the final closeout submittals.
   2. The as-built documentation must accurately reflect final field conditions and all installed communications systems.
   3. All required submittals shall be compiled into a single package and submitted in accordance with this section.

B. Required As-Built Documentation

   The full as-built package shall include all documentation from Section 3.3– As-Built Documentation, including:
   1. Final CAD Drawings (AutoCAD & PDF) with all required layers and callouts.
   2. Pathway Documentation – Conduit sizes, fill ratios, GIS locations of vaults and pull boxes per the Districts GIS requirements identified in 27 05 50.
   3. Equipment Layouts – MDF/IDF/BDF room layouts with labeled equipment racks.
   4. Labeling & Identification Reports – Per Section 27 05 53.
   5. Photo Documentation – Firestopping, pathways, vaults, and conduit terminations.

C. Certification & Test Results
   1. The following test reports and certifications shall be submitted:
      - 27 13 00 – Copper Backbone Cabling
      - 27 15 00 – Horizontal Cabling
      - 27 15 43 – Fiber Optic Backbone Cabling
   2. Test results shall include:
      - Copper Cabling – Wiremap, attenuation, NEXT/PSNEXT.
      - Fiber Optic Cabling – OTDR traces and insertion loss results.
      - Manufacturer Certification Reports – If required for extended warranties.

D. Additional Required Submittals
   1. Additional documentation required by other Division 27 sections:

E. Format & Delivery
   1. Digital Copies – The full as-built package shall be submitted in both PDF and native file formats (AutoCAD, Excel, etc.).

2. Hard Copy – A printed copy shall be provided if required by the District or ITS Project Manager
3. Signed Receipt – The Contractor shall obtain a signed receipt from the District confirming delivery of the full as-built package.

3.4.2 Turnover Items & Spare Parts

A. General Requirements
1. The Contractor shall provide all required turnover items, spare parts, and documentation at project closeout. These shall be included in the final submittal package and verified before project acceptance.

B. Required Turnover Items
1. Keys – All keys required for access to installed communications equipment, cabinets, and enclosures.
2. Software & Licensing – Any required software, licenses, and activation codes for system operation.
3. Operations & Maintenance Manuals – Complete documentation for installed equipment, including programming guides, troubleshooting procedures, and maintenance schedules.
4. Spare Parts – District-required spare parts as specified in the project documents, including extra patch cables, connectors, and backup power supplies.

C. Delivery & Documentation
1. All turnover items shall be inventoried, labeled, and submitted along with the final as-built package.
2. A complete list of delivered items shall be included in the closeout documentation.
3. The Contractor shall provide a signed receipt from the District or their representative confirming that all required turnover items have been received.

3.4.3 Warranty Submittals

A. General Requirements
1. The Contractor shall submit complete warranty documentation as part of the final closeout package. Warranties shall be valid from the date of final system acceptance and registered in the District's name where applicable.

B. Required Warranty Documentation
1. Contact information for warranty claims and support.
2. Copies of all manufacturer warranties for installed equipment, cabling, and materials.
3. Warranty Tracking Sheet (Excel & PDF), listing:
   - Device Name & Description
   - Manufacturer
   - Model Number
   - Serial Number
   - Warranty Start Date
   - Warranty End Date
   - Coverage Details (e.g., parts, labor, on-site service, extended warranties)
   - Warranty Provider Contact Information
4. Manufacturer Warranty Certificates for all installed equipment and cabling.
5. Proof of Warranty Registration, if required by the manufacturer.
6. Service-Level Agreements (SLAs) for any support or maintenance contracts.

C. Delivery & Documentation
1. All warranty documentation shall be included in the final closeout submittals.
2. A signed receipt from the District or their representative shall confirm that all warranty materials have been received.

END OF SECTION

SECTION 27 05 53 – IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This Section defines requirements for labeling, identification, naming, and marking of all communications infrastructure elements, including cables, outlets, patch panels, racks, pathways, equipment, and spaces. B. All identification shall support system documentation, maintenance, and expansion by providing clear, standardized, and permanent labeling. C. Requirements of this Section apply to all Division 27 and Division 28 systems, unless otherwise noted.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27, and Division 28 sections and requirements in their entirety. For list of all Division 27, and Division 28 sections see section 1.3 of 27 00 00. If section 27 00 00 was not provided contact Districts ITS Department Project Manager to receive complete copy of the Division 27, and Division 28 sections.

1.2.2 Specific Related Sections

A. 27 00 00 – Communications General Requirements
B. 27 05 26 – Grounding and Bonding for Communications Systems
C. 27 05 50 – Communications Documentation & Submittals

1.3 SUBMITTAL REQUIREMENTS

1.3.1 Prior to beginning work, the Contractor shall submit a Labeling Plan to the District ITS Department Project Manager for review and approval.

1.3.2 The Labeling Plan shall include:

A. Proposed numbering/labeling schema for:
   1. Cables
   2. Patch panels
   3. Outlets
   4. Racks
   5. Equipment
   6. Pathways (conduits, sleeves, cable trays)
   7. Pull boxes and vaults
B. Format, font, size, material specifications of all labels.
C. Sample label images for each type of system (horizontal cable, backbone cable, outlet, patch panel, etc.).
D. Color-coding or special identification schemes, if any.

1.3.3 Coordination with District ITS Department Project Manager:

A. Contractor shall coordinate with the District ITS Department Project Manager to:
   1. Obtain any required District-assigned prefixes, numbering blocks, or naming conventions.
   2. Verify or receive approval for the starting point of all sequential numbering schemes.
   3. Confirm assignment of equipment rack numbers, IDF/MDF identifiers, and cross-connect labeling standards.
B. The District ITS Department Project Manager reserves the right to assign specific starting points or blocks of numbers to ensure consistency across all projects and campuses.
C. If no pre-assigned numbering is provided, the Contractor shall propose a logical and scalable system for review and approval.

1.3.4 No permanent labeling work may begin until the Labeling Plan is reviewed and approved by the District ITS Department Project Manager.

1.3.5 Any deviations from the approved labeling scheme during construction must be submitted for re-approval prior to implementation.

1.4 LABELING CONSISTENCY REQUIREMENTS

1.4.1 All labeling, numbering, and identification shall be consistent across:

A. Field installations (physical labels at devices, cables, racks, patch panels, pathways, vaults, etc.),
B. All documentation, including but not limited to:
   1. Shop drawings
   2. As-built drawings (PDF and CAD formats)
   3. Labeling schedules
   4. Testing and certification reports
   5. Photo documentation
   6. GIS data submissions
   7. Warranty and asset tracking documents

1.4.2 The exact same label identifiers shall be used in:

A. Physical labels applied to cables, equipment, and pathways.
B. CAD layers and drawings submitted for as-built documentation.
C. GIS data attributes (for ports, pathways, pull boxes, vaults, etc.).
D. All communications and submittal documents provided to the District.

1.4.3 No discrepancies between field labeling and submitted documentation are permitted.

A. Inconsistent, missing, or mismatched labeling will be grounds for rejection of submittals or installed work.
B. The Contractor shall be responsible for correcting all labeling inconsistencies at no additional cost to the District.

1.4.4 The Contractor shall verify during installation and again at project closeout that:

A. Labeling is complete, accurate, and matches the approved Labeling Plan.
B. All field labels correspond exactly with the identifiers used in as-builts and GIS submissions.

PART 2 - PARTS

2.1 GENERAL

2.1.1 Performance Requirements for All Labels

A. Labels must meet UL 969 requirements for legibility, defacement, exposure, and adhesion.
B. **Handwritten labels are strictly prohibited on all systems.**
C. Labels must maintain consistency across field labeling, as-built documentation, CAD drawings, submittals, and GIS records.
D. All label text shall:
   1. Use sans-serif fonts (e.g., Arial, Helvetica) for maximum readability.
   2. Be in uppercase characters.
   3. Be sized appropriately to remain legible under normal viewing conditions.
   4. Contrast strongly with the background surface (e.g., white on black, black on white, yellow on dark backgrounds).

2.2 PRE-APPROVED MATERIALS

2.2.1 Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved cable types and manufacturers.

2.2.2 Products listed in 27 06 50 do not require additional approval.

2.2.3 Any proposed substitutions, or products or cable types not explicitly listed in Section 27 05 50, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 The following products are strictly prohibited:

2.4 WIRE LABELS

2.4.1 Application:

A. Used for labeling low-voltage cabling, including but not limited to backbone fiber, horizontal fiber, copper data cabling, and system-specific cabling (e.g., security, AV, control). Intended for flexible, serviceable identification during maintenance, upgrades, or repurposing.

2.4.2 Type:

A. Flexible, self-laminating wrap-around labels, heat-shrink sleeves, or equivalent field-printable materials.

2.4.3 Material & Construction:

A. Must conform to curved cable surfaces without lifting or cracking.
B. Use aggressive adhesives suitable for plenum, riser, and outdoor-rated cable jackets.
C. Must withstand routine handling and pulling forces.

2.4.4 Print Requirements:

A. Computer-printed or pre-printed only. Handwritten labels are prohibited.
B. High-contrast print (black text on colored background, unless otherwise specified).

2.4.5 Label Color (System Type):

System Type	Label Color	Pantone Code
Fiber Backbone	Yellow	101C
Copper Backbone	Gray	442C
Fiber Horizontal	White	N/A
Copper Horizontal	White	N/A
EMS / Lighting / HVAC	Orange	150C
Intrusion Alarm	Blue	291C
Access Control	Purple	264C
Other Systems	Brown	465C
Audio/Visual	Green	353C

TABLE 27 05 53 - 1

2.5 FACEPLATE LABELS

2.5.1 Application:

A. Used for identifying network outlets, voice/data jacks, or device ports located on wall-mounted faceplates, typically in workstation or classroom environments.
B. Designed to snap into label windows or recesses on communications faceplates.

2.5.2 Label Construction:

A. Labels shall be pre-printed or computer-printed (no handwritten labels permitted).
B. Printed on durable material compatible with the faceplate's label window.
C. Label color shall be white with black text.

2.5.3 Installation Requirements:

A. Labels must be sized to fit flush within the faceplate label window without curling or obstruction.
B. Labels shall be non-destructively removable, allowing for easy removal without damage to the faceplate or label recess, enabling access to underlying screws or components.
C. Clear protective covers shall be used if provided with the faceplate design to prevent label wear or contamination.

2.6 PERMANENT EQUIPMENT LABELS

2.6.1 Application:

A. Intended for permanent identification of outdoor or indoor fixed infrastructure components, including but not limited to junction enclosures, electrical panels, wall-mounted enclosures, and mounted communications infrastructure.

2.6.2 Material Requirements:

A. Labels shall be fabricated from one of the following materials:
   1. Stainless steel
   2. Anodized or engraved aluminum
   3. UV-stable, impact-resistant polymer composites (indoor or protected outdoor use only)

2.6.3 Label Format & Engraving:

A. Labels shall include content as specified in Part 3
B. All text shall be mechanically engraved or stamped, recessed into the surface of the label.
C. Raised text is not acceptable.
D. Lettering height shall be between 0.5 inch and 2 inches, depending on the application, as specified in Part 3.
E. Engraving depth shall be a minimum of 1/32 inch (0.8 mm) for durability and legibility.

2.6.4 Physical Characteristics:

A. Labels must be:
B. Weatherproof and UV-stable for exterior or exposed applications.
C. Corrosion-resistant in moist, high-humidity, or chemically exposed environments.
D. Abrasion-resistant to withstand cleaning, contact, and operational wear.

2.6.5 Label Size:

A. Label dimensions shall be proportional to the text and mounting surface, with a minimum size of 1 inch x 2.5 inches (25 mm x 64 mm) unless otherwise specified.

2.7 SEMI-PERMANENT EQUIPMENT LABELS

2.7.1 Application:

A. Used for labeling system hardware, including but not limited to patch panels, modular jacks, faceplates, racks, enclosures, and front-facing telecom equipment. Labels must conform to the physical dimensions of the equipment surface and support replacement or reconfiguration without damaging the underlying surface.

2.7.2 Type:

A. Vinyl, polyester, or equivalent semi-permanent tape labels designed for flat surfaces.
B. Must be suitable for mounting on racks, panels, enclosures, patch panels, faceplates, or devices.

2.7.3 Material & Construction:

A. Field-printable using thermal transfer or laser printers.
B. Must allow field trimming to custom lengths and widths.
C. Must be available in:
   1. Widths: From ¼ inch (6 mm) to 2 inches (51 mm)
   2. Lengths: From ½ inch (13 mm) to 24 inches (610 mm)
D. Adhesive must adhere to powder-coated steel, painted metal, plastic, and composite surfaces.

2.7.4 Durability:

A. Indoor-rated minimum; UV-stable preferred for long-term reliability.
B. Resistant to oils, cleaning solvents, and ambient heat from electronics.

2.7.5 Print Requirements:

A. Pre-printed or computer-printed; handwritten labels are prohibited.
B. High-contrast, clearly legible black text.

2.8 UNDERGROUND STRUCTURE LABELS

2.8.1 Application:

A. Used for long-term identification of buried or partially buried telecom infrastructure, including but not limited to vault lids, handhole covers, and access panels. Installed in high-durability environments subject to vehicular traffic, soil contact, and environmental exposure.

2.8.2 Label Type:

A. Integral cast marking or mechanically fastened plate identifying structure type and ID.

2.8.3 Material:

A. Ductile iron or stainless steel only.
B. Aluminum and composite materials are prohibited due to insufficient mechanical durability.

2.8.4 Durability Requirements:

A. Labels must be designed to withstand:
   1. Vehicular traffic loads
   2. Moisture exposure, including submersion and varying weather conditions
   3. Long-term outdoor exposure, ensuring legibility and structural integrity over time.

2.8.5 Lettering Specifications:

A. Shall support a minimum of two lines of engraved text.
B. Characters shall be a minimum of 1 inch in height and may be up to 2 inches, depending on application-specific requirements.
C. All lettering shall be recessed (engraved) into the label surface to prevent degradation from wear.
D. The minimum engraving depth shall be 1/16 inch (1.6 mm) to ensure long-term legibility and resistance to environmental wear.
E. Raised lettering is prohibited.

2.8.6 Integration:

A. Labels shall be applied via one of the following methods:
   1. Cast integrally into the lid during manufacturing, ensuring permanent identification.
   2. Mechanically fastened to the lid using corrosion-resistant hardware, provided the attachment method meets the durability and environmental requirements specified herein.
   3. Directly Engraved into the lid.

2.9 UNDERGROUND CONDUIT TAGS

2.9.1 Application:

A. Used for permanent labeling of underground conduits, including but not limited to telecom conduit runs entering or exiting handholes, vaults, buildings, or pull boxes. Tags support long-term asset tracking, pathway tracing, and maintenance operations and must withstand harsh below-grade environments.

2.9.2 Construction Requirements:

A. Tags shall be engraved or stamped using high-durability materials.
B. Acceptable materials include:
   1. Stainless steel
   2. Brass
   3. Anodized aluminum
C. Labels must be corrosion-resistant, non-conductive (when required), and UV-stable if exposed.
D. Labels shall maintain legibility throughout the expected service life.

2.9.3 Engraving Specifications:

A. Minimum character height shall be 0.5 inches.
B. Minimum engraving depth shall be 0.015 inches.
C. All lettering shall be in high-contrast block format to ensure long-term legibility.

2.9.4 Tag Durability & Placement Requirements:

A. Tags shall resist moisture, soil acidity, mechanical abrasion, and temperature fluctuations.
B. Tags shall not deform, flake, or fade when installed underground.

2.10 MATERIAL PERFORMANCE REQUIREMENTS

2.10.1 All label materials shall resist exposure to:

A. UV light (indoor and outdoor applications).
B. Moisture, solvents, and mild chemicals.
C. Mechanical abrasion from handling and maintenance activities.

2.10.2 All adhesives must bond to the intended surface material (cable jackets, painted metal, plastic, conduit, etc.) without curling, peeling, or delaminating over the service life.

PART 3 - EXECUTION

3.1 GENERAL LABELING EXECUTION REQUIREMENTS

3.1.1 Scope and Coordination

A. All labeling requirements outlined in this section apply to physical field labels, CAD drawings, GIS documentation, and as-built records.
B. The Contractor shall coordinate all labeling schemes with the District ITS Project Manager.
C. Labeling schemas and starting point ID values must be submitted and approved prior to field implementation.

3.1.2 Label Consistency and Standardization

A. Labeling must remain consistent across:
   1. Physical infrastructure (tags, nameplates, wraps, etc.)
   2. CAD drawings and as-builts
   3. GIS records
   4. All project submittals and turnover documentation

B. Identifiers shall not be reused across different systems or assets, unless approved as a replacement for a decommissioned asset.
C. All labeling shall be consistent with the simplified schema outlined in this section, which is based on but not bound to ANSI/TIA-606-B.

3.1.3 Labeling Schema Coordination:

A. All labeling schemes must be coordinated and approved by the District ITS Project Manager prior to any field labeling or documentation.
B. Labeling shall conform to this specification, not the construction drawings or architectural naming conventions.
C. In the event of a conflict between the drawings and this section, the specification takes precedence.
D. No placeholder, estimated, or duplicate labels shall be used. All labels must be assigned based on actual field conditions and confirmed installation.

3.1.4 Label Visibility and Orientation

A. Labels shall be installed so they are:
1. Oriented for easy reading (horizontal or upright).
2. Located in visible, accessible positions on equipment, faceplates, patch panels, conduit, and structures.
3. Aligned consistently across similar assets within the site.

3.1.5 Label Format and Typography

A. All label text shall:
1. Be in uppercase characters.
2. Use sans-serif fonts (e.g., Arial, Helvetica) for maximum readability.
3. Be sized appropriately to remain legible under normal viewing conditions.
4. Contrast strongly with the background surface (e.g., white on black, black on white, black on yellow, black on orange backgrounds).

3.1.6 Character Size and Engraving Depth

A. Minimum character height requirements:
1. Equipment Labels: 0.5 inches.
2. Underground Structure Labels: 1.0 inch minimum; up to 2.0 inches as required.
3. Faceplate Inserts: Must fit within label window and remain legible.
4. Cable Labels: Must fit so the text remains legible without requiring the cable to be rotated more than 90 degrees.
B. Engraving depth for permanent labels: Minimum 1/16 inch (1.6 mm).

3.1.7 Label Revisions and Updates

A. Any field changes to labeling shall be clearly redlined on record drawings.
B. All revised labeling must be submitted to the District ITS Project Manager for review and approval prior to closeout.
C. Approved changes must be reflected in all final submittals, including:
1. Physical labels
2. CAD files
3. GIS datasets
4. Labeling schedules

3.2 IDENTIFICATION AND NAMING STANDARDS

3.2.1 General Requirements

A. Purpose and Scope: This section defines the standardized identification and naming rules applied to all telecommunications infrastructure components, including but not limited to:
   1. Pathways (conduits, pull points, vaults, handholes, pedestals, sleeves, pull boxes, etc.)
   2. Devices (network, security, AV, PA, EMS, fire alarm, etc.)
   3. Equipment enclosures (racks, cabinets, control panels, etc.)
   4. Cables and wiring systems
   5. All related elements appearing on physical labels, CAD drawings, as-built documents, GIS records, and turnover packages.

B. Objectives: These standards ensure that all identifiers:
   1. Are consistent across physical labeling CAD/as-built drawings, GIS records, and project documentation.
   2. Provide clear, unique, and traceable identification across the entire site.
   3. Avoid duplication, ambiguity, or conflict between systems or asset types.
   4. Comply with a simplified naming convention aligned with ANSI/TIA-606-B, tailored to the District's operational and maintenance needs.

C. Mandatory Cross-System Consistency:
   1. All assigned identifiers must be:
      - Applied identically on all physical tags or markings.
      - Reflected exactly in CAD/as-built documentation.
      - Recorded accurately in GIS system datasets.
      - Used consistently in all project submittals and turnover documentation.
   2. Any discrepancy between physical labels and project documentation shall be treated as a nonconformance and must be corrected before project closeout.

D. Division 27 Section Overrides
   1. If any individual Division 27 section includes more stringent labeling requirements or defines a labeling scheme that differs from the general standards in this section, the more stringent or specific section shall govern.
   2. In cases of conflict, the Contractor shall coordinate with the District ITS Project Manager to clarify which standard applies.
   3. All deviations from the general or specific standards must be documented and approved in writing by the District ITS Project Manager.

E. General Naming Rules
   1. All identifiers must be:
      - Assigned using approved prefixes as outlined in each relevant subsection (e.g., pathway, device, enclosure, cable).
      - Constructed using uppercase alphanumeric characters only.
      - Formatted using hyphens as delimiters between major identifier components (e.g., HH01-VA03-A).
      - Sequentially numbered or lettered, starting from "01" for numeric sequences and "A" for alphabetic sequences.
      - Free of special characters (e.g., &, @, *, !), spaces, or lowercase letters.
   2. Identifier sequencing and starting points must be coordinated and approved by the District ITS Project Manager prior to assignment.
      - Contractor shall submit a proposed numbering schema and starting point for each major system type before labeling begins.
      - The ITS Project Manager reserves the right to adjust or assign numbering blocks to ensure systemwide consistency and prevent conflicts.
   3. Identifiers shall be coordinated across all project stakeholders to avoid clashes with architectural, structural, mechanical, or electrical naming conventions.
      - In the event of conflict, the requirements of this specification take precedence over construction drawings or external discipline standards.

3.2.2 Telecommunications Space Identification Standards

A. Scope:

1. This section defines the standardized naming rules for all telecommunications spaces that serve as primary hubs, distribution points, or intermediate connection points for the structured cabling system, including but not limited to:
   - Main Distribution Frame (MDF)
   - Intermediate Distribution Frame (IDF)
   - Building Distribution Frame (BDF)
   - Minimum Point of Entry (MPOE)
   - Consolidation Points (CP)
2. These space identifiers anchor:
   - Enclosure and rack naming
   - Cable pathway and backbone labeling
   - CAD, GIS, and documentation references

B. Identifier Structure

1. Each telecommunications space shall be assigned a unique identifier using the following format:
   - [Prefix]-[Two-Digit Number]
   - Examples:
     ◊ IDF-01 (IDF 1)
     ◊ CP-05 (Consolidation Point 6)
     ◊ MPOE-01 (First MPOE)
2. Prefixes shall follow the standard set below:

PREFIX	DESCRIPTION
MDF	Main Distribution Frame
IDF	Intermediate Distribution Frame
BDF	Backbone Distribution Frame
CP	Consolidation Point Locations
MPOE	Service Provider Minimum Point of Entry

C. Special Rules:

1. MDF: Always considered ID 0 and referred to simply as “MDF” (numeric suffix may be omitted).
2. IDF/BDF Numbers: Assigned unique two-digit numeric suffixes; numbers shall not overlap or duplicate between IDF and BDF systems.
   - Example: You cannot have IDF01 and BDF01 at the same site. If IDF01 exists, BDF numbering starts at 02 or higher.
3. If an IDF later becomes a BDF (or vice versa), it retains its numeric suffix, but the prefix changes to reflect the new function.

3.2.3 Pathway Infrastructure Identification Standards

A. Scope

1. This subsection applies to the identification of all passive telecommunications pathway infrastructure, including but not limited to:
   - Handholes
   - Vaults
   - Manholes
   - Pedestals
   - Pull Boxes
   - Pull Points
   - Sleeves
   - Stub-ups / Stub-outs
   - Other underground or above-ground passive structures used to route, transition, terminate, or house telecommunications pathways.

B. Identifier Structure

1. Each pathway structure shall be assigned a unique identifier using the following format:
   - [Prefix][Two-Digit Number]
   - Examples:
     ◊ HH01 (Handhole 01)
     ◊ VA05 (Vault 05)
     ◊ PB12 (Pull Box 12)
     ◊ PE03 (Pedestal 03)
2. Prefixes shall follow the standard set below:

PREFIX	DESCRIPTION
JH	J-Hook Pathway
PB	Pull Box
SL	Sleeve
MH	Man Hole
HH	Handhole
TP	Telephone Pole
VA	Vault
PE	Pedestal
PP	Pull Points / Conduit Bodies
SB	Stub Up / Stub Out In Non-Telecom Spaces
TC	Stub Up / Stub Out In Telecom Spaces

3. Numbering shall:
   - Start at "01" for each prefix type.
   - Increment sequentially across the project site without skipping or reusing numbers.
   - Be unique to the site.
   - Be coordinated and approved by the District ITS Project Manager to ensure systemwide consistency.
4. Special Rules
   - For Stub Up / Stub Out In Telecom Spaces (TC) use the ID for the telecommunications space.
     ◊ Example: Stubs in IDF-05 would be identified as TC05
   - Each structure shall retain its identifier throughout its lifecycle, even if modified or expanded later.
   - If a structure is removed or decommissioned, its identifier shall be retired and not reassigned to a new asset.

3.2.4 Pathway Identification Standards

A. Scope
1. This subsection applies to the identification and naming of all linear telecommunications pathway components, including but not limited to:
   - Individual conduits
   - Conduit banks (parallel conduit runs between two points)
   - Sleeves (SL)
   - Stub-ups and stub-outs (SB)
   - Pathways terminating directly into telecommunications enclosures

B. Identifier Structure
1. All conduits and sleeves shall be labeled using the format:
   - [Prefix] [Originating Structure ID]- [Prefix] [Destination Structure ID]-[Conduit Letter] or,
   - [Prefix] [Originating Structure ID]- [Prefix] [Destination Equipment ID]-[Conduit Letter] or,
   - [Prefix]-[Originating Room Number]-[Destination Room Number]-[Conduit Letter] (For Sleeves)
   - Example:
     ◊ HH01-VA05-A → First conduit from Handhole 01 to Vault 05
     ◊ VA05-PP02-B → Second conduit from Vault 05 to Pull Point 02
     ◊ PB02-SB03-A → First conduit from Pull Box 02 to Stub 03 (non-telecom space)
     ◊ PB05-TS05-A → First conduit from Pull Box 05 to Stub Up in IDF05 (telecom space)

- ◊ PB07-ACP03-A → First conduit from Pull Box 07 to Access Control Panel 03
- ◊ SL-B101-B102-A → Sleeve between rooms B101 and B102

2. Rules for assigning conduit letters:
   - The first conduit between two points is always labeled A, even if it is the only conduit.
   - Additional conduits between the same two points increment alphabetically (B, C, D, etc.).
   - If conduits are arranged in a parallel duct bank, conduit A shall be the leftmost or uppermost conduit when facing the destination, followed by B, C, D, etc.
3. The "originating structure" is always the structure closes in the path to the MDF to ensure consistency.

C. Special Cases and Clarifications
1. Intermediate Pull Points:
   - Each conduit segment between pull points (vaults, handholes, pedestals) resets the naming sequence.
2. Conduit Bodies and Close Pull Points:
   - Conduit bodies (e.g., LBs) or pull points located adjacent and serving the same pathway are treated as part of the same duct bank and identified as A, B, C sequence.
3. Terminations into Telecom Spaces:
   - When a conduit terminates directly in a telecom space (e.g., IDF05), the stub is labeled using TS + space number (e.g., PB05-TS05-A).
4. Terminations into Enclosures:
   - Conduits terminating directly into panels or field devices (ACP, ICP, EMS, CP) use the enclosure identifier.

D. Numbering and Approval
1. All conduit and pathway identifiers must be approved and assigned in coordination with the District ITS Project Manager.
2. Sequential letters and numbers shall not be skipped or reused.

3.2.5 Equipment Identification Standards

A. Fixed Equipment
1. Scope
   - Applies to semi-permanent telecommunications-related equipment installed:
     - ◊ Within telecommunications spaces (MDF, BDF, IDF, MPOE)
     - ◊ At designated telecommunications consolidation points
2. Includes but is not limited to:
   - Access Control Panels
   - Intrusion Control Panels
   - Energy Management System Controllers
   - Fire Alarm Control Panels
3. Format:
   - [Equipment Prefix]-[Telecom Space or CP Number]-[Sequential Number (if multiple)]
4. Examples:
   - ACP-03 → Access Control Panel in IDF 3
   - EMS-05-2 → Second EMS controller in IDF 5
5. Prefixes:

PREFIX	DESCRIPTION
EMS	ENERGRY MANAGEMENT SYSTEM
ACP	ACCESS CONTROL PANEL
ICP	INTRUSION CONTROL PANEL

A. Racks and Cabinets
1. Scope
   - Applies to telecommunications racks and cabinets.

2. Includes but is not limited to:
   - IDF Racks / Cabinets
   - MDF Racks / Cabinets
   - BDF Racks / Cabinets
   - AV Racks / Cabinets
   - Radio Racks / Cabinets
3. Format:
   - [Prefix]-[Telecom Space ID]-[Sequential Number (if multiple)]
   - If there is only one rack then the sequential number can be omitted.
4. Examples:
   - MDF → Campus MDF
   - IDF-01 → Rack 1 in IDF-01
   - IDF-01-2 → Rack 2 in IDF-01
5. Prefixes:

PREFIX	DESCRIPTION
IDF	IDF RACKS OR CABINETS
MDF	MDF RACKS OR CABINETS
BDF	BDF RACKS OR CABINETS
AV	AUDO / VIDEO RACKS OR CABINETS
RF	RADIO RACKS OR CABINETS

B. Wired Network Equipment
1. Scope
   - Applies wired network equipment.
   - Includes but is not limited to:
     ◊ Switches
     ◊ Routers
     ◊ Firewalls
2. Format:
   - [Assigned IPv4 Address] -[Sequential Number (if stacked)]
   - Examples:
     ◊ 10.34.192.10 → Single Network Devices
     ◊ 10.34.250.11-1 → First device in a stack of switches
     ◊ 10.34.250.11-2 → Second device in a stack of switches

C. Wireless Network Equipment
1. Scope
   - Applies wireless network equipment.
   - Includes but is not limited to:
     ◊ Wireless Access Points
2. Format:
   - [MAC Address of devices]
   - Minimum 1” high text
   - Examples:
     ◊ 00:1A:C2:7B:00:4C

3.2.6 Copper Cabling Identification Standards

A. Scope
1. This subsection applies to the identification and naming of all copper telecommunications cabling systems, including but not limited to:
   - Work area outlets (faceplates, data jacks)
   - Patch panels

- Consolidation points (CP) for copper systems
- Horizontal cabling
- Backbone (riser) copper cabling

B. Identifier Structure

1. Patch Panels:
   - Format: [Panel Letter]
     ◊ Panel Letter: Unique within each telecom room, starting with A and incrementing (A, B, C…)
2. Patch Panel Ports:
   - Format: [Prefix]-[Location]
     ◊ Only used for non-client devices
     ◊ When a port is located in a room then the room number on the door shall be used.
     ◊ When a port is located outside of the building then utilize compass directions (North, East, South, West)
   - Example:
     ◊ W-P11 → Wireless Access Point device port in room P11
     ◊ S-N → Security device port located on the north side of the building.
     ◊ P-IDF1 → PA device port located in IDF1
3. Horizontal Data Cabling / Jacks / Faceplate Ports:
   - Format: [Space ID]-[Patch Panel Letter]-[Port Number (1–48)]-[Device Type ID (if non-client port)]
     ◊ Space ID: Matches the telecom room (IDF, MDF, BDF)
     ◊ Patch Panel Letter: Matches the patch panel
     ◊ Port Number: As numbered on the panel (typically 1–24, 1–48)
     ◊ Device Type ID (suffix, only if applicable):

PREFIX	DESCRIPTION
W	WIRELESS ACCESS POINT
S	SECURITY DEVICE (ALARM, CCTV, ACCESS CONTROL, ETC)
F	FACILITIES DEVICE (HVAC, EMS, LIGHTING, ETC)
P	PA DEVICES (IP CLOCK SPEAKERS, PA SPEAKERS, AMPLIFIERS, ETC)
A	AV DEVICES
FIRE	FIRE ALARM CABELING

   - Examples:
     ◊ 03-B-35 → IDF 3, Patch panel B, port 35, client data port
     ◊ 03-B-35-W → IDF 3, Patch panel B, port 35, WAP connection
     ◊ 01-A-12-S → IDF 1, Patch panel A, port 12, security device
4. Backbone Cabling:
   - Format: [Cable Size]-[Service]-[Origin Space ID]-[Destination Space ID]- [CableNumber(ifmultiple)]
   - Example:
   - 25PAIR-VOICE-MDF-IDF5 → 25-pair voice cable from MDF to IDF 5
   - 25PAIR-VOICE-MDF-IDF5-2 → Second 25-pair voice cable from MDF to IDF 5
   - 18/8-PA-MDF-IDF3 → 18/8 PA cable from MDF to IDF 3

C. Numbering Rules

1. Patch panel letters must be unique within each telecom space, starting at A and incrementing.
2. Patch panel port numbers follow the manufacturer's panel numbering.
3. Jacks on faceplates are labeled left-to-right or top-to-bottom (A, B, C, etc.).
4. If only one cable exists, no sequential number is required.
5. If multiple cables of the same type and service run between the same spaces, assign sequential numbers starting at 1.
6. Each cable must carry a unique identifier both on physical labels and in all documentation.

3.2.7 Fiber Cabling Identification Standards

A. Scope

1. Applies to all backbone fiber optic cabling installed between telecommunications spaces, including but not limited to:
   - MDF, BDF, IDF, MPOE rooms
   - Consolidation points (if backbone-fed)
   - Equipment rooms or hubs

B. Identifier Structure.
1. Fiber Backbone Cabling:
   - Format:
     ◊ [Fiber Count]-[Fiber Type]-[Origin Space ID]-[Destination Space ID]-[CableNumber(ifmultiple)]
   - Components:
     ◊ Count: Total number of strands (e.g., 6S, 12S, 24S, 48S)
     ◊ Type: Specifies the optical type (e.g., MM for multimode, SM for singlemode)
     ◊ Origin Space ID: MDF, IDF, BDF, MPOE, or equivalent
     ◊ Destination Space ID: MDF, IDF, BDF, MPOE, or equivalent
     ◊ Sequential Cable Number: Required if multiple cables of the same type run between the same spaces (e.g., -1, -2, -3…)
2. Examples
     ◊ 12S-SM-MDF-IDF2 → 12-strand singlemode fiber from MDF to IDF 2
     ◊ 12S-MM-MDF-IDF2-2 → second 12-strand singlemode fiber between MDF and IDF 2
     ◊ 24S-MM-MDF-IDF2 → 24-strand multimode fiber from MDF to IDF 2

C. Numbering Rules
1. If only one cable exists, the sequential number is omitted.
2. If multiple cables of the same type, count, and destination exist, assign sequential numbers starting at 1

D. Approval
1. All fiber backbone identifiers must be coordinated with the District ITS Project Manager prior to installation.
2. No duplicate or placeholder numbers are allowed without explicit approval.

3.3 PATHWAY COMPONENT LABELING

3.3.1 General Requirements

A. This subsection applies to labeling requirements for all physical pathway infrastructure including but not limited to: Conduits, Pull Points, Handholes, Vaults, Sleeves, Pedestals, Other passive infrastructure components used to support low voltage cabling.
B. Each label must provide sufficient information to uniquely identify the component and relate it to both entry and exit points, where applicable (e.g., conduits).

3.3.2 Label Content

A. Labels shall display the exact identifier assigned per Section 3.2 Identification and Naming Standards
B. Labels must match identifiers exactly across:
1. Physical equipment
2. CAD/as-built documentation
3. GIS system records
4. All submittal and turnover documentation
5. No abbreviations, shortened versions, or placeholder tags are permitted on the physical label unless otherwise specified in Section 3.2

3.3.3 Label Materials and Specifications

A. All equipment labels shall follow the materials, durability, font, contrast, and character size requirements outlined in Part 2 – Label Products and Materials of this specification.
B. Labels shall be permanent, corrosion- and weather-resistant, and remain legible for the full service life of the equipment.

3.3.4 Pathway Infrastructure Labeling

A. Scope:
1. This subsection applies to the labeling of all pull point pathway structures including but not limited to handholes (HH), vaults (VA), pedestals (PE), manholes (MH), pull boxes (PB), and above-ground telecommunications enclosures used for cable routing, splicing, or access.

B. Label Structure:
1. Labeling sequence shall proceed logically from the point of entry or service origin (e.g., MDF/BDF) outward to end-use locations.
2. Final numbering shall be coordinated with and approved by the District ITS Project Manager.

C. Label Format Requirements
1. Lettering: Minimum 1" height.
- Exception: For pull points where a 1-inch character height is not physically feasible (e.g., small conduit bodies, junction boxes), the lettering shall be the largest possible size that ensures clear legibility and proper fit within the available labeling area.

D. Label Placement:
1. Underground Pull Points (e.g., Handholes, Vaults, Manholes):
- The structure lid/cover must include a permanent, engraved or cast-in-place label that reads "TELECOM" on the top line and the unique pull point ID on the second line.
- A second permanent interior label (metal or engraved plastic tag) shall be permanently affixed to the interior wall of the structure with weather-resistant fasteners. This label shall include the same identifier used on the lid.
2. Above-Ground Pull Points (e.g., Pedestals, Surface-Mounted Enclosures):
- A permanent label must be mounted to the interior of the enclosure in a clearly visible location.
- Labels may be:
  ◊ Engraved or stamped tags affixed with weather-resistant fasteners, or
  ◊ Weatherproof printed labels using UV-resistant print and weather-resistant adhesive. Labels must remain legible and adhered throughout the enclosure's service life.

3.3.5 Conduit Labeling

A. Scope:
1. This subsection defines labeling requirements for all communications conduits, including but not limited to:
- Individual conduit runs (PVC, EMT, GRC, etc.)
- Conduit banks (multiple conduits bundled together)
- Stub-ups and stub-outs
- Conduits entering or exiting buildings, pull points, vaults, handholes, pedestals, and equipment enclosures.

B. The purpose of conduit labeling is to provide clear, permanent identification for pathway tracing, asset management, and future maintenance or expansion.

C. Simplified Conduit Label Within Enclosures:
1. The actual label affixed to the conduit at each end only needs to include the ID of the opposite end and the sequential conduit letter.
2. Example: For the conduit PB01-VL03-A, the label placed at VL03 shall read PB01-A.

D. Label Placement and Materials
1. Above-Ground Termination Points (e.g., surface-mounted pull boxes, conduit bodies, above-ground junctions):
- Labels must be mounted inside the enclosure or fitting in a clearly visible position.
- Approved Label Types:
  ◊ Engraved or stamped metal tags affixed with corrosion- and weather-resistant fasteners, or
  ◊ Weatherproof printed labels using UV-resistant print and high-bond adhesive.
- Labels must remain securely attached and legible for the full enclosure service life.

2. Underground Termination Points (e.g., vaults, handholes, manholes, buried conduit heads):
   - Conduit ends must be labeled using permanent engraved brass or aluminum ID tags.
   - Tags shall be permanently affixed directly to the conduit or on the structure next to the conduit.
     ◊ Attachment must not obstruct or impede cable pulling operations within the conduit.
     ◊ Tags must resist corrosion, moisture, soil contact, and mechanical stress over the full life of the system.

3.4 EQUIPMENT LABELING

3.4.1 Scope

A. This section defines the physical labeling requirements for all fixed telecommunications-related equipment, including but not limited to:
   1. Access control panels
   2. Intrusion control panels
   3. Energy management system controllers
   4. Fire alarm control panels
   5. Telecommunications racks and cabinets
   6. Other semi-permanent equipment installed within telecommunications spaces or consolidation points

3.4.2 Label Content

A. Labels shall display the exact identifier assigned per Section 3.2 Identification and Naming Standards
B. Labels must match identifiers exactly across:
   1. Physical equipment
   2. CAD/as-built documentation
   3. GIS system records
   4. All submittal and turnover documentation
   5. No abbreviations, shortened versions, or placeholder tags are permitted on the physical label unless otherwise specified in Section 3.2

3.4.3 Label Materials and Specifications

A. All equipment labels shall follow the materials, durability, font, contrast, and character size requirements outlined in Part 2 – Label Products and Materials of this specification.
B. Labels shall be permanent, corrosion- and weather-resistant, and remain legible for the full service life of the equipment.

3.4.4 Label Placement

A. Access control, intrusion, EMS, and fire alarm panels:
   1. Affix label to the upper left corner of the exterior cabinet door.
   2. Affix a second label on the upper right side of the interior cabinet door.
B. Racks and cabinets:
   1. Place labels on the top center of the front face of the rack or cabinet.
   2. Place a second label on the top center of the rear face (if rear access is provided).
C. Network Equipment
   1. Affix label to the front of the equipment so that it is not obstructing any vital information such as serial numbers, interface names, or indicator lights.
   2. Labels shall be affixed either horizontally or vertically
   3. Label location shall be constant across all of the same model of equipment.
D. Wireless Access Points
   1. Affix label to the front of the wireless access point.
   2. Labels shall be affixed either horizontally or vertically
   3. Label location shall be constant across all of the same model of equipment.
E. Outdoor or weather-sealed equipment enclosures:

1. Install the label on an interior surface that is immediately visible and quickly identifiable by an untrained person when the enclosure is opened.
2. External labels may be used for redundancy but are not required if environmental exposure would compromise readability.

3.4.5 Special Notes

A. Handwritten labels are strictly prohibited.
B. Labels must be mechanically affixed (screws, rivets, permanent adhesive with protective overlay); adhesive tape or temporary stickers are not acceptable.
C. Any changes to equipment identifiers after initial installation must be reported, updated in all documentation, and fully relabeled prior to project closeout.

3.5 CABLE LABELING

3.5.1 Scope

A. This subsection defines the labeling requirements for all telecommunications cables, including but not limited to:
   1. Copper horizontal cabling (data, voice, PA, security, EMS)
   2. Fiber optic backbone and horizontal cabling
   3. Copper backbone cabling (voice, PA, control systems)
   4. Specialized cables (e.g., intrusion alarm, access control, audio-visual)

3.5.2 Label Content

A. Labels shall display the exact identifier assigned per Section 3.2 Identification and Naming Standards
B. Labels must match identifiers exactly across:
   1. Physical equipment
   2. CAD/as-built documentation
   3. GIS system records
   4. All submittal and turnover documentation
   5. No abbreviations, shortened versions, or placeholder tags are permitted on the physical label unless otherwise specified in Section 3.2

3.5.3 Label Materials and Specifications

A. All equipment labels shall follow the materials, durability, font, contrast, and character size requirements outlined in Part 2 – Label Products and Materials of this specification.
B. Labels shall be permanent, corrosion- and weather-resistant, and remain legible for the full service life of the equipment.

3.5.4 General Label Application Requirements

A. All cables shall be labeled:
   1. At both ends (origin and termination point).
   2. With labels applied directly to the cable jacket.
   3. Using self-laminating, wraparound labels or equivalent rated materials.
   4. Using environmental ratings appropriate to the installation location.
B. Label placement:
   1. Horizontal Cabling (Copper and Fiber):
      - Labels shall be placed within 6 inches of the point of termination (e.g., patch panel, jack, LIU, device end).
   2. Backbone Cabling (Copper and Fiber):
      - Labels shall be placed within 6 inches of both termination points (e.g., MDF, IDF, BDF, MPOE, LIU, terminal block).

- Additionally, labels shall be applied at every pull point (e.g., handholes, vaults, pull boxes, conduit bodies) along the route.

C. Label durability:
1. Labels must be rated for the environment in which they are installed (indoor, outdoor, underground, plenum, riser, etc.).
2. Labels used inside outdoor or underground enclosures must be rated for extended submersion without loss of adhesion or legibility.

D. Label color standards:
1. Follow the color assignments specified in Section 2.4

3.5.5 Special Notes

A. Handwritten labels are strictly prohibited on all cabling.
B. Labels shall be oriented for easy reading, without requiring more than 90 degrees of cable rotation.
C. Where cables pass through underground or exterior environments, labeling at intermediate points must comply with submersion and weather-resistance standards.
D. All intermediate labels (at pull points) shall be securely affixed and positioned to avoid interference with cable pulling or future maintenance.

3.6 PORT AND TERMINATION HARDWARE LABELING

3.6.1 Scope

A. This section defines the physical labeling requirements for:
1. Copper patch panels
2. Fiber optic LIUs (fiber termination/splice units)
3. Faceplate and outlet (jack) ports
4. Special non-client ports (e.g., wireless, security, PA)

3.6.2 Label Content

A. Labels shall display the exact identifier assigned per Section 3.2 Identification and Naming Standards
B. Labels must match identifiers exactly across:
1. Physical equipment
2. CAD/as-built documentation
3. GIS system records
4. All submittal and turnover documentation
5. No abbreviations, shortened versions, or placeholder tags are permitted on the physical label unless otherwise specified in Section 3.2

3.6.3 Label Materials and Specifications

A. All equipment labels shall follow the materials, durability, font, contrast, and character size requirements outlined in Part 2 – Label Products and Materials of this specification.
B. Labels shall be permanent, corrosion- and weather-resistant, and remain legible for the full service life of the equipment.

3.6.4 Patch Panel Labeling

A. Panel-Level Labels:
1. Each patch panel shall have a permanent label displaying its unique panel identifier (per Section 3.2.6).
2. Labels shall be placed:
- On the left side of the patch panel front face.
- On the right side of the patch panel front face.
3. Labels shall be mechanically affixed or inserted in manufacturer-designated label slots.

B. Port Labels (Special Ports Only):

- Non-client device ports (e.g., WAPs, security devices, PA, AV) must be labeled with the corresponding port identifier.
- Labels shall be placed in the space or window provided by the patch panel manufacturer next to each port.
- Where no label window exists, use a durable printed label affixed directly adjacent to the port.

3.6.5 Faceplate and Outlet Port Labeling

A. General Requirements:
   1. All faceplates, surface-mounted boxes, or workstation outlets shall be labeled using the identifier assigned per Section 3.2.6.

B. Label Placement:
   1. Where the faceplate includes a manufacturer-provided label window, insert printed labels behind the window.
   2. Where no label window exists, affix a durable, printed label directly to the faceplate or biscuit jack surface next to the port.

C. Label Clarity:
   1. Labels must be easily legible without the need to unplug cords or rotate the plate.
   2. Handwritten or temporary labels are strictly prohibited.

3.6.6 Fiber LIU Labeling

A. Panel-Level Labels:
   1. Each LIU shall be labeled with its assigned identifier (per Section 3.2.7) on the front face or cover.

B. Port or Splice Cartridge Labels:
   1. Individual fiber strands or fusion splice cartridges shall be labeled on the inside of the LIU cover in the designated labeling area.
   2. Labels must correspond to fiber assignments as documented in the as-built splice matrix.
   3. Printed labels must be clear, durable, and secured inside the LIU without interfering with cable access or management.

END OF SECTION

SECTION 27 05 86 – TESTING & CERTIFICATION OF STRUCTURED CABLING

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section outlines certification requirements for copper and fiber structured cabling.

1.1.2 Applicable to all backbone and horizontal Cat 5e, Cat 6, Cat 6A, and fiberoptic cabling installed under Division 27.

1.1.3 Ensures compliance with industry standards, contract documents, and manufacturer requirements.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27, and Division 28 sections and requirements in their entirety. For list of all Division 27, and Division 28 sections see section 1.3 of 27 00 00. If section 27 00 00 was not provided contact Pomona Unified School Districts ITS Department to receive complete copy.

1.2.2 Testing and certification requirements are specifically impacted by, but not limited to, the following sections:

A. 27 05 50 – Communications Documentation & Submittals
B. 27 05 53 – Identification for Communications Systems
C. 27 13 00 – Communications Backbone Cabling
D. 27 13 13 – Communications Copper Backbone Cabling
E. 27 13 23 – Communications Fiber Optic Backbone Cabling
F. 27 15 00 – Communications Horizontal Cabling

1.3 SUBMITTALS

1.3.1 All submittals shall comply with 27 05 50 – Communications Documentation & Submittals, unless otherwise specified in this section.

1.3.2 Test Equipment Calibration & Certification

A. Provide manufacturer calibration certificates for all test equipment, including copper and fiber testers.

1.3.3 Testing Procedures

A. Include pass/fail criteria based on applicable standards (ANSI/TIA-568.2-D, ANSI/TIA-568.3-D, and ANSI/TIA-1152-A).

1.3.4 Sample Test Report

A. It is recommended to provide a sample of the proposed Copper Certification Report and Fiber Certification Report for approval prior to testing to ensure compliance with District standards
B. Sample reports must demonstrate all required test parameters and performance criteria

1.3.5 Closeout Submittals

A. General
1. All reports must include test equipment details, including model, serial number, and calibration date
2. All test results must be recorded and submitted in electronic format.
3. Include full test results for each installed cable.
4. The contractor must certify in writing that all installed fiber optic cabling meets or exceeds the specified performance standards and complies with ANSI/TIA-568.3-D.
5. Marginal test results, defined as any measurement within the tester's accuracy uncertainty range, must be clearly indicated in the report and accompanied by documentation of re-testing procedures and final pass/fail status.

6. Retest Documentation
   - The contractor shall provide a separate log listing all ports and cable runs that required retesting due to initial failure or marginal test results.
   - The log shall include:
     - ◊ Cable ID and location (patch panel & workstation outlet)
     - ◊ Reason for retest (e.g., failed NEXT, marginal return loss)
     - ◊ Number of retests performed
     - ◊ Corrective action taken (e.g., re-termination, cable replacement)
     - ◊ Final pass/fail status after remediation
   - This log shall be submitted as part of the final certification report and reviewed before project closeout.

B. Copper Cable Certification Reports
1. General Copper Certification Requirements
   - All installed copper cabling (Cat 5e, Cat 6, Cat 6A) must be tested per ANSI/TIA-568.2-D and ANSI/TIA-1152-A standards.
   - Each report shall include:
     - ◊ Cable ID & test location
     - ◊ Cable category & type (e.g., Cat 6A, UTP vs. STP).
     - ◊ Wiremap results (continuity, split pairs, miswires).
     - ◊ Length measurement (must not exceed 90m permanent link or 100m channel).
     - ◊ NEXT, Return Loss, Insertion Loss, and other TIA-specified parameters.
     - ◊ Pass/Fail status based on TIA limits for the respective cable category.
     - ◊ Tester model, serial number and calibration date
2. PoE Testing (Required for Certain Ports & Lengths)
   Note: PoE Testing requirements include all requirements laid out in General Copper Certification.
   - PoE testing is required on:
     - ◊ All Wireless Access Point (WAP) ports
     - ◊ All IP security camera ports
     - ◊ All IP speaker ports
     - ◊ All ports designed for use as part of an AV system
     - ◊ All copper cables exceeding 60 meters
   - Each report shall include:
     - ◊ Device port tested (switch & patch panel port locations).
     - ◊ Measured PoE voltage, current, and wattage under load.
     - ◊ PoE class/type detected (802.3af/at/bt).
     - ◊ Pass/Fail results for each tested port.

C. Fiber Optic Certification Reports
1. Testing must be performed per ANSI/TIA-568.3-D using the proper equipment.
2. All fiber strands must be tested in both directions at the required wavelengths.
3. Maximum Loss Budgets must be shown and verified against the current TIA-568.3-D standards.
4. Testing Wavelengths:
   - Multimode Fiber (MMF): 850 nm & 1300 nm
   - Singlemode Fiber (SMF): 1310 nm & 1550 nm
5. Tier 1 Certification Report (OLTS Testing)
   - Required for all fiber optic links, including backbone and horizontal fiber.
   - Reports must include:
     - ◊ Length, attenuation, and pass/fail status for each fiber strand.
     - ◊ Bidirectional loss measurements at 850 nm & 1300 nm (Multimode) or 1310 nm & 1550 nm (Singlemode).
     - ◊ Connector loss measurements to ensure compliance with loss budgets.
6. Tier 2 Certification Report (OTDR Testing)

- Required in addition to Tier 1 testing for fibers installed in pathways containing:
  - ◊ Conduit bodies (e.g., LB fittings).
  - ◊ Conduits smaller than 2" in diameter.
- Event analysis required for:
  - ◊ Splice loss & reflectance
  - ◊ Connector reflectance
  - ◊ Bends, macrobends, or unexpected attenuation points
- OTDR launch and receive cables (a.k.a. "dead zones") must be used to ensure proper measurement of the first and last connectors.
- Testing must use a pulse width appropriate to the fiber length to ensure accurate results.

1.4 QUALIFICATIONS

1.4.1 Technician & Testing Personnel Requirements

A. All personnel conducting testing must be certified for the specific test equipment used.
B. Technicians must have at least one of the following:
   1. Manufacturer-approved training for the test equipment being used.
   2. BICSI Technician (TECH) or higher certification.
   3. At least 3 years of experience in structured cabling testing and certification.
C. Upon request, the contractor shall provide proof of technician certifications to the District ITS Project Manager before testing begins.

1.4.2 Testing Equipment Requirements

A. Certification shall be conducted using calibrated, industry-approved test equipment that meets ANSI/TIA and IEEE standards.
B. Test equipment must be within manufacturer-recommended calibration intervals, and calibration certificates shall be available upon request.
C. Only test equipment capable of producing electronic certification reports is allowed. Handwritten reports are not acceptable.
D. The District ITS Project Manager reserves the right to:
   1. Independently verify the calibration and accuracy of testing equipment.
   2. Request calibration records prior to the start of testing.
   3. Require test equipment to be available during punch walks for District personnel to perform spot checks on installed cabling.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT REQUIREMENTS

2.1.1 General Requirements

A. All test equipment shall comply with the latest applicable standards, including:
   1. ANSI/TIA-568.2-D (Copper Cabling)
   2. ANSI/TIA-568.3-D (Fiber Optic Cabling)
   3. ISO/IEC 11801 (Structured Cabling Performance)
   4. IEEE 802.3 (Ethernet Performance & PoE Testing)
B. Equipment must be capable of generating electronic reports in manufacturer-supported formats (e.g., Fluke LinkWare, EXFO FastReporter).
C. All test instruments shall be calibrated in accordance with the manufacturer's specifications and within the calibration interval recommended by the manufacturer at the time of testing.

2.1.2 Copper Cable Certification Equipment

A. Test Equipment Type: Level IIIe or greater field testers compliant with ANSI/TIA-1152-A.

B. Required Tester Components
   1. Permanent Link Adapter (PLA):
      - Required for testing installed cabling from patch panel to outlet.
      - Must be used for certification of structured cabling links.
   2. Channel Adapter (Module Adapter):
      - Required for testing end-to-end channel performance (e.g., patch cords + horizontal cable).

C. Required Capabilities:
   1. Measure Cable Length
   2. Provide cable wiremap
   3. Measure:
      - Insertion Loss
      - NEXT
      - PSNEXT
      - ACR-FB
      - PSACR-F
      - Return Loss
      - ACR-N
      - PSACR-N
      - PSANEXT
      - PSAACR-F
   4. Support for Category 6A, 6, and 5e certification.
   5. Capable of flagging/identifying marginal test results.

D. Approved Models: (or approved equivalent)
   1. Fluke DSX-5000/8000
   2. Ideal LanTEK IV
   3. Softing WireXpert 500

2.1.3 Copper Cable PoE Testing Equipment

A. The copper cable certification tester shall support PoE load simulation for IEEE 802.3af (15.4W), 802.3at (30W), and 802.3bt (60W & 90W) compliance verification.
B. Testers shall be capable of verifying actual power delivery under load conditions for all WAP, Camera, and IP Speaker ports, as well as any cable run exceeding 200 feet (60 meters).
C. PoE load testing must include:
   1. Voltage and current draw verification at the endpoint.
   2. Detection of improper polarity or miswiring affecting PoE functionality.
   3. Verification of the correct PoE power class assignment.
D. Approved Models: (or approved equivalent)
   1. Fluke DSX-8000 With +POE Test Option

2.1.4 Fiber Optic Test Equipment

A. Tier 1 (OLTS) Equipment
   1. Test Type: Optical Loss Test Set (OLTS) with bidirectional measurement capability.
   2. Required Capabilities:
      - Insertion loss, length measurement, and pass/fail analysis.
      - Supported Wavelengths:
        ◊ 850 nm & 1300 nm (Multimode)
        ◊ 1310 nm & 1550 nm (Singlemode)

B. Approved Models:
   1. Fluke CertiFiber Pro
   2. EXFO MaxTester OLTS

C. Tier 2 (OTDR) Equipment

1. Test Type: Optical Time Domain Reflectometer (OTDR)
2. Required Capabilities:
   - Event detection for splices, bends, connectors, and macrobends.
   - Dynamic range sufficient for backbone fiber distances.
3. Approved Models:
   - EXFO MaxTester OTDR Series
   - Fluke OptiFiber Pro

2.2 TESTING ACCESSORIES

2.2.1 Copper Cable Testing Accessories

A. Modular adapters for testing shielded/unshielded links.
B. Calibration verification kit for tester self-checks.
C. Wiremap adapters for continuity testing.

2.2.2 Fiber Optic Testing Accessories

A. Reference jumpers (matching fiber type and polish) for OLTS testing.
B. Launch and receive cables for OTDR testing.
C. Fiber inspection scope with IEC 61300-3-35 compliance for connector cleanliness.

PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

3.1.1 Scope of Testing

A. 100% of installed cables shall be tested after installation and termination.
B. Testing shall be conducted before final acceptance and system activation.
C. Pre-Test Installation Requirements
   1. Testing shall only begin after the following conditions are met:
      - All copper and fiber optic cables are permanently installed, dressed, and secured in their final locations.
      - All terminations at patch panels, racks, outlets, and equipment enclosures are fully completed.
      - All junction boxes, faceplates, and fiber optic enclosures are secured in place with covers installed.
      - All cable management (Velcro ties, cable trays, ladder racks, J-hooks, etc.) is properly installed and free of obstructions.
      - Required firestopping is completed in all penetrations.
   2. Any testing performed before completion of these conditions will be considered invalid, and re-testing will be required at the contractor's expense.

3.1.2 Testing Standards

A. All tests shall comply with the latest versions of:
   1. ANSI/TIA-568.2-D (Copper cabling)
   2. ANSI/TIA-568.3-D (Fiber optic cabling)
   3. ANSI/TIA-1152-A (Field testing procedures)
   4. IEEE 802.3 (Ethernet & PoE performance testing)

3.1.3 Handling of Failed or Marginal Test Results

A. Failed cables shall be repaired or replaced and re-tested until a PASS result is achieved.
B. Marginal test results, as defined in Section 1.3.5, must be:
   1. Retested immediately using the same calibrated tester.
   2. If a second marginal result occurs, tested again using an independent tester (if available).
   3. If two out of three tests yield marginal or failing results, the cable must be re-terminated or replaced.

C. Retest documentation shall be maintained per Section 1.3.5.

3.2 COPPER CABLING TESTING (APPLIES TO ALL CAT 6A, CAT 6, AND CAT 5E CABLES)

3.2.1 Test Methodology

A. Permanent Link testing shall be performed per ANSI/TIA-568.2-D using a Level IIIe or higher field tester.
B. If Channel Testing is required, it must be specified in contract documents and performed separately.

3.2.2 Permanent Link Testing

A. Standard permanent links (e.g., jack-to-patch panel) shall be tested using a Permanent Link Adapter on both the Main and Remote Test Units.
B. Channel adapters or patch cord adapters shall not be used for permanent link testing.
C. Test equipment must support the cable category being tested and meet TIA accuracy requirements.
D. Test limits shall be configured in accordance with ANSI/TIA-568.2-D Permanent Link test parameters.

3.2.3 Modular Plug Terminated Link (MPTL) Testing

A. Where MPTL terminations are utilized, testing shall be performed per ANSI/TIA-568.2-D Annex F.
B. Testing shall use:
   1. A Permanent Link Adapter on the Main Unit.
   2. A Patch Cord Adapter rated for the Category being tested (Cat 6 or Cat 6A) on the Far End or Remote Unit.
   3. Channel adapters shall not be used under any circumstances.
   4. The patch cord adapter shall meet head accuracy specifications per Annex C (Cat 6) or Annex D (Cat 6A).
   5. Test limits shall be set to match MPTL performance requirements per ANSI/TIA-568.2-D Annex F.

3.2.4 All cables shall be tested for:

A. Wire Map (continuity, split pairs, miswires, reversals)
B. Length (must not exceed 90m for permanent link or 100m for channel)
C. NEXT (Near-End Crosstalk) & PSNEXT (Power Sum Near-End Crosstalk)
D. RL (Return Loss)
E. ACR (Attenuation-to-Crosstalk Ratio) & PSACR (Power Sum ACR)
F. ELFEXT (Equal-Level Far-End Crosstalk)
G. Propagation Delay & Delay Skew

3.2.5 CAT 5e Performance Margins

A. Contactor to provide internal testing data that demonstrates typical channel performance margins above ANSI/TIA-568-D standard

3.2.6 CAT 6 Performance Margins

A. Contactor to provide internal testing data that demonstrates typical channel performance margins above ANSI/TIA-568-D standards as listed below.
   1. Insertion Loss 3%
   2. NEXT 3 dB
   3. PSNEXT 3 dB
   4. ACR-F 3 dB
   5. PSACR-F 5 dB
   6. Return Loss 2 dB
   7. ACR-N 3 dB
   8. PSACR-N 5 dB

3.2.7 CAT 6A Performance Margins

A. Contactor to provide internal testing data that demonstrates typical channel performance margins above ANSI/TIA-568-D standards as listed below.
   1. Insertion Loss 3%
   2. NEXT 3 dB
   3. PSNEXT 4 dB
   4. ACR-F 8 dB
   5. PSACR-F 8 db
   6. Return Loss 3 dB
   7. ACR-N 4 dB
   8. PSACR-N 5 dB
   9. PSANEXT 4 dB
   10. PSAACR-F 5 dB

3.2.8 Poe Testing – Required for Certain Installations

A. PoE testing is required in addition to other copper cabling testing under the following conditions:
   1. All Wireless Access Point (WAP) ports
   2. All IP security camera ports
   3. All IP speaker ports
   4. All ports designed for use as part of an AV system.
   5. All copper cables exceeding 60 meters
B. Each cable shall be tested for:
   1. Voltage and Current Testing under simulated load
   2. DC Resistance Unbalance
   3. Pair-to-Pair Resistance Unbalance
   4. CAT6 PoE Performance
      - IEEE 802.3at (Type 1) Power over Ethernet (PoE) applications up to 15.4 watts
      - IEEE 802.3at (Type 2) Power over Ethernet (PoE+) applications up to 30 watts
   5. CAT6A PoE Performance
      - IEEE 802.3at (Type 1) Power over Ethernet (PoE) applications up to 15.4 watts
      - IEEE 802.3at (Type 2) Power over Ethernet (PoE+) applications up to 30 watts
      - IEEE 802.3bt (Type 3) Power over Ethernet (PoE++) applications up to 60 watts
      - Cisco Universal Power Over Ethernet (UPOE/UPOE+) applications up to 90 watts
      - IEEE 802.3bt (Type 4) Power over Ethernet (PoE++) applications up to 90 watts
      - Power over HDBaseT™ (POH) applications up to 95 watts
      - Other PoE standards up to 100 watts.
   6. The negotiated PoE power class without excessive voltage drop
C. Performance Margins
   1. DC Resistance Unbalance Within a Pair:
      - Limit: The difference in resistance between the two conductors of a pair should not exceed 3% or 0.2 ohms, whichever is greater
   2. Pair-to-Pair Resistance Unbalance:
      - Limit: The resistance difference between pairs should not exceed 7% or 0.2 ohms, whichever is greater.

3.2.9 Acceptance Criteria

A. All cables must achieve a PASS result.
B. Performance margins in shall be verified against manufacturer documentation.
C. Marginal results must be flagged and documented per Section 3.1.3
D. Retests must be performed for any failed or marginal results.

3.3 FIBEROPTIC TESTING (APPLIES TO BACKBONE AND HORIZONTAL FIBER)

3.3.1 Testing Requirements for All Fiber Types

A. All testing shall be performed using the equipment specified in Section 2.1.4 – Fiber Optic Test Equipment.
B. Tier 1 (OLTS) Certification – Required for All Fiber Links
   1. Testing shall be conducted using an Optical Loss Test Set (OLTS) in accordance with ANSI/TIA-568.3-D.
   2. The following parameters shall be measured:
      - End-to-end attenuation (insertion loss)
      - Fiber length
      - Polarity verification
      - Connector loss
   3. Test wavelengths:
      - Multimode Fiber (MMF): 850 nm & 1300 nm
      - Singlemode Fiber (SMF): 1310 nm & 1550 nm
   4. Loss budgets shall be calculated per the latest TIA-568.3-D standard.
C. Tier 2 (OTDR) Certification – Required for Certain Installations
   1. OTDR testing is required in addition to Tier 1 testing under the following conditions:
      - Fiber runs longer than 100 meters
      - Backbone fiber installations
      - Any fiber installed in pathways containing:
        ◊ Conduit bodies (e.g., LB fittings)
        ◊ Conduits smaller than 2 inches in diameter
      - Any fiber cable containing splices
   2. OTDR test reports shall include:
      - Bi-directional event trace analysis
      - Splice loss & reflectance
      - Connector reflectance
      - Bends, macrobends, or unexpected attenuation points
   3. OTDR launch and receive cables ("dead zone eliminators") must be used to ensure accurate readings.
D. Fiber Endface Inspection
   1. All fiber endfaces shall be inspected with a fiber inspection microscope prior to testing.
   2. Inspection criteria shall comply with IEC 61300-3-35 standards for connector cleanliness.
   3. Endfaces failing inspection must be cleaned and re-tested before connection.

3.3.2 Singlemode Fiber (SMF) Testing Requirements

A. General Requirements
   1. All singlemode fiber strands must be tested in both directions at 1310 nm and 1550 nm wavelengths.
   2. The maximum allowable insertion loss per connector pair shall be ≤ 0.75 dB (including splice and connection loss).
   3. The maximum allowable loss budget shall not exceed TIA-568.3-D specified limits for the installed link length.
B. OTDR Testing (Tier 2) for Singlemode Fiber
   1. OTDR traces shall be captured in both directions to compensate for reflectance differences.
   2. Events shall be analyzed for:
      - Connector reflectance (≤ -40 dB for UPC, ≤ -55 dB for APC)
      - Splice loss (≤ 0.1 dB per fusion splice)
      - Fiber attenuation rate (≤ 0.4 dB/km @ 1310 nm, ≤ 0.3 dB/km @ 1550 nm)
C. Acceptance Criteria
   1. PASS result must be achieved for all fibers.
   2. Any fiber failing loss budget calculations must be re-evaluated for damage, re-terminated, or replaced.

3.3.3 3.3.4 Multimode Fiber (MMF) Testing Requirements

A. General Requirements
   1. All multimode fiber strands must be tested in both directions at 850 nm and 1300 nm wavelengths.

2. The maximum allowable insertion loss per connector pair shall be ≤ 0.75 dB.
3. The total link loss shall not exceed TIA-568.3-D specified limits for the installed link length.

B. Encircled Flux (EF) Compliance for MMF Testing
1. Multimode OLTS testing must be performed using Encircled Flux (EF)-compliant test cords in accordance with ANSI/TIA-526-14-C.
2. The contractor shall provide certification that test cords meet EF compliance.
3. OTDR Testing (Tier 2) for Multimode Fiber
4. Required for any multimode fiber installation longer than 100 meters.
5. OTDR traces must be performed at 850 nm and 1300 nm.
6. Maximum allowable attenuation rate:
   - ≤ 3.5 dB/km @ 850 nm
   - ≤ 1.5 dB/km @ 1300 nm
7. Any high-loss events (e.g., splices, macrobends) must be investigated and corrected.

C. Acceptance Criteria
1. PASS result must be achieved for all fiber strands.
2. Failed fibers must be re-terminated or replaced.

3.4 REMEDIATION AND RETESTING PROCEDURES

3.4.1 General Requirements

A. Any cable that fails initial certification testing must be repaired or replaced and retested until a PASS result is obtained.
B. Marginal results, as defined in Section 1.3.5, require additional testing and documentation before acceptance.
C. The contractor shall bear all costs associated with remediation and retesting, including labor, materials, and test equipment usage.

3.4.2 Remediation Procedures for Copper Cabling

A. Failed Cable Runs:
1. If a copper cable fails due to improper termination, the connector(s) shall be re-terminated, and the cable shall be re-tested.
2. If a cable fails due to excessive insertion loss, return loss, or NEXT, the entire cable run must be replaced and re-tested.
3. If failure is due to interference or grounding issues, the cause must be identified, corrected, and re-tested.

B. Marginal Test Results:
1. Marginal test results require two additional retests using the same calibrated tester.
2. If a second marginal result occurs, the cable shall be tested a third time using an independent tester (if available).
3. If two out of three tests yield marginal or failing results, the cable must be re-terminated or replaced.

C. PoE Failures:
1. Any copper cable failing PoE load testing must be examined for excessive resistance, poor terminations, or conductor damage.
2. If PoE performance issues persist, the cable shall be replaced and re-tested.

3.4.3 Remediation Procedures for Fiber Optic Cabling

A. Failed Fiber Links:
1. Fiber links that exceed maximum allowable insertion loss must be inspected for connector cleanliness, proper seating, and cable damage.
2. If cleaning does not resolve the issue, connectors shall be re-terminated.
3. If attenuation failures persist, the fiber run must be replaced.

B. Splice Loss Failures:

1. Fusion splices that exceed loss limits must be re-spliced and re-tested.
2. If re-splicing does not resolve the issue, the affected fiber strand shall be replaced.

C. OTDR Event Failures:
1. Any fiber exhibiting excessive macrobending, reflectance, or attenuation anomalies must be examined and corrected.
2. OTDR traces must be compared against pre-installation fiber manufacturer data to verify performance.

D. Retesting Requirements
1. The entire affected cable or fiber link shall be retested after remediation.
2. Retest results shall be included in the final test report with a notation indicating the failure and corrective action taken.
3. A separate log of retested cables shall be submitted per Section 1.3.5.A.6.

3.5 FINAL ACCEPTANCE & CLOSEOUT PROCEDURES

3.5.1 Final Inspection and Testing Verification

A. The contractor shall notify the District ITS Project Manager at least five (10) business days in advance to schedule a final inspection and review of test results.
B. The District reserves the right to conduct random spot testing using either District-owned test equipment or contractor-provided test equipment to verify compliance. The contractor shall provide access to and operation of their test equipment upon request.
C. The District may also require verification of the contractor's test equipment calibration and accuracy before acceptance of results.
D. Any cable that fails the district's verification testing must be re-tested at the contractor's expense.

3.5.2 Submission of Test Reports and Documentation

A. The contractor shall submit a complete electronic test report package including:
1. Copper Certification Reports (per Section 1.3.5.B)
2. Fiber Certification Reports (per Section 1.3.5.C)
3. Retest Log (detailing all failed cables, corrective actions, and final pass/fail results)
4. Test Equipment Calibration Certificates
5. As-Built Cable Labeling Map (detailing all installed cables, outlet locations, and patch panel assignments)

B. Test reports shall be in manufacturer-supported formats (e.g., Fluke LinkWare, EXFO FastReporter). Handwritten reports are not acceptable.

3.5.3 Final Approval and Sign-Off

A. The District ITS Project Manager must review and approve all submitted test results prior to final acceptance.
B. No installed cabling system shall be considered operational until all required documentation is reviewed and approved.
C. Any discrepancies found during review must be resolved before final project closeout.

END OF SECTION

SECTION 27 06 50 – COMMUNICATIONS EQUIPMENT & MATERIALS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section provides a comprehensive schedule of approved communications equipment, cabling, and materials, including pathways, structured cabling, data, voice, and audio-visual communications.

1.2 MANUFACTURER REQUIREMENTS

1.2.1 Structured Cabling:

A. All structured cabling components for data or voice networks shall be Leviton brand to qualify for the manufacturer's Lifetime Warranty. This includes Leviton patch panels, jacks, connectors, fiber enclosures, and cabling.
B. No substitutions will be accepted unless approved in writing by the ITS Project Manager.

1.2.2 SUBSTITUTION APPROVAL PROCESS

A. Only listed manufacturers and models are permitted.
B. Any product substitutions must be submitted in writing to the ITS Project Manager for approval.
C. Substitutions must meet or exceed the listed product specifications and be certified for compatibility.
D. Approval must be obtained before procurement and installation.

PART 2 - PRODUCTS

2.1 PATHWAYS COMPONENTS

(CONDUITS, PULL BOXES, VAULTS, CABLE TRAYS, FIRESTOPPING, ETC.)

ITEM	MANUFACTURE	MODEL NUMBER	DESCRIPTION
Metallic Raceway	Wiremold	5701	700 Series - Coupling
Metallic Raceway	Wiremold	V5703	700 Series - Supporting Clip
Metallic Raceway	Wiremold	V711	700 Series - Flat Elbow
Metallic Raceway	Wiremold	V717	700 Series - Internal Elbow
Metallic Raceway	Wiremold	V718	700 Series - External Elbow
Metallic Raceway	Wiremold	V5741	500/700 Series – Single Gang Box
Metallic Raceway	Wiremold	5748	500/700 Series – Single Gang Box
Metallic Raceway	Wiremold	V5751	500/700 Series – Single Gang Box
Metallic Raceway	Wiremold	V5744	500/700 Series – Single Gang Box
Metallic Raceway	Wiremold	V5748-2	500/700 Series – Double Gang Box
Metallic Raceway	Wiremold	V5747-2	500/700 Series – Double Gang Box
Metallic Raceway	Wiremold	V5744-2	500/700 Series – Double Gang Box
Metallic Raceway	Wiremold	V5744S-2	500/700 Series – Double Gang Box
Metallic Raceway	Wiremold	V5744-3	500/700 Series – Three Gang Box
Metallic Raceway	Wiremold	V5748-3	500/700 Series – Three Gang Box
Metallic Raceway	Wiremold	V5744S-3	500/700 Series – Three Gang Box
Non-Metallic Raceway	Wiremold	WM2300BAC	3200 Series - Raceway
Non-Metallic Raceway	Wiremold	WM2310A	3200 Series - Entrance End Fit
Non-Metallic Raceway	Wiremold	WM2306	3200 Series - Raceway Clip Cover

Non-Metallic Raceway	Wiremold	WM2311	3200 Series - Flat Elbow
Non-Metallic Raceway	Wiremold	WM2317	3200 Series – Internal Elbow
Non-Metallic Raceway	Wiremold	WM2318	3200 Series – External Elbow
Non-Metallic Raceway	Wiremold	5400TB	5400 Series – Raceway
Non-Metallic Raceway	Wiremold	5400C	5400 Series – Raceway Cover
Non-Metallic Raceway	Wiremold	5450	5400 Series – Device Bracket
Non-Metallic Raceway	Wiremold	5410DFO	5400 Series – Radiused Divided Entrance Cap Fitting
Non-Metallic Raceway	Wiremold	5410	5400 Series – Blank End Fitting
Non-Metallic Raceway	Wiremold	5411FO	5400 Series – Radiused Full Capacity Flat Elbow Fitting
Non-Metallic Raceway	Wiremold	5417FO	5400 Series – Radiused Full Capacity Internal Elbow Fitting
Non-Metallic Raceway	Wiremold	5415FO	5400 Series – Radiused Full Capacity Tee Fitting
Non-Metallic Raceway	Wiremold	5500BD3	5500 Series – Raceway
Non-Metallic Raceway	Wiremold	5507B	5500 Series – Raceway Cover
Non-Metallic Raceway	Wiremold	WMD5550	5500 Series – Device Bracket
Non-Metallic Raceway	Wiremold	5550	5500 Series – Radiused Divided Entrance Cap Fitting
Non-Metallic Raceway	Wiremold	5510	5500 Series – Blank End Fitting
Non-Metallic Raceway	Wiremold	5511FO	5500 Series – Radiused Full Capacity Flat Elbow Fitting
Non-Metallic Raceway	Wiremold	5517FO	5500 Series – Radiused Full Capacity Internal Elbow Fitting
J-Hook	B-Line	BL-BCH32-W2	2-inch cable hook with clip
J-Hook	B-Line	BL-BCH21-RB	2-inch cable hook with L-Bracket

2.2 STRUCTURED CABLING

(COPPER, FIBER, PATCH PANELS, TERMINATIONS – LEVITON ONLY)

ITEM	MANUFACTURE	MODEL NUMBER	DESCRIPTION
Data Outlet	Leviton	6110G-RP6	Purple Cat 6 QuickPort Jack
Data Outlet	Leviton	6110G-RO6	Orange Cat 6 QuickPort Jack
Data Outlet	Leviton	6110G-RR6	Red Cat 6 QuickPort Jack
Data Outlet	Leviton	6110G-RV6	Green Cat 6 QuickPort Jack
Data Outlet	Leviton	61110-RP6	Purple Cat 6A QuickPort Jack
Data Outlet	Leviton	61110-RO	Orange Cat 6A QuickPort Jack
Data Outlet	Leviton	61110-RR6	Red Cat 6A QuickPort Jack
Data Outlet	Leviton	61110-RV6	Green Cat 6A QuickPort Jack
Faceplate	Leviton	42090-[2,4]WS	Single-Gang QuickPlate Tempo Wallplates with ID Windows – Retrofit Cutin 2 – 4 ports
Faceplate	Leviton	42080-[1,6]WS	Single-Gang QuickPort Wallplate with ID Windows 1 – 6 ports
Faceplate	Leviton	42090-[1,8]WS	Dual-Gang QuickPort Wallplate with ID Windows 1- 8 ports
Faceplate	Leviton	42081-[1-4]WS	Angled Single-Gang QuickPort Wallplate with ID Windows 1 – 4 ports
Faceplate	Leviton	3080-1L[1-6]	Single-Gang Stainless-Steel QuickPort
Faceplate	Leviton	3080-2L[4-8]	Dual-Gang Stainless-Steel QuickPort
Faceplate	Leviton	4108W-1SP	Recessed Stainless Steel QuickPort Telephone Wallplate
Biscuit	Leviton	41089-[1-4]xP	Surface-Mount QuickPort Boxes 1 – 4 ports

Bracket	Leviton	49223-CB[C,0]	QuickPort In-Ceiling Bracket
Bracket	Leviton	49223-BAK	QuickPort Box Adapter
DIN Rail-Mount Box	Leviton	41089-6DN	QuickPort 6-Port DIN Rail-Mount Box
Adapter Bracket	Leviton	HDXAD-ACC	Adapter bracket for HDX components in SDX enclosures
Fusion Splice Module	Leviton	SPLCH-12BL	12-Fiber LC Shuttered Fusion Splice Module (Singlemode)
Fusion Splice Module	Leviton	SPLCH-12AQ	12-Fiber LC Shuttered Fusion Splice Module (Multimode)
Patch Panel	Leviton	49255-48N	48-Port 2RU Flat QuickPort Patch Panel with Vertical Numbering
Patch Panel	Leviton	49255-v48	48-Port 1RU High-Density Flat QuickPort Patch Panel with Vertical Numbering

2.3 COMMUNICATIONS RACKS, CABINETS, AND ENCLOSURES

(RACKS, CABINETS, ENCLOSUERS, AND RELATED COMPONENTS)

ITEM	MANUFACTURE	MODEL NUMBER	DESCRIPTION
Floor Mount Cabinet	APC	AR3140	42U 750mm Wide x 1070mm Deep Networking Enclosure
Floor Mount Cabinet	APC	AR3157B2	48U 750mm Wide x 1070mm Deep Networking Enclosure
Floor Mount Rack	APC	AR203A	NetShelter 4 Post Open Frame Rack 44U Square Holes
Floor Mount Rack	Chatsworth	15254-703	Adjustable Rail Server Rack 45U Square Hole
Wall Mount Cabinet	CUBE-iT	11840-724	24" Wall-Mount Cabinet
Wall Mount Cabinet	CUBE-iT	11840-736	36" Wall-Mount Cabinet
Wall Mount Cabinet	CUBE-iT	11840-748	48" Wall-Mount Cabinet
Wire Management	Hellerman Tyton	WMB2	2U 3"x3" front 2"x4" rear with hinges
Wire Management	Hellerman Tyton	WMBP2	1U 1.5"x3" front 1.5"x4" rear
Wire Management	Chatsworth	12465-xxx	Cabling ring for cabinet enclosures
Wire Management	CPI	13170-700	Cable management system for enclosures
Wire Management	CPI	13168-701	Tray for enhanced cable management
Wire Management	CPI	30165-703	Vertical cable management for rack systems
Wire Management	CPI	11374-103	Vertical cable management for rack systems
Wire Management	APC	AR8625	Performance, Vertical Cable Manager for 2 & 4 Post Racks, 84"H x 6"W, Double-Sided with Doors
UPS	APC	SRTL5KRM2UT	APC Smart-UPS Ultra On-Line, 5000VA, Lithium-ion, Rack/Tower 2U, 208V
PDU	Eaton	PDU3V6L2130	8.6kW 208/120V 3-Phase Basic PDU - 48 Outlets (36 C13, 6 C19, 6 5-15/20R), L21-30P Input
PDU	Eaton	EMA333-10	Managed PDU, L21-30P input, 8.64kW, 24A, 120/208V, 28 Outlets (21) C13 (6) C19 (1) 5-20R
PDU	Eaton	EBA200-10	Basic rack PDU, L14-30P input, 5.76 kW max, 120/240V, 24A, Outlets: (8) 5-20R, (20) C13 Outlet grip, (6) C19

2.4 DATA COMMUNICATIONS

(NETWORK EQUIPMENT, WAPS, SWITCHES, FIREWALLS, ETC.)

ITEM	MANUFACTURE	MODEL NUMBER	DESCRIPTION
Edge Switch	Ruckus	ICX-7550-48ZP	48x 10/100/1000/2.5G, POE++, 2x40/100 QSFP28, 2000W power supply
AV Switch	Ruckus	ICX8200-48PF2-E2	48×10/100/1000 Mbps PoE+ ports, 4×25 GbE SFP28 stacking/uplink-ports 1480 W PoE budget, hot swap power supplies and fans, two power supplies and two fans included, three-year remote TAC support

AV Switch	Ruckus	ICX8200-24PV	AV Ports-in-back, 24×10/100/1000 Mbps PoE+ ports, 4×25 GbE SFP28 stacking/uplink-ports, 370W PoE budget, three-year remote TAC support
AV Switch	Ruckus	ICX8200-C08PFV	AV Ports-in-back Compact Switch, 8×10/100/1000 Mbps PoE+ ports, 2×10 GbE SFP+ stacking/uplink-ports, 124W PoE budget, three-year remote TAC support
Edge Switch	Cisco	WS-C3650-48PQ-S	48-Port PoE+ Switch with 10GbE SFP+ Uplinks
Edge Switch	Cisco	WS-C3650-24PD-S	24-Port PoE+ Switch with 10GbE SFP+ Uplinks
Wireless AP	Ruckus	901-R670-US00	Wi-Fi 7 High-Performance Wi-Fi 7 2x2:2 Indoor Access Point with 9.3 Gbps max rate
Wireless AP	Ruckus	901-R770-US00	Wi-Fi 7 Very-High-Performance Tri-Radio Wi-Fi 7 2x2:2 | 4x4:4 | 2x2:2 Indoor Access Point with 12.22 Gbps max rate
Wireless AP	Aerohive	AH-AP230	802.11a/g/n/ac Access Point (3x3
Router	Cisco	ASR-9001	Aggregation Services Router
Router	Cisco	ISR-2921	Integrated Services Router
Core Switch	Cisco	4500-E	Chassis for 4500-E series switch
Core Switch	Cisco	Sup8-E	Supervisor 8-E for 4500-E series
Core Switch	Cisco	Sup7-E	Supervisor 7-E for 4500-E series
Core Switch	Cisco	Sup7-LE	Supervisor 7-LE for 4500-E series
Core Switch	Cisco	PWR-C4-2800WAC	2800W AC Power Supply for 4500-E series
Core Switch	Cisco	6500-E	Chassis for 6500-E series switch
Core Switch	Cisco	SupT2	Supervisor T2 for 6500-E series
Core Switch	Cisco	Sup6T	Supervisor 6T for 6500-E series
Core Switch	Cisco	PWR-3000W-AC	3000W AC Power Supply for 6500-E series

2.5 VOICE COMMUNICATIONS

(ANALOG PHONES, VOIP PHONES, GATEWAYS, ETC.)

2.5.1 No pre-approved parts at this time

2.6 PA SYSTEMS

(AMPLIFIERS, GATEWAYS, SPEAKERS, ETC.)

2.6.1 No pre-approved parts at this time

2.7 CLASSROOM AUDIO-VISUAL SYSTEMS

(AMPLIFIERS, CONTROLS, ENCODERS/DECODERS, MIXERS, SPEAKERS, ETC.)

2.7.1 No pre-approved parts at this time

2.8 GYM / MPR AUDIO-VISUAL SYSTEMS

(AMPLIFIERS, CONTROLS, ENCODERS/DECODERS, MIXERS, SPEAKERS, ETC.)

2.8.1 No pre-approved parts at this time

2.9 SPECIALIZED AUDIO-VISUAL SYSTEMS

(AMPLIFIERS, CONTROLS, ENCODERS/DECODERS, MIXERS, SPEAKERS, ETC.)

2.9.1 No pre-approved parts at this time

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 The Contractor shall install all communications equipment and materials per the manufacturer's specifications, industry best practices, and applicable codes.

3.1.2 All structured cabling components must be installed in compliance with **Leviton manufacturer guidelines** to maintain the **Lifetime Warranty.**

3.1.3 All equipment, cabling, and hardware must be protected from damage during storage and installation.

3.2 MATERIAL HANDLING & STORAGE

3.2.1 The Contractor shall store all materials in a clean, dry, and secure location until installation.

3.2.2 Equipment and materials must be protected from moisture, dust, and physical damage.

3.2.3 Any damaged or defective materials must be replaced at no additional cost to the District.

3.3 INSTALLATION & FIELD QUALITY CONTROL

3.3.1 Equipment & Materials Verification

A. Before installation, the Contractor shall verify that all equipment and materials match the approved submittals and schedules in Section 27 06 50.
B. Any discrepancies must be reported to the ITS Project Manager for resolution before installation begins.

3.3.2 Approved Manufacturers & Substitutions

A. Only products listed in this section shall be used for the project.
B. Any proposed substitutions must follow the approval process outlined in Section 1.4.
C. Unauthorized materials will be rejected and must be replaced at the Contractor's expense.

3.4 FINAL INSPECTION & ACCEPTANCE

3.4.1 Testing & Certification

A. All structured cabling shall be tested per Section 27 08 00 – Commissioning of Communications.
B. The Contractor shall provide test results demonstrating compliance with performance specifications.

3.4.2 Warranty Registration & Documentation

A. All Leviton structured cabling components must be registered with Leviton to activate the Lifetime Warranty.
B. The Contractor shall provide proof of warranty registration to the District as part of Section 3.4 – Closeout Submittals in 27 05 50.
C. All installed equipment warranties shall be transferred to the District upon project acceptance.

3.5 OWNER-FURNISHED, CONTRACTOR-INSTALLED (OFCI) PRODUCTS

3.5.1 General Requirements

A. Certain products may be Owner-Furnished, Contractor-Installed (OFCI) as identified in the project specifications and equipment schedules.
B. The Contractor is responsible for receiving, inspecting, handling, storing, and installing all OFCI equipment per project requirements.

3.5.2 Delivery & Inspection

A. The Contractor shall coordinate the delivery schedule of OFCI products with the District to ensure timely installation.
B. Upon receipt, the Contractor shall inspect all OFCI items for damage or missing components.
C. Any damage or missing items must be documented and reported to the District immediately before installation begins.

3.5.3 Storage & Protection

A. The Contractor shall store OFCI products in a secure, dry, and climate-controlled environment until installation.
B. Any loss, theft, or damage to OFCI items while in the Contractor's possession shall be the Contractor's responsibility.

3.5.4 Installation & Coordination

A. The Contractor shall install OFCI products per manufacturer instructions and project specifications.
B. The Contractor shall provide all labor, mounting hardware, cabling, and accessories required for installation unless otherwise specified.
C. Any integration requirements with Contractor-provided systems shall be coordinated before installation begins.

3.5.5 Testing & Commissioning

A. The Contractor shall test all installed OFCI products per project requirements.
B. Any issues with OFCI products during installation or testing shall be documented and reported to the District immediately.
C. The Contractor shall assist with District-provided warranty registration if required.

PART 4 - SUBSITIONS REQUEST FORM

General information

Project name: _____

Project location: _____

Contractor name: _____

Contact person: _____

Phone number: _____

Email: _____

Date submitted: _____

Substitution details

Specification section (e.g., 27 11 00): _____

Pre-approved product (manufacturer & model): _____

Proposed substitute (manufacturer & model): _____

Reason for substitution request: (check one)

☐ specified product is discontinued or unavailable

☐ proposed product offers equal or better performance at no additional cost

☐ project-specific conditions require a substitution

☐ other (explain): _____

Performance & compliance

(attach supporting documentation as required)

Requirement	Pre-approved product	Proposed substitute	Meets or exceeds? (yes/no)
Manufacturer warranty			
Compliance with TIA/NEC standards			
Physical dimensions (rack units, size, weight)			
Electrical requirements (voltage, amperage)			
Environmental ratings (temp, humidity)			
Network/power compatibility			
Availability (lead time)			

Required Attachments

(submissions without required attachments will be rejected)
☐ manufacturer data sheets/specifications for both products
☐ independent test reports (if applicable)

☐ installation instructions & compatibility documentation
☐ sample (if requested by the district)

Contractor certification

I certify that the proposed substitution meets or exceeds the requirements of the specified product and will be installed in full compliance with contract requirements. I acknowledge that if the substitute product is later found to be incompatible, the contractor will be responsible for replacing all non-compatible equipment at no additional cost to the district.

Contractor signature: _____ date: _____

District review & approval *(for district use only)*
Review date: _____ Substitution request status: ☐ approved – substituted product may be used ☐ approved with conditions – (see comments) ☐ rejected – contractor must use the specified product Comments/conditions:

District its project manager signature: _____ date: _____

END OF SECTION

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 Work Included

A. This section specifies the requirements for Communications Equipment Rooms, including:
   1. Main Distribution Frame (MDF) Rooms
   2. Building Distribution Frame (BDF) Rooms
   3. Intermediate Distribution Frame (IDF) Rooms

B. Work includes, but is not limited to:
   1. Work includes, but is not limited to:
      - Room-Level Requirements
      - Clearances for racks and cabinets
      - Dedicated power circuits & receptacles
      - Grounding and bonding infrastructure
      - HVAC and environmental controls
   2. Pathways for Cable Routing:
      - Overhead conduits, ladder racks, basket trays
      - Sleeves and penetrations for cable entry
   3. Exclusions (Refer to Related Sections)
      - Rack, Cabinet, & Enclosure Specifications → 27 11 16
      - Patch Panel & In-Rack Cable Management → 27 11 16
      - Rack-Mounted Power (PDUs, UPS) → 27 11 16

C. All work must comply with District standards, contract documents, and applicable industry standards.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a list of all Division 27 and Division 28 sections, refer to Section 27 00 00 part

1.2.2 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.2.3 Related Requirements:1.1.3. If Section 27 00 00 was not provided, contact the District ITS Department Project Manager to obtain a complete copy of the Division 27 and Division 28 sections.

1.2.4 Specific Related Sections

A. Section 27 05 26 - Grounding & Bonding For Telecommunications Systems
B. Section 27 05 28 – Pathways for Communications Systems
C. Section 27 05 43 - Underground Ducts & Raceways for Communications Systems
D. Section 27 11 16 – Communications Racks, Cabinets, and Enclosures
E. Division 26 – Electrical
F. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC)

1.3 REFERENCES

1.3.1 The installation shall comply with the latest editions of the following standards unless otherwise noted in the District standards. In the event of a conflict between these standards and the District's requirements, the District's standards shall take precedence, provided they meet or exceed the minimum requirements set forth by applicable codes and regulations.

A. TIA Standards:
   1. ANSI/TIA-568.0-D – Generic Telecommunications Cabling for Customer Premises
   2. ANSI/TIA-568.1-D – Commercial Building Telecommunications Cabling Standard
   3. ANSI/TIA-569-E – Telecommunications Pathways and Spaces
   4. ANSI/TIA-606-D – Administration Standard for Telecommunications Infrastructure
   5. ANSI/TIA-607-D – Bonding and Grounding for Telecommunications Systems
B. BICSI Standards:
   1. BICSI TDMM – Telecommunications Distribution Methods Manual (Latest Edition)
   2. BICSI ITSIMM – Information Technology Systems Installation Methods Manual
C. NFPA Standards:
   1. NFPA 70 – National Electrical Code (NEC)
   2. NFPA 75 – Standard for the Protection of Information Technology Equipment

1.4 DESIGN REQUIREMENTS – GENERAL

1.4.1 General Requirements

A. All telecommunications spaces shall meet the following minimum design criteria:
   1. Physical Security: Access shall be restricted to authorized personnel only.
   2. Environmental Protection: Spaces shall be free from excessive dust, moisture, vibration, and potential water intrusion (e.g., no installations in janitorial closets or near plumbing).

1.5 ELECTRICAL & COOLING

A. All MDF, BDF, and IDF rooms shall be equipped with:
   1. Dedicated electrical circuits for racks and backboards
   2. Proper HVAC systems per equipment load requirements

1.6 DESIGN REQUIREMENTS – DETICATED TELECOMMUNICATIONS AND/OR ELECTRICAL ROOM

1.6.1 Room Usage & Restrictions

A. MDF, BDF, and IDF rooms shall be used exclusively for IT and/or electrical infrastructure.
B. These rooms shall not be used for storage, office space, classrooms, or any other non-IT functions.
C. Permitted Systems:
   1. Electrical panels, subpanels, transformers, EMS, UPS systems, and fire protection equipment may be located in telecommunications spaces, provided they do not interfere with IT equipment, cable pathways, or required clearances.
D. Prohibited Systems:
   1. Mechanical systems (HVAC units, air handlers, water heaters, etc.) shall not be installed within MDF, BDF, or IDF rooms, except when dedicated to cooling the telecommunications room.
   2. Plumbing, drain lines, and any non-fire protection water pipes shall not pass through or be installed above telecommunications spaces.

1.6.2 Minimum Room Size

A. MDFs and BDFs must be located in dedicated telecommunications rooms and shall not be shared with other functions such as electrical rooms, storage rooms, or mechanical spaces.
B. Minimum Room Sizes
   1. MDF rooms: Minimum 16' x 13', unless otherwise specified.
   2. BDF rooms: Minimum 10' x 11', unless otherwise specified.
   3. IDF rooms: Minimum 7' x 11', unless otherwise specified.
   4. Larger spaces may be required depending on the number of racks and expected equipment density.

1.6.3 Equipment Clearances Requirements

A. Racks
   1. Front & Rear Clearance: Minimum 4 feet in front and rear of all racks.
   2. Side Clearance (End of Rack Rows):
      - MDF: Minimum 4 feet on the side closest to the door, 3 feet on the opposite side.
      - BDF/IDF: Minimum 3 feet on the side closest to the door.

B. Backboard
   1. Minimum 4 feet in front of all backboards.

C. Overhead cable tray and conduits shall be routed to avoid blocking access to racks.

1.6.4 Room Construction & Security

A. Walls
   1. Construction Requirements:
      - Walls shall extend from the floor to the structural ceiling, maintaining a minimum fire rating of 1 hour, or as required by local building codes.
      - All wall penetrations, including cable pathways, conduits, and HVAC ductwork, shall be firestopped using materials and methods approved by the Authority Having Jurisdiction (AHJ).
   2. Backboard Installation:
      - Provide ¾-inch, Grade A-C plywood backboards on all walls in front of and behind equipment racks.
      - Plywood shall be fire-retardant treated

B. Surface Finish:
   1. Walls shall be finished with durable, non-reflective paint in a light color to enhance visibility.
   2. Paint shall be low VOC.

C. Floors shall be smooth, non-porous, and utilize dust-free materials such as Luxury Vinyl Tile (LVT), epoxy coating, or polished concrete with anti-static properties. Flooring materials shall be durable, easily cleanable, and resistant to moisture and chemical exposure.

D. Doors shall meet the following requirements:
   1. Minimum Width: Doors shall be a minimum of 36 inches wide to accommodate equipment movement and maintenance access.
   2. Construction:
      - Solid-core construction for security and sound attenuation.
      - Comply with applicable fire-rating requirements, if located in a fire-rated corridor.
   3. Operation:
      - Doors shall open outwards.
      - Equipped with panic hardware to allow emergency egress.
   4. Access Control and Security:
      - Doors shall be integrated with the access control system and comply with all Division 28 requirements.
      - Doors shall be keyed to the Access Control Override key system and not part of the site master key system to enhance security.
      - Doors shall include the following devices:
        ◊ DPDT Door Position Sensor (DPS): Monitors the open/closed status of the door for access control and triggers the intrusion alarm system.
        ◊ Request-to-Exit (REX) Motion Detector: Shall be installed per Division 28 requirements, ensuring compliance with security and safety standards.
   5. No water, gas, or drain pipes shall run through or above MDF/BDF/IDF rooms.

1.6.5 Cable Pathways & Basket Tray Design

A. All telecommunications rooms (MDF, BDF, and IDF) shall include a continuous wire cable basket pathway to support structured cabling.

B. The cable basket shall be installed above:
   1. All backboards (full length).
   2. All equipment racks and cabinets (from wall to wall).

3. All cable entry points into the room.

C. Cable baskets must be interconnected to provide a continuous and structured pathway throughout the room.

1.6.6 Power Requirements

A. All power installations shall comply with Division 26 – Electrical and NEC requirements.
B. Electrical Panels
   1. Each MDF/BDF shall have a dedicated 208V, three-phase electrical panel (minimum 200A) serving only the MDF/BDF room.
   2. Each IDF shall have a dedicated 208V, three-phase electrical panel (minimum 100A) serving only the IDF room.
   3. Electrical panels shall be installed within the MDF/BDF room.
C. Power for Racks & Backboards
   1. Each equipment rack shall have:
      - (2) L6-30 receptacles on separate 208V, 30A dedicated circuits.
      - (1) 5-20 duplex receptacle on a 120V, 20A dedicated circuit.
      - Receptacles shall be mounted above racks for clear access.
   2. Backboard Receptacles:
      - (1) 5-20 duplex receptacle per 4 feet of backboard length.
      - Minimum of two (2) receptacles per backboard wall.
      - No more than (2) receptacles per circuit
      - Receptacles shall be mounted at 5 feet AFF.
      - Quad receptacles are not allowed unless specified in contract documents.
D. Conduit Requirements
   1. Routing:
      - Shall minimize impact on backboards, wall space, and cable pathways.
      - Vertical routing preferred; horizontal allowed only:
      - Within 18 inches AFF.
      - Within 1 foot below cable tray.
      - Above 10 feet AFF.
   2. Conduit Type Restrictions:
      - FMC, MC, BX are not permitted except for final connections to lighting or equipment.
      - Where required, length shall be minimized per AHJ requirements.

1.6.7 Grounding & Bonding Requirements

A. All telecommunications rooms shall be designed to include a Telecommunications Grounding Busbar
B. (TGB) as required by 27 05 26 – Grounding & Bonding for Communications Systems.
C. The grounding system shall be designed in accordance with TIA-607-D, NEC, and Division 27 05 26 requirements.
D. The grounding system design shall support low-impedance bonding of all telecommunications equipment.
E. Mounting Location:
   1. The TGB shall be located on the backboard within the telecommunications room.
   2. The TGB shall be positioned on the backboard between 18 inches below the cable tray.

1.6.8 Lighting Requirements

A. Lighting shall be positioned to provide adequate illumination at the front and rear of racks.
B. Minimum illumination levels:
   1. 500 lux (50 foot-candles) at 36 inches AFF at the front and rear of racks.
   2. 200 lux (20 foot-candles) in general room areas.
C. Fixtures shall be installed parallel to racks to minimize shadows.
D. Lighting shall be powered from the dedicated data room electrical panel to ensure independent operation.

E. Occupancy Sensor Requirements:
1. Must control lighting for the entire room.
2. Must provide full sensor coverage at the front and rear of racks.
3. Must have a minimum 30-minute timeout before shutoff.

1.6.9 HVAC & Cooling Requirements

A. General HVAC Guidelines for All Telecommunications Rooms:
1. HVAC equipment, including air handlers and fan coil units, shall not be mounted above any telecommunications equipment, racks, or pathways.
2. No thermostats shall be installed inside MDF, BDF, or IDF rooms unless they control that room's dedicated HVAC unit.
3. HVAC ductwork shall not obstruct cable trays, conduits, or rack access.
4. Condensation drain lines shall not pass through or terminate inside telecommunications rooms.
5. A temperature sensor shall be installed in each telecommunications room (MDF, BDF, and IDF) and must be integrated with the intrusion alarm system. Temperature sensor shall be programmed to trigger if the room temperature exceeds 85°F.

B. MDFs, BDFs, and Multi-Rack IDFs shall have a dedicated HVAC system to ensure proper temperature and humidity control independent from the building's general HVAC system.
1. Dedicated HVAC systems shall maintain the following room conditions
- Temperature: 70°F to 85°F
- Relative Humidity: 30% to 55%, non-condensing
2. HVAC systems must operate 24/7 and shall not be dependent on building occupancy schedules.

C. Single-Rack IDFs may use passive cooling by drawing conditioned air from the surrounding space, provided:
1. The IDF room has an open return path to the building's HVAC system.
2. The room temperature does not exceed 85°F under full equipment load.
3. Ventilation grilles and ducts shall only pull air from inside conditioned spaces and shall not be connected to outside air intakes.

1.6.10 Sample Room Layouts

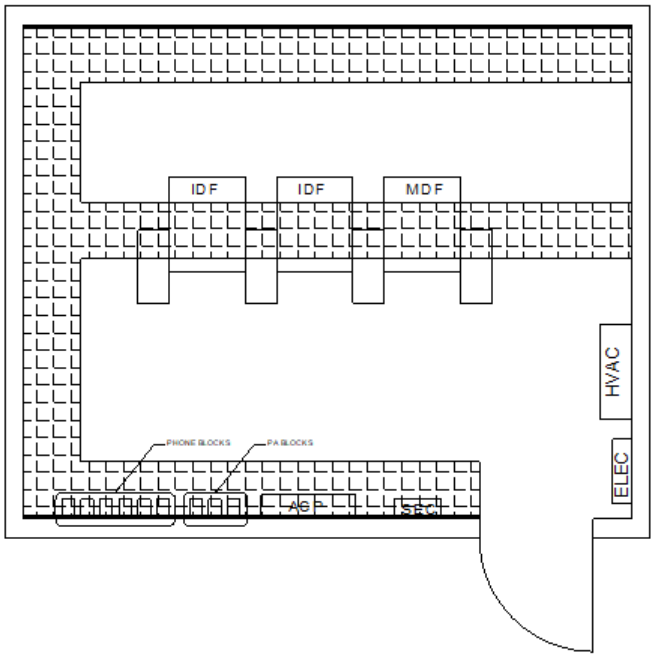


FIGURE 27 11 00 - 1: SAMPLE MDF LAYOUT

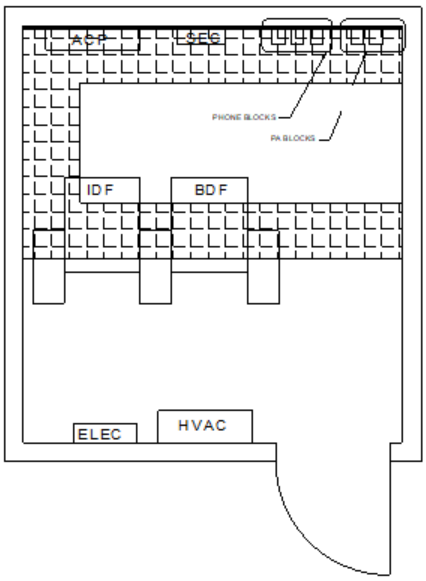


FIGURE 27 11 00 - 2 - SAMPLE BDF LAYOUT

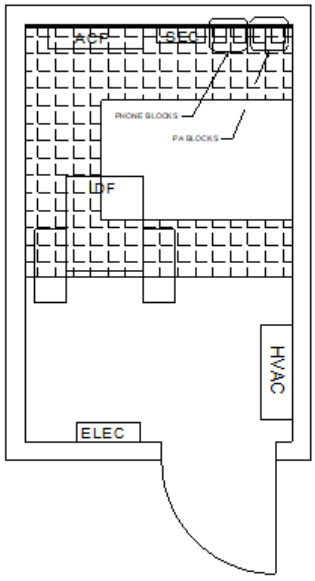


FIGURE 27 11 00 - 3 - SAMPLE IDF LAYOUT

1.7 DESIGN REQUIREMENTS – TELECOMMUNICATIONS EQUIPTMENT IN SHARED SPACE

1.7.1 General Requirements

A. IDFs installed in non-dedicated spaces shall be wall-mounted inside a secure, lockable enclosure on a 4’ x 8’ fire rated plywood backboard.
B. This installation is only permitted in existing buildings when a dedicated telecommunications room is not a feasible option.
C. All shared-space IDF installations must be approved by the ITS Project Manager before implementation.
D. The IDF shall be installed in a low-traffic area to minimize risk of damage or interference.

1.7.2 Mounting & Placement Requirements

A. IDF enclosures shall be mounted in a corner of the room to maximize available space and minimize obstructions.
B. The IDF must be mounted to allow both the front and back of the cabinet to fully swing open a minimum of 90 degrees.
C. The IDF enclosure shall not be installed in walkways or areas that obstruct access to other equipment or furnishings.
D. The placement of the IDF enclosure must take into account room layout and aesthetics to minimize visual and physical impact while maintaining full accessibility.
E. Mounting height:
   1. The top of the IDF enclosure shall be positioned 1 foot below the finished ceiling or at 9 feet above finished floor (AFF), whichever is lower.
F. The IDF shall be wall-mounted on a 4’ x 8’ plywood backboard.

1.7.3 Additional Systems on the Backboard

A. Alarm Panel
B. Access Control Panel
C. 66 Phone Blocks (Located inside of IDF Cabinet)

1.7.4 Power Requirements

A. All receptacles shall be on separate dedicated circuits and comply with Division 26 – Electrical and NEC requirements.
B. Each backboard shall have:
   1. (1) Dedicated 240V, 20A L6-20 Receptacle located within IDF cabinet.
   2. (1) Dedicated 120V, 20A circuit for powering the Alarm and Access Control panels.

1.7.5 Grounding & Bonding Requirements

1. IDFs shall be bonded to the building's electrical grounding system in accordance with the NEC (National Electrical Code) and manufacturer guidelines.
2. A minimum 5-position grounding lug shall be installed inside the IDF cabinet to provide designated bonding points for:
   - The IDF enclosure.
   - Rack-mounted equipment requiring grounding.
   - Shielded cabling, if applicable.
   - Other metallic components within the IDF, as required.

1.8 SUBMITTALS

1.8.1 General Requirements

A. All submittals shall comply with Section 27 05 50 – Communications Documentation & Submittals, unless otherwise specified in this section.
B. Submittals shall be provided in electronic format (PDF and native file format where applicable).

1.8.2 Product Data

A. The contractor shall submit manufacturer's data sheets for:
   1. Equipment racks, cabinets, and enclosures
   2. Cable management components
   3. Power distribution units (PDUs), UPS systems, and electrical components
   4. Cooling and ventilation equipment
   5. Bonding and grounding components

1.8.3 Shop Drawings

A. The contractor shall submit detailed shop drawings in DWG format (AutoCAD) and PDF format for review and approval.
B. Drawing Requirements:
   1. Scale: All shop drawings shall be drawn at 1:1 scale to ensure accurate representation.
   2. Major Dimensions: Drawings shall clearly indicate:
      - Room size and layout with dimensions.
      - Clearances between equipment, including minimum required working space.
      - Rack and cabinet locations, including:
        ◊ Distance from walls and adjacent equipment.
        ◊ Door swing clearances.
        ◊ Access space for maintenance.
      - Overhead cable pathways, including ladder racks, cable trays, and conduits.
      - Power outlet and grounding locations in relation to racks and equipment.
   3. Coordination Requirements: Drawings must align with architectural, electrical, and HVAC plans to ensure compliance with spatial and environmental requirements.

1.8.4 Test Reports & Certifications

A. Grounding and bonding test reports as required in Section 27 05 16.

B. Power system verification and load calculations.

1.9 QUALITY ASSURANCE

1.9.1 Contractor Qualifications

A. All work shall be performed by contractors and technicians meeting the following qualifications:
   1. Minimum 5 years of experience in structured cabling and communications equipment room installations.
B. Manufacturer Certification: If required by the manufacturer for proper installation or to maintain the product warranty, technicians shall be trained and certified by the manufacturer for all major installed components, including:
   1. Racks, cabinets, and enclosures.
   2. Power distribution units (PDUs), UPS systems.
   3. Cable management and pathways.
   4. Bonding and grounding components.

1.9.2 Equipment and Material Standards

A. All materials shall be UL-listed, ETL-listed, or third-party tested for compliance with industry standards.
B. Equipment and accessories shall be from an approved manufacturer as listed in Part 2 – Products.

1.10 DELIVERY, STORAGE, AND HANDLING

1.10.1 Equipment and materials shall be delivered in original packaging and protected from moisture, dust, and damage.

1.10.2 Storage shall be in a secure, climate-controlled environment to prevent exposure to excessive heat, cold, or humidity.

1.10.3 Damaged materials shall not be installed and must be replaced at no additional cost to the District.

1.11 PROJECT CONDITIONS

1.11.1 Communications equipment rooms must be fully constructed, enclosed, and secure before installation of any equipment.

1.11.2 Power and HVAC systems must be operational before equipment is installed.

1.11.3 Firestopping, grounding, and cable pathways must be completed per Division 27 and Division 28 requirements.

1.12 COORDINATION REQUIREMENTS

1.12.1 Contractor shall coordinate with:

A. District ITS Department Project Manager to confirm room layouts and infrastructure requirements.
B. Electrical contractor for power and grounding per Division 26.
C. Mechanical contractor for HVAC per Division 23.

PART 2 - PRODUCTS

2.1 GENERAL

2.1.1 All telecommunications equipment, racks, PDUs, UPS systems, and cable management products shall comply with the requirements set forth in Section 27 11 16 – Communications Racks, Cabinets, and Enclosures

2.1.2 Standard parts and materials shall be selected from the Pre-Approved Materials Schedule listed in Section 27 05 50 – Communications Documentation & Submittals.

2.1.3 Use of items from the Pre-Approved Materials Schedule does not require a substitution request.

2.1.4 Any products not listed in the Pre-Approved Materials Schedule shall require written approval from the ITS Project Manager prior to procurement and installation.

2.2 POWER

2.2.1 Receptacles

A. All receptacles shall be specification-grade or higher, designed for high-durability and long-term reliability in telecommunications environments.
B. Common Receptacle Types for Telecommunications Rooms
1. NEMA L6-30 (208V, 30A, twist-lock)
2. NEMA L6-20 (208V, 20A, twist-lock)
3. NEMA L5-30 (120V, 30A, twist-lock)
4. NEMA L5-20 (120V, 20A, twist-lock)
5. NEMA L21-30 (208V, 30A, three-phase)
6. NEMA L14-30 (120/208V, 30A, split-phase)
7. NEMA 5-20 (120V, 20A, standard duplex)

2.3 DETICATED TELECOMMUNICATIONS ROOM FLOORING & FINISHES

2.3.1 Flooring Options (Approved Finishes):

A. Luxury Vinyl Tile (LVT)
B. Epoxy Coating
C. Polished Concrete

2.3.2 Wall Finishes:

A. Painted with light-colored, non-reflective, low-VOC paint.
B. Fire-retardant treatment for backboards.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Installation shall comply with the requirements of:

A. TIA-569-E – Telecommunications Pathways and Spaces
B. TIA-607-D – Grounding and Bonding
C. NEC (National Electrical Code) – Article 800 and 250
D. Division 27 and Division 26 project specifications
E. Manufacturer installation guidelines

3.1.2 All equipment shall be installed in a neat, professional manner with proper alignment, cable routing, and accessibility for maintenance.

3.1.3 All fasteners, mounting hardware, and supports shall be rated for the installed equipment’s weight and load-bearing requirements.

3.1.4 Contractor shall coordinate installation with other trades to avoid conflicts with electrical, mechanical, and fire protection systems.

3.2 BACKBOARD INSTALLATION

3.2.1 General Requirements

A. All telecommunications rooms (MDF, BDF, IDF) and wall-mounted IDF enclosures shall include a backboard for mounting network equipment, grounding busbars, and other necessary components.

B. Backboards shall be a minimum of ¾ inch thick fire-rated plywood and painted to match the room they are occupying. Backboards in dedicated telecommunications and/or electrical rooms do not need to be painted.
C. Backboards shall be fully painted and allowed to fully dry prior to the installation of any conduits, junction boxes, outlet boxes, or telecommunications equipment.
D. All backboards shall be securely fastened to the wall structure using fasteners capable of supporting a minimum load of 300 lbs to accommodate heavy wall-mounted equipment.
E. Fasteners shall be installed into wall studs, blocking, or other structural elements—drywall anchors or unreinforced mounting is not permitted.

3.2.2 Placement & Mounting

A. All backboards shall be mounted with the bottom edge at 1 foot above finished floor (AFF) and extend up to 8 feet AFF
B. Backboards in dedicated telecommunications rooms (MDF, BDF, multi-rack IDFs) shall be mounted vertically and cover the entire walls located in front of and behind the racks.
C. Backboards in non-dedicated spaces (e.g., wall-mounted IDFs in shared spaces) may be mounted either vertically or horizontally, depending on design constraints and installation needs.
D. Horizontally mounted backboards shall be installed with the top edge positioned 1 inch below the finished ceiling or the bottom edge at 9 feet above finished floor (AFF), whichever is lower.
E. For non-dedicated spaces, smaller backboards may be used if approved by the ITS Project Manager; however, the backboard must span a minimums of 3 studs.
F. For wall-mounted IDFs, the backboard shall be a single 4’ x 8’ sheet and securely fastened to the mounting wall.
G. All cable management, grounding busbars, and wall-mounted equipment shall be installed on the backboard in a structured and organized manner.

3.2.3 Clearances & Integration

A. No conduits, piping, or electrical equipment shall obstruct the backboard mounting area.
B. Conduits entering the backboard shall be positioned to minimize impact on available mounting space and shall follow vertical routing wherever possible.

3.3 EQUIPMENT RACK & CABINET INSTALLATION

A. Refer to Section 27 11 16 – Communications Racks, Cabinets, and Enclosures

3.4 POWER INSTALLATION

3.4.1 General Requirements

A. All power installations shall comply with:
1. NEC (NFPA 70) and Division 26 – Electrical
2. Equipment manufacturer requirements
3. IEEE 1100 – Powering and Grounding Electronic Equipment
B. Power circuits shall be properly labeled at both:
1. The rack or backboard receptacle
2. The panelboard end per Section 27 05 53 – Identification for Communications Systems

3.4.2 Power Receptacle Installation

A. Receptacle Placement – Backboard Installations
1. General Requirements:
- Backboard-mounted receptacles shall be surface-mounted and readily accessible.
- A minimum of two (2) receptacles per backboard wall shall be provided.
2. Spacing & Layout:
- One (1) NEMA 5-20 duplex receptacle shall be installed per 4 feet of backboard length.

- Height Requirement: Receptacles shall be installed at 5 feet AFF (Above Finished Floor).
- No quad receptacles shall be used unless explicitly approved by the ITS Project Manager.

3. Grounding Considerations:
   - All backboard power receptacles shall be bonded to the telecommunications grounding system per 27 05 26 – Grounding & Bonding for Communications Systems.

B. Receptacle Placement – Floor-Mounted Racks (MDF, BDF, IDF in Dedicated Rooms)
1. Above-Rack Installation:
   - Power receptacles shall be installed above each rack to allow clear access for power cords.
   - Height Requirement: Receptacles shall be mounted 6 to 12 inches above the top of the rack.
2. Circuit Distribution & Conduit Routing:
   - Power circuits shall be individually dedicated to each rack, ensuring redundancy.
   - Conduits shall terminate inside racks using approved strain relief fittings.
   - Power conduits shall be routed separately from network cable pathways to avoid EMI.

C. Receptacle Placement – Wall-Mounted IDF Cabinets (Shared Spaces)
1. Inside Cabinet Installation:
   - The power receptacle shall be installed inside the cabinet, near the bottom hinge corner.
   - The receptacle shall be readily accessible but not obstructive to equipment or cable management.
   - Do not install receptacles on the cabinet's rear panel where they may interfere with network gear.
2. Conduit & Raceway Integration:
   - Power conduit shall enter the cabinet via the smallest factory-provided knockout or raceway opening.
   - No modifications to the cabinet shall be made beyond those specified by the manufacturer.

D. Additional Installation Requirements
1. Spacing & Accessibility:
   - No more than two receptacles per circuit unless otherwise approved.
   - Receptacles shall be positioned for easy access without obstructing cable management.

3.5 GROUNDING & BONDING EXECUTION

3.5.1 (Refer to 27 05 26 – Grounding & Bonding for Communications Systems for detailed requirements)

3.5.2 Telecommunications Grounding Busbar (TGB) Installation

A. The TGB shall be installed within 1 foot of the main cable entry point on the backboard.
B. TGB shall be bonded to the building's Telecommunications Main Grounding Busbar (TMGB) using a #6 AWG minimum copper conductor.
C. All racks, cabinets, and cable pathways shall be bonded to the TGB.

3.5.3 Grounding for Wall-Mounted IDFs

A. A minimum 5-position ground lug shall be installed in all wall-mounted IDFs.
B. IDF enclosures shall be bonded to the building grounding system per NEC and TIA-607-D.

3.6 CABLE BASKET INSTALLATION

3.6.1 Wire cable basket pathway shall be securely installed above all backboards, racks, and cable entry points per Part 1 – Design Requirements.

3.6.2 The cable basket pathway shall be installed above the backboard a minimum of 1' above the top of the racks.

3.6.3 Basket tray sections shall be interconnected using manufacturer-approved splices and grounding jumpers where required.

3.6.4 Cabling shall be properly secured using Velcro straps, with no excessive bundling or tension.

3.6.5 All basket trays shall be bonded to the TGB per TIA-607-D to ensure proper grounding continuity.

3.7 LABELING & FINAL INSPECTION

3.7.1 The contractor shall coordinate with the District ITS Project Manager to obtain the official MDF, BDF, and IDF room numbers before labeling.

3.7.2 Labeling Requirements

A. All equipment, racks, power circuits, and grounding connections shall be labeled in accordance with 27 05 53 – Identification for Communications Systems
B. Labels shall be permanent, legible, and machine-printed (handwritten labels are not acceptable).

3.7.3 Rack Labeling Requirements:

A. All racks shall be labeled with the room designation and rack number (e.g., MDF-01, IDF-02).

3.7.4 Electrical Labeling Requirements:

A. All receptacles shall be labeled with the panel and circuit number.
B. All junction and pull boxes shall be labeled with the panel and circuit numbers for all circuits contained within the box.

3.7.5 Final Inspection & Verification

A. The contractor shall perform a punch list walk with the ITS Project Manager prior to final acceptance.
B. The ITS Project Manager reserves the right to randomly test installed components using the contractor's test equipment.
C. The contractor must provide:
   1. As-built drawings in DWG format.
   2. Warranty documentation.
   3. Proof of compliance with 27 05 26 (Grounding & Bonding).

END OF SECTION

SECTION 27 11 16 – COMMUNICATIONS RACKS, CABINETS, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 Work Included

A. This section specifies the requirements for Communications Racks, Cabinets, and Enclosures, including:
   1. Main Distribution Frame (MDF)
   2. Building Distribution Frame (BDF)
   3. Intermediate Distribution Frame (IDF)
B. Work includes, but is not limited to:
   1. Equipment racks, cabinets, and enclosures
   2. Cable management systems (horizontal/vertical)
   3. Pathways for cable routing (conduits, cable tray, ladder racks)
   4. Power requirements (UPS, power distribution)
   5. Bonding and grounding
C. Exclusions (Refer to Related Sections):
   1. Room-Level Requirements (clearances, environmental controls, power circuits): See 27 11 00
D. All work must comply with District standards, contract documents, and applicable industry standards.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a list of all Division 27 and Division 28 sections, refer to Section 27 00 00 part

1.2.2 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.2.3 Related Requirements:1.1.3. If Section 27 00 00 was not provided, contact the District ITS Department Project Manager to obtain a complete copy of the Division 27 and Division 28 sections.

1.2.4 Specific Related Sections

A. Section 27 05 26 - Grounding & Bonding For Telecommunications Systems
B. Section 27 05 28 – Pathways for Communications Systems
C. Section 27 05 43 - Underground Ducts & Raceways for Communications Systems
D. Section 27 11 00 - Communications Equipment Room Fittings
E. Division 26 – Electrical
F. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC)

1.3 REFERENCES

1.3.1 The installation shall comply with the latest editions of the following standards unless otherwise noted in the District standards. In the event of a conflict between these standards and the District's requirements, the District's standards shall take precedence, provided they meet or exceed the minimum requirements set forth by applicable codes and regulations.

A. TIA Standards:
   1. ANSI/TIA-568.0-D – Generic Telecommunications Cabling for Customer Premises
   2. ANSI/TIA-568.1-D – Commercial Building Telecommunications Cabling Standard
   3. ANSI/TIA-569-E – Telecommunications Pathways and Spaces
   4. ANSI/TIA-606-D – Administration Standard for Telecommunications Infrastructure
   5. ANSI/TIA-607-D – Bonding and Grounding for Telecommunications Systems

B. BICSI Standards:
   1. BICSI TDMM – Telecommunications Distribution Methods Manual (Latest Edition)
   2. BICSI ITSIMM – Information Technology Systems Installation Methods Manual
C. NFPA Standards:
   1. NFPA 70 – National Electrical Code (NEC)
   2. NFPA 75 – Standard for the Protection of Information Technology Equipment

1.4 SUBMITTALS

1.4.1 General Requirements

A. All submittals shall comply with Section 27 05 50 – Communications Documentation & Submittals, unless otherwise specified in this section.
B. Submittals shall be provided in electronic format (PDF and native file format where applicable).

1.4.2 Product Data

The contractor shall submit manufacturer's data sheets for:
1. Equipment racks, cabinets, and enclosures
2. Cable management components
3. Power distribution units (PDUs), UPS systems, and electrical components

1.4.3 Shop Drawings

A. The contractor shall submit detailed shop drawings in DWG format (AutoCAD) and PDF format for review and approval.
B. Drawing Requirements:
   1. Scale: All shop drawings shall be drawn at 1:1 scale to ensure accurate representation.
   2. Major Dimensions: Drawings shall clearly indicate:
      - Room size and layout with dimensions.
      - Clearances between equipment, including minimum required working space.
      - Rack and cabinet locations, including:
        ◊ Distance from walls and adjacent equipment.
        ◊ Door swing clearances.
        ◊ Access space for maintenance.
      - Overhead cable pathways, including ladder racks, cable trays, and conduits.
      - Power outlet and grounding locations in relation to racks and equipment.
   3. Coordination Requirements: Drawings must align with architectural, electrical, and HVAC plans to ensure compliance with spatial and environmental requirements.

1.4.4 Test Reports & Certifications

A. Grounding and bonding test reports as required in Section 27 05 16.
B. Power system verification and load calculations.

1.5 QUALITY ASSURANCE

1.5.1 Contractor Qualifications

A. All work shall be performed by contractors and technicians meeting the following qualifications:
   1. Minimum 5 years of experience in structured cabling and communications equipment room installations.
   2. Manufacturer Certification: If required by the manufacturer for proper installation or to maintain the product warranty, technicians shall be trained and certified by the manufacturer for all major installed components, including:
      - Racks, cabinets, and enclosures.
      - Power distribution units (PDUs), UPS systems.

- Cable management and pathways.
- Bonding and grounding components.

B. Equipment and Material Standards
1. All materials shall be UL-listed, ETL-listed, or third-party tested for compliance with industry standards.
2. Equipment and accessories shall be from an approved manufacturer as listed in Part 2 – Products.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Equipment and materials shall be delivered in original packaging and protected from moisture, dust, and damage.

1.6.2 Storage shall be in a secure, climate-controlled environment to prevent exposure to excessive heat, cold, or humidity.

1.6.3 Damaged materials shall not be installed and must be replaced at no additional cost to the District.

1.7 PROJECT CONDITIONS

1.7.1 Communications racks, cabinet and enclosures must be fully constructed, and secure before installation of any equipment.

1.7.2 Firestopping, grounding, and cable pathways must be completed per Division 27 and Division 28 requirements.

1.8 COORDINATION REQUIREMENTS

1.8.1 Contractor shall coordinate with:

A. District ITS Department Project Manager to confirm room layouts and infrastructure requirements.
B. Electrical contractor for power and grounding per Division 26.
C. Mechanical contractor for HVAC per Division 23.

PART 2 - PARTS

2.1 GENERAL

2.1.1 All telecommunications equipment, racks, PDUs, UPS units, and cable management products shall comply with the requirements set forth in this section.

2.1.2 Standard parts and materials shall be selected from the Pre-Approved Materials Schedule listed in Section 27 05 50 – Communications Documentation & Submittals.

2.1.3 Use of items from the Pre-Approved Materials Schedule does not require a substitution request.

2.1.4 Any products not listed in the Pre-Approved Materials Schedule shall require written approval from the ITS Project Manager prior to procurement and installation.

2.2 EQUIPMENT RACKS AND CABINETS

2.2.1 General Requirements

A. Shall be EIA-310 compliant for standard 19-inch equipment mounting.
B. Constructed of heavy-duty steel or aluminum for durability.
C. Shall have adjustable mounting rails to support various equipment depths.
D. Shall be provided with:
1. Vertical and horizontal cable management as needed.
2. Bonding provisions for telecommunications grounding per TIA-607-D.
3. Shall support seismic-rated anchoring where required.
4. Shall be black powder-coated for corrosion resistance.

2.2.2 4-Post Racks (Standard Open-Frame Racks)

A. General Requirements
1. Shall be free-standing, open-frame, floor-mounted racks designed for structured cabling, networking, and server applications.
2. Constructed of welded or bolted steel with a durable powder-coated finish.
3. Shall have a minimum height of 44U, unless otherwise specified.
4. Racks shall comply with the following standards:
   - UL 2416 for structural and safety compliance
   - Designed to support a minimum static load of 2,000 lbs

B. Structural & Mounting Features
1. Shall have square-hole mounting rails for universal compatibility with cage-nut style equipment mounting.
2. Rack Dimensions:
   - Minimum Width: 22 inches
   - Minimum Depth: 28 inches
3. Mounting Width: Standard 19-inch EIA rack-mountable rails
4. Maximum mounting depth: 29.13 inches
5. Minimum mounting depth: 29.13 inches
6. Shall include pre-drilled mounting holes for anchoring to the floor using seismic-rated anchors where required.
7. Shall provide optional side-bracing kits for additional stability in high-load or seismic environments.

C. Cable Management & Accessories
1. Shall support installation of vertical and horizontal cable management systems.
2. Racks shall have provisions for mounting vertical PDUs (0U space) along the rear uprights.
3. Compatible with overhead ladder racks and basket trays for structured cable routing.
4. Shall allow for tool-less mounting of compatible cable organizers, PDUs, and accessories.

2.2.3 4-Post Cabinets (Fully Enclosed Racks)

A. General Requirements
1. Shall be free-standing, floor-mounted cabinets designed for high-density networking and switching environments.
2. Shall have a minimum height of 42U unless otherwise specified.
3. Cabinets shall comply with the following standards:
   - UL 2416 and UL 60950-1 for structural and safety compliance
   - Designed to support a minimum static load of 3,000 lbs and a dynamic load of 2,000 lbs.

B. Structural & Mounting Features
1. Shall have adjustable mounting rails to support various equipment depths.
2. Cabinet Dimensions:
   - Minimum Width: 28 inches
   - Minimum Depth: 42 inches
3. Mounting Width: Standard 19-inch EIA rack-mountable rails
4. Minimum mounting depth: 11.00 inches
5. Maximum mounting depth: 37.75 inches
6. Shall include pre-installed leveling feet and casters for mobility and stability.
7. Cabinets shall be designed for baying (ganging) multiple units together using manufacturer-approved hardware.

C. Security & Access Features
1. Shall include locking front and rear perforated doors for airflow and security.
2. Side panels shall be lockable and removable for easy service access.
3. Doors shall be made from 16-gauge steel with reinforced framing for durability.
4. Side panels shall be made from 18-gauge steel and shall be secured using keyed locks.

D. Cable Management & Airflow
1. Cabinets shall include vertical cable managers on both sides.

2. Shall feature an improved cable access roof to support high-density cable bundles.
3. Compatible with overhead ladder racks and basket trays for structured cable routing.

E. Mounting Provisions:
1. Shall include dedicated vertical mounting space (0U) for cable management, PDUs, and accessories.
2. Vertical mounting areas shall support tool-less installation of manufacturer-approved PDUs and cable organizers.
3. Shall provide multiple attachment points for securing structured cabling, fiber distribution units, and other accessories.

2.2.4 Wall-Mount Enclosures

A. General Requirements
1. Shall be wall-mounted, enclosed cabinets designed for telecommunications, networking, and structured cabling equipment.
2. Constructed of welded steel with a durable powder-coated finish for enhanced durability and security.
3. Available in 12U standard height, with 19U and 26U options available upon approval by the ITS Project Manager.
4. Shall have a minimum depth of 24 inches to accommodate standard network and IT equipment.
5. Front door shall be clear tempered glass to allow visual inspection of equipment without opening the cabinet.
6. Shall be UL 2416 Listed with a minimum load rating of 300 lbs.

B. Structural & Access Features
1. Three-Part Swing-Out Design:
- Allows full front and rear access to installed equipment.
- Rear panel shall be removable to simplify wall mounting and installation.
2. Security & Locking Mechanism:
- A single front door lock (CH751 key) provides access to the entire cabinet.
- Internal latch mechanism secures the rear panel to prevent unauthorized access.
- Enclosures must include security locking mechanisms and shall be installed per manufacturer recommendations to prevent unauthorized access.
3. Equipment Mounting & Depth Adjustment:
- Shall include one pair of adjustable-depth 19" EIA threaded equipment mounting rails.
- Rails shall allow for flexible equipment positioning to accommodate various device depths.

C. Cable Management & Cooling
1. Rear Panel Features:
- Includes 1” and 3” knockouts, supporting conduit sizes of ¾” and 2.5”.
- Edge-protection grommets shall be provided for all 3” knockouts.
- Provides cable tie points and attachment locations for accessory rack-mount brackets.
2. Cable Pass-Through Management:
- Shall include a cable pass-through knockout with optional brush seal to allow retrofit installations without excessive air leakage.
3. Cooling & Ventilation:
- Option for low-decibel (31 dB) fan kit shall be available for quiet, active cooling.
4. Power & Bonding Considerations:
- Shall be factory-prepped with a dedicated bonding feature to streamline electrical grounding connections

2.3 CABLE MANAGEMENT EQUIPMENT

2.3.1 Vertical Cable Managers

A. General Requirements
1. Vertical cable managers shall be installed adjacent to all equipment racks to support structured cable routing.

2. Cable managers shall be dual-sided to support cable routing for both front and rear cabling.
3. All vertical cable managers shall include locking front and rear doors to protect and conceal cables.
4. Managers shall be designed to support high-density cabling applications and allow for easy moves, adds, and changes (MACs).

B. Size & Construction
1. Vertical cable managers shall have a minimum width of 6 inches to accommodate large cable bundles.
2. Cable fingers shall be large and spaced evenly to provide proper separation for structured cabling.
3. Managers shall be constructed of high-strength steel or heavy-duty composite plastic to ensure durability and long-term support.
4. The cable manager depth shall be sufficient to allow proper cable bend radius and prevent cable strain.
5. Managers shall have rounded edges to prevent damage to cables during installation and maintenance.

C. Compatibility & Mounting
1. Vertical cable managers shall be compatible with both 2-post and 4-post racks.
2. Managers shall be designed for standard 19-inch racks.
3. Shall integrate with horizontal cable management solutions to maintain cable organization across the entire rack system.
4. Must support installation in both new construction and retrofit environments.

D. Additional Features
1. Managers shall provide tool-less mounting options where possible to facilitate easy installation.
2. Shall include cable pass-through openings to support structured cabling across multiple racks.
3. Optional accessories, such as cable retainers, grounding points, and additional support brackets, shall be available to enhance cable management.

2.3.2 Horizontal Cable Managers

A. General Requirements
1. Horizontal cable managers shall be dual-sided to support both front and rear cable management.
2. Managers shall include snap-on or hinged covers to protect and conceal cabling.
3. Cable managers shall support both copper and fiber optic cabling while maintaining proper bend radius.

B. Size & Construction
1. Width: Standard 19-inch rack-mountable design.
2. Height: 2U cable managers shall be used for all installations, except where space limitations require a 1U manager.
3. Depth: Sufficient to accommodate high-capacity cable bundles without crushing or deformation.
4. Cable managers shall have rounded edges and large openings to prevent cable damage.
5. Shall be constructed of high-strength steel or heavy-duty plastic for durability.

C. Additional Features
1. Cable retention features such as built-in Velcro straps, cable clips, or lacing bars shall be available for additional cable support.
2. Shall allow for routing of power cables separately from data cables to prevent interference.
3. Must allow for easy access to cables for moves, adds, and changes (MACs).

2.4 POWER EQUIPTMENT

2.4.1 Power Distribution Units (PDUs)

A. General Requirements
1. PDUs shall be rack-mountable and designed for use in 4-post racks, enclosed cabinets, and wall-mount enclosures.
2. All PDUs shall be UL-listed (UL 60950-1 or UL 62368-1) and comply with NEC (NFPA 70).
3. Shall be available in either horizontal or vertical mounting configurations as required by project specifications.
4. Shall support tool-less vertical (0U) mounting where applicable.
5. PDUs shall be available in basic, metered, and switched configurations as required by project specifications.

B. Voltage & Amperage:
1. 208V PDUs shall be rated for 30A and utilize L6-30P input plugs.
2. Single Phase 220/120V shall be rated for 30A and utilize L14-30P input plugs.
3. Three Phase 208/120V shall be rated for 30A and utilize L21-30P input plugs.
4. 120V PDUs shall be rated for 20A and utilize 5-20P input plugs.

C. Outlet Types:
1. 208V PDUs: C13 and C19 receptacles
2. 208/120V PDUs: C13, C19, and 5-20R receptacles.
3. 220/120V PDUs: C13, C19, and 5-20R receptacles.
4. 120V PDUs: 5-20R or C13 receptacles

D. Monitoring & Control (As Required):
1. Basic PDUs: No monitoring, standard power distribution only.
2. Metered PDUs: Display real-time power consumption per unit.
3. Intelligent/Switched PDUs (Optional):
   - Provide remote power monitoring and outlet control.
   - Support SNMP, web-based management, and power alerts.
4. Protection:
   - PDUs shall have built-in circuit breakers or overload protection.

2.4.2 Uninterruptible Power Supply (UPS)

A. General Requirements
1. UPS systems shall provide backup power for IT and network equipment in MDF, BDF, and IDF rooms.
2. UPS units shall be rack-mountable.
3. All UPS equipment shall be sized to provide a minimum of 15 minutes of runtime at full load.
4. All UPS's must support automatic voltage regulation (AVR).
5. All UPS's must provide a pure sine wave output.

B. UPS Specifications
1. Voltage & Capacity:
   - All UPS systems shall be 208V/220V, 30A input.
   - MDF/BDF: Minimum 3000VA (3kVA) UPS per rack.
   - IDF (if UPS is used): Minimum 1500VA (1.5kVA) UPS per rack.
2. Battery Requirements:
   - UPS systems shall use lithium-ion (Li-Ion) or lithium iron phosphate (LiFePO4) batteries.
   - Batteries must include a minimum 5-year manufacturer warranty.
   - Batteries shall be hot-swappable for easy replacement.
3. Monitoring & Management:
   - UPS systems shall be network-enabled and support SNMP-based monitoring for remote status and alerts.
   - Must include an LCD display to show real-time load, runtime, and battery health.
4. Bypass & Redundancy Features:
   - UPS systems shall support automatic bypass in case of internal failure.
5. Scalability & Runtime Extension:
6. UPS systems shall allow for external battery pack expansion where required.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 All installations shall comply with the following standards:

A. TIA-569-E – Telecommunications Pathways and Spaces
B. TIA-607-D – Bonding and Grounding
C. NEC (NFPA 70) – Article 645, 800, and 250

D. Manufacturer installation guidelines
E. Division 27 and Division 26 project specifications

3.1.2 All equipment shall be installed in a neat, professional manner with proper alignment, cable routing, and accessibility for maintenance.

3.1.3 All fasteners, mounting hardware, and supports shall be rated for the installed equipment's weight and load-bearing requirements.

3.1.4 Contractor shall coordinate installation with other trades to avoid conflicts with electrical, mechanical, and fire protection systems.

3.2 RACK EQUIPMENT LAYOUTS

3.2.1 General

A. Refer to FIGURE 27 11 16 - 1: Rack Layout Examples for visual guidance.
B. Equipment layouts shown are representative; final configurations shall comply with project-specific drawings and approved submittals.

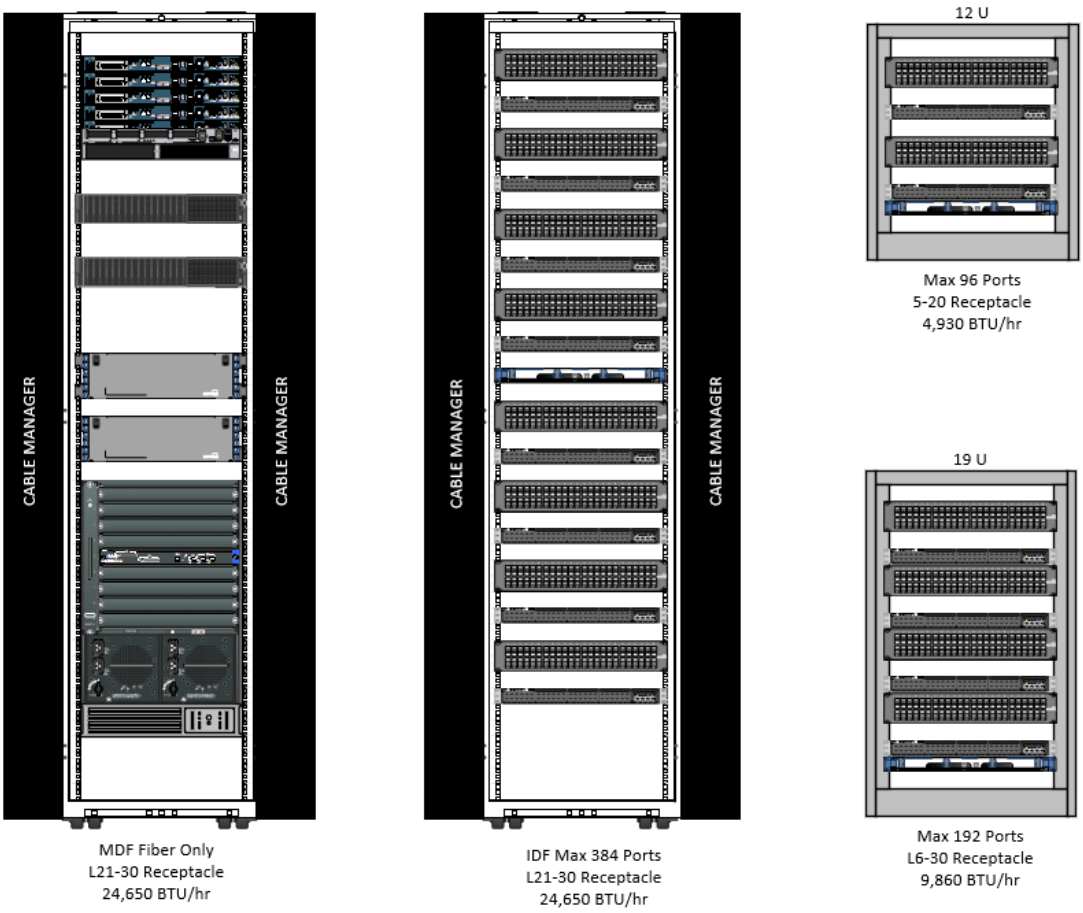


FIGURE 27 11 16 - 1: RACK LAYOUT EXAMPLES

3.2.2 Equipment Positioning

A. Patch panels shall be mounted starting at 1U from the top of the rack and spaced 3U apart.
B. Network switches shall be mounted 1U below each associated patch panel.
C. Horizontal cable managers shall be installed between patch panels and switches.
D. Spacing shall be maintained to facilitate cable bend radius, airflow, and serviceability.
E. Wall Mounted IDF Cabinets

1. LIUs shall be mounted 1U from the bottom of the enclosure.
2. PDUs shall be mounted on the back wall of the IDF cabinet

F. Floor Mounted IDF Racks / Cabinets
1. LIUs shall be mounted 27U from the bottom of the enclosure.
2. PDUs shall be installed in designated vertical (0U) locations unless otherwise approved.
3. UPS, if required, to be mounted 4U from the bottom of the rack.

G. Floor Mounted MDF Racks / Cabinets
1. LAN LIU shall be mounted 26U from the bottom of the enclosure.
2. PDUs shall be installed in designated vertical (0U) locations unless otherwise approved.
3. UPS to be mounted 4U from the bottom of the rack.
4. Core switch to be mounted 7U from bottom of rack.
5. Voice Gatways to be mounted starting at 1U below top of rack.
6. Voice Routers to be mounted starting at 41U above bottom of rack.
7. Site servers to be mounted between 30U and 38U above bottom of rack
8. MDF racks shall not have any copper patch panels installed. MDF is for backbone infrastructure only.

H. LIU Mounting
1. LIUs shall maintain clearance to allow front/rear access and cable management as per manufacturer guidelines.

3.3 EQUIPMENT RACK & CABINET INSTALLATION

3.3.1 4-Post Open Frame Rack Installation

A. Racks shall be securely anchored to the floor.
1. Use seismic-rated anchors where required.

B. Rack uprights shall be plumb, level, and aligned per manufacturer specifications.
C. All racks shall be individually bonded to the Telecommunications Grounding Busbar (TGB) using a #6 AWG copper conductor per TIA-607-D.
D. Vertical cable managers shall be installed adjacent to each rack, ensuring structured cable routing.
E. Racks shall be positioned to maintain clearance requirements as specified in 27 11 00.

3.3.2 4-Post Enclosed Cabinet Installation

A. Cabinets shall be installed on a level surface, with pre-installed leveling feet adjusted accordingly.
B. Cabinets shall be securely anchored to the floor, unless otherwise specified in writing by the ITS Department Project Manager.
1. Use seismic-rated anchors where required.

C. Casters shall be locked to prevent movement after installation.
D. Cabinets shall be positioned for proper airflow, ensuring adequate front-to-rear ventilation.
E. Cabinet baying (ganging) shall be performed using manufacturer-approved hardware.
F. Vertical cable managers and PDU mounting brackets shall be installed per manufacturer specifications.
G. All enclosed cabinets shall be individually bonded to the TGB.

3.3.3 Wall-Mount Enclosure Installation

A. Mounting
1. Enclosures shall be securely fastened to a 4’ x 8’ fire-rated plywood backboard.
2. Fasteners shall be installed into wall studs, blocking, or other structural elements—drywall anchors or unreinforced mounting is not permitted.
3. Enclosures shall be mounted in accordance with the manufacturer’s installation requirements.
4. Enclosures shall be positioned so that the top of the rack is 6 inches below the finished ceiling or the bottom of the rack is 10 feet above the finished floor, whichever is lower. Unless approved in writing by the ITS Department Project Manager.

B. Operation and Clearance Requirements

1. Ensure that the front door and middle cabinet are installed and adjusted to allow for full operational clearance.
2. Both the front door and middle cabinet shall be capable of opening to a minimum of 90 degrees from the closed position, without obstruction.
3. Installation shall be verified to ensure that adjacent walls, trim, hardware, or any other elements do not impede the full 90-degree opening.
4. Adjust hinges, stops, or other hardware components as necessary to achieve the specified opening clearance.

C. Cable entry points shall be sealed with brush grommets where applicable.
D. Wall-mounted enclosures shall be individually bonded to the TGB.

3.4 POWER EQUIPMENT INSTALLATION

3.4.1 Power Distribution Units (PDUs)

A. Mounting
   1. PDUs to be mounted in locations outlined in 3.2 Rack Equipment Layouts.
   2. Vertical PDUs shall be installed in designated vertical (0U) mounting areas of racks and cabinets.
   3. Horizontal PDUs (if required) shall be mounted in a 1U or 2U space at the rear of the rack.
B. PDUs shall be connected to the dedicated power circuits as specified in 27 11 00.
C. Cable routing shall be managed to avoid obstruction of equipment and airflow.

3.4.2 Uninterruptible Power Supply (UPS) Installation

A. UPS units to be mounted in locations outlined in 3.2 Rack Equipment Layouts.
B. UPS units shall be installed in rack-mount trays or brackets per manufacturer specifications.
C. UPS systems shall be connected to dedicated circuits specified in 27 11 00.
D. Battery packs (if required) shall be installed securely and tested for proper function.
E. Network Configuration
   1. UPS units shall be connected to the network and assigned an IP address for remote management and SNMP monitoring.
   2. Each UPS shall be assigned a static IP address and configured with appropriate SNMP community strings or credentials.
   3. Time synchronization settings shall be configured using District-provided NTP servers.
   4. Contractor shall coordinate with the District ITS Project Manager to verify successful integration into the District's centralized network monitoring system.

3.5 CABLE MANAGEMENT INSTALLATION

3.5.1 Vertical Cable Managers

A. Vertical cable managers shall be installed adjacent to racks and cabinets on both sides to support structured cabling. When multiple racks are utilized in a row the middle cable manager may be used for both racks.
B. Cable managers shall have front and rear doors.
C. Cables shall be secured using Velcro ties (zip ties are not permitted).

3.5.2 Horizontal Cable Managers

A. Shall be installed above and below patch panels and switches except under the following circumstances:
   1. When patch panels and switches are arranged in an alternating switch / patch panel pattern and patch cords of 1' or less are utilized.
B. Managers shall include covers to protect and conceal cabling.

3.6 GROUNDING & BONDING EXECUTION

3.6.1 All racks, cabinets, and enclosures shall be bonded to the Telecommunications Grounding Busbar (TGB).

3.6.2 Wall-mounted enclosures shall have a dedicated grounding lug bonded to the TGB.

3.6.3 All bonding connections shall be tested for continuity and compliance with TIA-607-D.

3.7 FINAL INSPECTION & ACCEPTANCE

3.7.1 The contractor shall coordinate with the ITS Project Manager to perform a final inspection.

3.7.2 All equipment shall be labeled in accordance with 27 05 53 - Identification for Communications Systems.

3.7.3 As-built documentation shall be provided per requirements outlined in 27 05 50

3.7.4 Warranty documentation and compliance test results shall be submitted for approval.

END OF SECTION

SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section specifies the minimum requirements for backbone cabling supporting telecommunications infrastructure.

1.1.2 The backbone cabling system includes:

A. Copper and fiber optic cabling between MDFs, BDFs, and IDFs.
B. Outside Plant (OSP) cabling installed between buildings and service entrances.

1.1.3 Backbone cabling shall be installed to provide reliable connectivity between network distribution points within and between buildings.

1.1.4 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a list of all Division 27 and Division 28 sections, refer to Section 27 00 00 part

1.1.5 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.1.6 Related Requirements:1.1.3. If Section 27 00 00 was not provided, contact the District ITS Department Project Manager to obtain a complete copy of the Division 27 and Division 28 sections.

1.1.7 Related sections for detailed requirements:

A. 27 13 13 - Copper Backbone Cabling
B. 27 13 23 - Fiber Optic Backbone Cabling

1.2 COMPLIANCE STANDARDS AND REGULATIONS

1.2.1 National Electrical Code (NEC) – Article 800

1.2.2 ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard

1.2.3 ANSI/TIA-568.2-D – Balanced Twisted-Pair Telecommunications Cabling and Components Standard

1.2.4 ANSI/TIA-606-D – Administration Standard for Telecommunications Infrastructure

1.2.5 BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition

1.2.6 NFPA 70 – National Fire Protection Association Electrical Code

1.2.7 2025 California Electrical Code (CEC)

1.3 TESTING REQUIRMENTS

1.3.1 General Testing Compliance:

A. All testing of backbone cabling systems shall comply with the procedures outlined in Section 27 05 86 - Testing of Communications Systems.
B. Contractors are responsible for ensuring that all backbone cabling is tested and certified per applicable ANSI/TIA standards.
C. Submit all test results as part of the project closeout documentation, as specified in Section 27 05 50 - Communications Submittals.

1.4 SUBMITTALS

1.4.1 Refer to Section 27 05 50 - Communications Submittals for all required submittals, including:

A. Product data for backbone cabling, termination hardware, and labeling systems.
B. Shop drawings showing cable routing, termination points, and pathway coordination.
C. As-built documentation, including labeling schemes, cable pathways, and test results.

1.4.2 Product Data: Provide manufacturer specifications for all cables, termination hardware, and labeling systems.

1.4.3 Shop Drawings: Include backbone cable routing, termination points, and pathway coordination with other utilities.

1.4.4 Test Reports:

A. Copper: Provide certification reports per ANSI/TIA-568.2-D.
B. Fiber: OTDR and power meter test results per ANSI/TIA-568.3-D.
C. As-Built Drawings:

1.4.5 Must indicate actual installed cable pathways, labeling schemes, and termination locations.

1.4.6 Manufacturer Certifications:

A. Submit proof that installers are certified for installing the specified cabling system.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualifications:

A. Contractors must have at least five (5) years of experience in structured cabling installation.
B. Lead technicians must hold manufacturer certifications for the installed cabling system.

1.5.2 Mock-Up Installation:

A. When required, install a sample backbone cabling system for approval before full deployment.

1.5.3 Pre-Installation Meeting:

A. The contractor shall coordinate with the ITS Project Manager and Facilities Project Manager to review the routing, labeling, and testing plan.

1.5.4 DELIVERY, STORAGE, AND HANDLING

A. Store all cables in a dry, climate-controlled space.
B. Do not bend cables beyond their minimum bend radius during handling or installation.

1.5.5 Protect fiber spools from impact and excessive stress during transport and staging.

1.5.6 WARRANTY

A. The backbone cabling system shall have a manufacturer’s performance warranty of at least 25 years covering defects in materials and workmanship.
B. Contractor shall warranty the installation for a minimum of one (1) year from final acceptance.

PART 2 - PRODUCTS

2.1 CABLE PULLING LUBRICANTS

A. All cable pulling lubricants must be non-wax-based, non-conductive, and safe for use with Category-rated copper cables and fiber optic cables.
B. Approved lubricants must be water-based or polymer-based and specifically designed for low-voltage communication cables.

C. **The following lubricants are strictly prohibited**:
   1. Wax-based lubricants, including Ideal Yellow 77 or equivalent.
   2. Any lubricant that leaves a sticky residue or can cause cable jacket deterioration over time.
   3. Oil-based lubricants that may degrade cable insulation.

D. All lubricants must be manufacturer-approved for the cable type being installed.

2.2 OSP CABLE REQUIREMENTS

2.2.1 Waterproofing: All OSP cables must be gel-filled or use dry water-blocking technology.

2.2.2 Rodent Protection: Where required, provide armored cables with interlocking steel tape.

2.2.3 UV Resistance: Jackets for cables in outdoor enclosures must be UV-resistant and direct burial-rated where applicable.

2.3 CABLE MANAGEMENT COMPONENTS

2.3.1 Zip Ties:

A. Prohibited for all data cabling and low-voltage wiring installations, except where specifically required by a manufacturer's installation guide, such as:
   1. Securing fiber cables within fusion splice cassettes.

B. When zip ties are permitted, they must:
   1. Be non-conductive and UL-listed.
   2. Not be over-tightened to prevent damage to cable jackets.

2.3.2 Hook-and-Loop (Velcro) Cable Ties

A. General Requirements:
   1. Must be non-conductive, durable, and reusable.
   2. Minimum width: 3/4 inch to provide adequate support without damaging cable jackets.
   3. UV-resistant if used in outdoor environments.

2.3.3 D-Rings:

A. Not approved for use with copper data cables or fiber optic cables.
B. May only be used for low-voltage control wiring, PA system cables, or non-data cable management.
C. Metal or plastic D-rings, with smooth edges to prevent cable abrasion.

2.3.4 J-Hooks:

A. Must comply with Section 27 05 28 - Pathways for Communications Systems.
B. Fill ratio, support spacing, and installation methods must meet the requirements outlined in Section 27 00 00 part **Error! Reference source not found. Error! Reference source not found.**.
C. UL-listed, with rounded edges, and appropriate sizing for the cable type and quantity.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Compliance with Standards:

A. All installations must comply with:
   1. Applicable building codes, industry standards, and manufacturer guidelines.
   2. All Division 27 sections.

3.1.2 Coordination with Other Trades:

A. Coordinate with Electrical, Mechanical, and General Contractors to avoid conflicts with other systems.
B. Verify that pathways and cable routes are clear and accessible before installation.

3.2 PATHWAY INSTALLATION:

A. All pathways shall be installed per Section 27 05 28 and Section 27 05 43 requirements.
B. Conduits entering buildings must be sealed to prevent water ingress, using firestopping materials where required.

3.3 MINIMUM BEND RADIUS

3.3.1 Unshielded Cable

A. Follow manufacturer recommendations or a minimum bend radius shall be 10 times the cable diameter, whichever is greater, unless otherwise specified.

3.3.2 Shielded Cable or Composite Bundles:

A. Follow manufacturer recommendations or a minimum of 10 times the cable diameter, whichever is greater, unless otherwise specified.

3.3.3 Bends must not be forced or flattened and must be supported during routing around corners or obstacles.

3.4 CABLE INSTALLATION REQUIREMENTS

A. General Pathway Requirements:
1. All backbone cabling, including fiber optic and copper cables, shall be installed in dedicated pathways specifically designated for backbone cabling.
2. Dedicated conduits shall be used exclusively for backbone cabling and may contain both fiber optic and copper cables within the same conduit, provided all fill ratio and separation requirements are met and all cables within the conduit are exclusively part of the backbone cabling system.
3. All pathways utilized shall comply with the requirements specified in:
   - 27 05 28 - Pathways for Communications Systems (for interior pathways).
   - 27 05 43 - Underground Ducts and Raceways for Communications Systems (for OSP and underground pathways).
4. All cable installs will comply with the max pathway fill ratios specified in Section 27 00 00

B. Cable Routing Requirements:
1. Cables shall be routed parallel to walls, ceilings, and structural elements. Running cables diagonally is prohibited.
2. Cables must be neatly dressed at termination points, with slack managed appropriately.
3. On backboards, cables shall be routed vertically or horizontally, maximizing available space and avoiding obstruction of equipment or pathways for future installations.
4. Cables installed in open ceiling environments or on backboards shall be organized and supported using approved cable management devices, ensuring a clean and serviceable installation.

C. Pre-Installation Verification:
1. Before any cable pulling begins, the contractor shall:
   - Verify the current fill ratio and calculate the required fill ratio for the project scope across all pathway sections utilized, including, but not limited to: conduits, J-hooks, sleeves, raceways, and cable trays.
   - Verify that all conduits have bushings installed prior to pulling cable.
   - Confirm that the combined fill ratio will not exceed the maximum allowed as outlined in Section 27 00 00 Part **Error! Reference source not found. Error! Reference source not found.**
   - Ensure that all abandoned cables have been removed from pathways before cable pulling begins.
   - Inspect all pull boxes and junction boxes to ensure they are clear of debris, and that unused conduits are capped or sealed.

3.5 LABELING REQUIREMENTS FOR BACKBONE CABLING

3.5.1 All backbone cabling (fiber optic and copper) shall be labeled per Section 27 05 53 – Identification for Communications Systems.

3.5.2 Labels shall be machine-printed, durable, and permanently affixed at:

A. Both ends of the cable.
B. All splice/transition points.
C. Every pull point along the cable route.
D. Within 1 foot of entering a fiber splice cartridge.
E. Every 100 feet along J-hook or basket pathways.
F. Every 10 feet in baskets or cable trays located in dedicated electrical rooms or telecommunications rooms.

3.6 SERVICE LOOP REQUIREMENTS

3.6.1 Service loops shall be installed to support future maintenance, re-termination, or repair of backbone communications cabling.

A. The required service loop length shall be in addition to the cable length necessary to reach the termination point.
B. Service loops shall be measured after all terminations, rework, and punch list corrections are complete and must meet the specified minimum lengths at the time of final inspection.
C. Service loop cable shall not be used to compensate for misrouting, installation errors, field modifications, or construction punch list corrections.
D. If any portion of a service loop is used or compromised during the course of construction, the contractor shall undertake whatever corrective action is required to restore the full required loop length prior to final acceptance, while maintaining full compliance with all applicable Division 27 and Division 28 requirements.

3.6.2 Service Loop Standards:

A. Provide a minimum 10-foot service loop on both sides of all backbone cabling runs, including:
   1. MDF, BDF, and IDF rooms.
   2. Termination points, cabinets, and cable trays.
B. Service loops must be:
   1. Neatly dressed and secured using Velcro ties.
   2. Mounted on backboards, within cable trays, or above ceiling tiles in occupied/shared spaces.

3.6.3 Pull Boxes & Underground Structures:

A. Above Ground Pull Boxes:
   1. Minimum of 1 complete loop of cable slack in each pull box.
B. Underground Structures:
   1. Minimum of 3 complete loops of cable slack in vaults, handholes, and maintenance holes.
   2. Cable to be neatly dressed in around the permitter of the structure, and attached to cable management arms if installed.

3.6.4 Additional Mounting Requirements:

A. Service loops installed above ceiling tiles must be property supported and not rest on tiles.
B. Service loops must be located within the room the cables are terminating in unless otherwise approved by the ITS Department Project Manager.
C. Utilize J-hooks, cable trays, or Velcro straps to support loops properly.

3.7 CABLE PULLING PROCEDURES

A. Pre-Pulling Requirements:
   1. Confirm the pathway is prepared per 3.4 Cable Installation Requirements and is ready for cable pulling.
   2. If the specified fill ratio cannot be achieved, submit a Request for Information (RFI) to the District ITS Project Manager.
B. Cable Pulling Lubricants:

1. Cable pulling lubricant shall be used for all installations to reduce friction and prevent cable damage.
2. Apply lubricant in accordance with 3.8 Cable Pulling Lubricant Usage & Cleanup, ensuring compatibility with all cable types.
3. Only use approved lubricants as specified, avoiding over-application to prevent residue build-up in conduits.

C. Pulling Techniques:

1. Cable pulling tension and bend radius shall not exceed the lesser of:
   - The maximums specified in this section, or
   - The manufacturer's requirements for each specific cable type.
2. Maximum Pull Tension:
   - Copper cables: Not to exceed 25 lbs (110 N) unless a lower limit is specified by the manufacturer.
   - Fiber optic cables: Not to exceed 600 lbs (2670 N) or as per manufacturer's guidelines, whichever is more restrictive.
3. Bend Radius Compliance:
   - Maintain a minimum bend radius of 4 times the cable diameter for UTP/STP copper cables.
   - For fiber optic cables, maintain a minimum bend radius of 20 times the cable diameter during installation.
   - Follow the more stringent requirement if the manufacturer's specifications are more restrictive than the above.
4. Techniques to Avoid Cable Damage:
   - Use appropriate pulling tools, including grips, swivels, and pull socks to distribute tension evenly.
   - Prevent cable twisting and kinking during the pulling process.
   - Monitor pulling speed to avoid excessive strain on cables.

3.8 CABLE PULLING LUBRICANT USAGE & CLEANUP

3.8.1 Approved Lubricants

A. Only District-approved, non-wax-based, non-sticky cable pulling lubricants shall be used.

1. Acceptable lubricants must be:
   - Water-based and residue-free after drying.
   - Compatible with copper and fiber optic cables per manufacturer recommendations.
   - UL-listed and compliant with ANSI/TIA and NEC requirements.

3.8.2 Prohibited Lubricants

A. **Wax-based lubricants (e.g., Yellow 77) are strictly prohibited** due to residue buildup that hinders future cable pulls.
B. Silicone-based lubricants that leave excessive residue are also not permitted.

3.8.3 Application Guidelines

A. Apply lubricant per cable manufacturer and lubricant manufacturer recommendations.
B. Use only the amount necessary to facilitate smooth pulling—over-application is not permitted.
C. Do not apply lubricant directly to fiber optic connectors or exposed copper terminations.

3.8.4 Cleanup Requirements

A. After cable installation, all excess lubricant must be removed from pathways, pull boxes, and handholes.
B. Contractor shall ensure that lubricants do not pool inside conduits or vaults.
C. Any spills must be cleaned immediately to prevent slip hazards or damage to adjacent equipment.

END OF SECTION

SECTION 27 13 13 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section specifies the minimum requirements for copper backbone cabling supporting telecommunications infrastructure, including:

A. Copper backbone cabling between MDFs, BDFs, and IDFs.
B. Inside Plant (ISP) and Outside Plant (OSP) copper cabling, where applicable.

1.1.2 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a list of all Division 27 and Division 28 sections, refer to Section 27 00 00 part

1.1.3 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.1.4 Related Requirements: 1.1.3. If Section 27 00 00 was not provided, contact the District ITS Department Project Manager to obtain a complete copy of the Division 27 and Division 28 sections.

A. All backbone cabling work shall comply with Section 27 13 00 - Communications Backbone Cabling unless otherwise specified in this section.
B. All pathway & firestopping work shall comply with 27 05 28 – Pathways For Communications Systems and 27 05 43 Underground Ducts & Raceways.

1.2 SUBMITTALS

1.2.1 General Submittal Requirements:

A. Provide all required submittals in accordance with Section 27 05 50 - Communications Submittal Requirements.
B. Submittals shall include, but not be limited to:
   1. Shop drawings, including cable routing, termination points, and connection details.
   2. As-built documentation, including pathway fill ratios, termination locations, and labeling information.
   3. RFI documentation, approved variances, and installation method adjustments.
   4. Refer to Section 27 05 50 - Communications Submittal Requirements for a more detailed list of required submittals.
   5. Warranty documentation verifying manufacturer-backed system warranty registration.
C. Exclusions:
   1. Product data sheets are not required for materials specified under Section 27 06 50 – Communications Equipment & Materials Schedule, unless otherwise directed by the District ITS Project Manager.

PART 2 - PRODUCTS

2.1 GENERAL

2.1.1 All parts listed in 27 06 50 – Communications Equipment & Materials Schedule are pre-approved for use unless otherwise specified.

2.1.2 All cables must have copper conductors; **the use of aluminum, copper-clad aluminum (CCA), or other conductor materials is prohibited.**

2.2 COPPER BACKBONE CABLING

2.2.1 Cable Types:

A. Category 5e (Cat5e) Backbone Cables:
   1. 25-pair is the default cable size for voice applications.
   2. Other sizes (12-pair, 50-pair, 100-pair) may be used if specifically required by the design or approved by the District ITS Project Manager.
B. Multiconductor Cables for Low-Voltage Applications:
   1. Suitable for low-voltage data, control, and communication systems, including but not limited to:
      - Data transmission.
      - Control wiring for building systems.
      - Public Address (PA) and general signaling systems.
   2. Available in common configurations such as 18/2, 18/4, 18/6, 18/8

2.2.2 Cable Construction:

A. General Cable Material Requirements:
   1. All cables, including Cat5e and multiconductor cables, must have copper conductors.
   2. The use of aluminum, copper-clad aluminum (CCA), or any other conductor materials is strictly prohibited.
B. Cat5e Backbone Cables:
   1. Twisted Pair (UTP or STP) construction.
   2. Solid copper conductors
   3. Must comply with ANSI/TIA-568.2-D standards.
C. Multiconductor Cables:
   1. Must comply with NEC Article 800 requirements for communications circuits.
   2. Stranded or solid copper conductors
   3. Minimum 18 AWG or as required by system design.
   4. Shielding, if specified, to minimize EMI/RFI interference.
   5. The Contractor is responsible for verifying the appropriate cable size based on:
      - Application requirements indicated in the construction drawings.
      - Consideration of voltage drop, distance limitations, and current-carrying capacity.
      - Adherence to manufacturer recommendations and industry standards.
D. Cables must be rated as:
   1. CMP (Plenum) for indoor plenum spaces.
   2. OSP (Outside Plant) for outdoor environments.
   3. OSP-CMP where cables transition directly from outdoor to plenum spaces without a transition point.
E. OSP / OSP-CMP Cables:
   1. Must be gel-filled or use dry water-blocking technology.
   2. Jackets must be UV-resistant.
F. Armored cables may be required for rodent protection, in interior or OSP installations, as specified in the construction documents or by the District ITS Project Manager.

2.2.3 Cross-Connect Wire (Tie Cables)

2.2.4 Cross-connect wire shall be:

A. Category 5e rated or better
B. 24AWG or better
C. Sold copper conductors only; aluminum, CCA, and other materials are prohibited
D. Rated for use within telecom rooms
E. Compatible with 66 blocks.

2.2.5 Cross-connect wire color shall match the corresponding system type. All cross-connect wire shall be color-coded as follows:

1. Blue – Horizontal station cabling (standard work area cabling)
2. Orange – Demarcation points for Central Office connections

3. Red – Data circuits including T1, PRI, or dedicated WAN circuits
4. Brown – Public Address (PA) system cross-connects
5. Green – Access control switches and door contacts
6. Yellow – Other low-voltage or auxiliary systems

2.2.6 Termination hardware

A. 66 Blocks:
1. General
- 50-pair 66 blocks with standoff brackets to accommodate 25-pair cables.
- Blocks must support Category 5e (Cat5e) cabling and be compatible with 66 punch-down tools.
- Must be UL-listed and meet ANSI/TIA-568.2-D standards.
2. Accessories:
- Bridging Clips for cross-connects.
  ◊ Metal bridging clips are required for telephone (voice) terminations.
  ◊ Plastic-coated bridging clips shall be used for all other applications, including low-voltage control systems and data wiring.
  ◊ Clips must maintain secure connections and resist corrosion.
- Covers to protect terminated cables from dust and damage.

B. Screw Terminals & Terminal Blocks
1. Approved Types:
- Euro-style terminal strips and DIN-style terminal blocks only.
- **Barrier-style terminal strips or any terminal block with exposed conductors are prohibited.**
2. Protection Requirements:
- All terminal blocks must provide permanent protection against accidental contact with conductors.
- Terminal blocks with removable plastic covers are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL EXECUTION REQUIREMENTS

3.1.1 Compliance with Standards

A. The contractor is responsible for complying with all applicable requirements of Section 27 13 00 - Communications Backbone Cabling and all Division 27 and Division 28 sections.
B. All installation work shall conform to industry standards, including but not limited to:
1. NEC (NFPA 70), including Article 800 for communications circuits.
2. ANSI/TIA-568.2-D for copper cabling.
3. BICSI Telecommunications Distribution Methods Manual (TDMM), latest edition

3.1.2 General Installation Requirements

A. All work shall be performed in accordance with Section 27 13 00 - Communications Backbone Cabling, unless otherwise specified in this section.
B. All cabling and associated hardware shall be installed per manufacturer recommendations and industry best practices.
C. Backbone Cabling Rating Requirements:
1. Plenum-rated (CMP) for indoor plenum spaces.
2. Plenum/OSP-rated for cables transitioning directly from outdoor to plenum spaces without a transition point.
3. Indoor/Outdoor Plenum-rated for installations requiring both environmental resistance and compliance with indoor fire safety codes.
D. Backbone Cabling Pathway and Routing Requirements
1. All pathway & firestopping work shall comply with 27 05 28 – Pathways For Communications Systems and 27 05 43 – Underground Ducts & Raceways.

2. Backbone copper cabling shall be installed in a neat and professional manner, with proper cable management, support, and separation from other systems as required.
3. All backbone cables shall be routed separately from horizontal cabling to simplify maintenance and reduce interference.
4. Backbone cables shall use separate pathways from horizontal cables, unless otherwise specified in the project design.
5. Backbone cables may be grouped together with other backbone cables, including fiber optic, copper, and PA backbone cables, as long as all cables within the pathway meet the same pathway rating and installation requirements.

3.1.3 Labeling Requirements

A. All terminations and cables shall be labeled per:
   1. 27 05 53 – Identification for Communications Systems.
   2. 27 13 00 Section 3.5 – Labeling Requirements for backbone
B. Labels shall be machine-printed, durable, and permanently affixed.

3.2 BACKBOARD LAYOUT

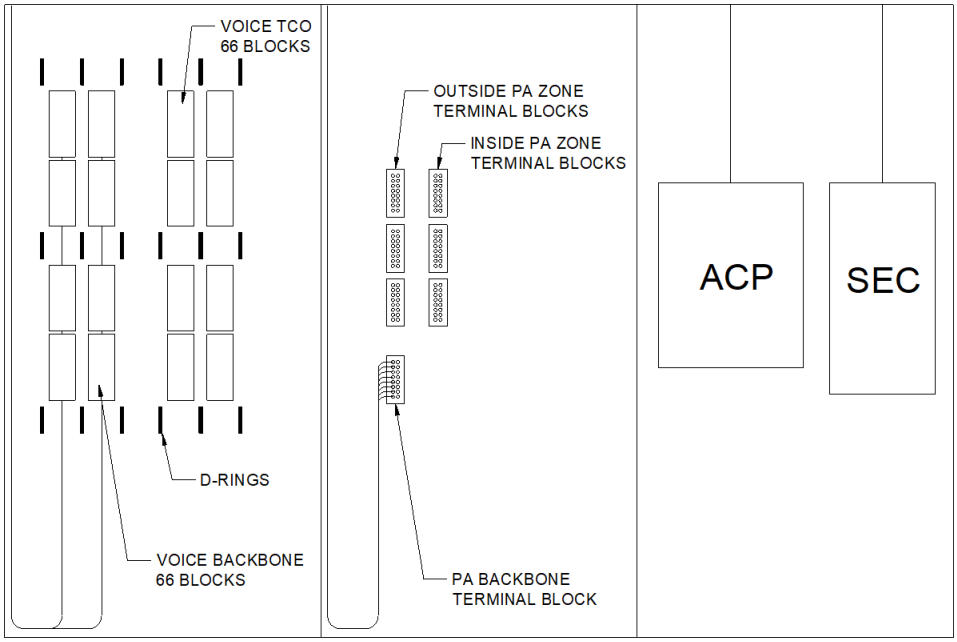


FIGURE 27 13 13 - 3.2-1: BACKBOARD LAYOUT

3.3 CABLE ROUTING & MANAGEMENT

3.3.1 Follow installation requirements outlined in Section 27 13 00 Part 3.

3.3.2 Voice Cables: Vertical Routing Method

A. Cables entering from above the backboard shall be routed vertically down the entire length of the backboard before turning upward to enter the 66 blocks from the bottom.
B. Maintain a neat and organized appearance, ensuring cables do not obstruct other equipment or future installations.
C. See FIGURE 27 13 13 - 3.2-1: Backboard layout for example cable routing.

3.3.3 Grouping Requirements

A. Copper backbone cabling shall be grouped together with other copper backbone cables of the same type.

B. Backbone copper cabling must be routed and managed separately from horizontal copper cabling to maintain clear separation and simplify maintenance.

3.3.4 Cable Management Practices

A. Cables shall be dressed vertically and horizontally, following building structural lines.
B. Avoid diagonal cable runs and ensure a professional and maintainable installation.
C. Cables should be properly secured using only approved cable management devices, avoiding the use of zip ties as specified in Section 27 05 28.

3.4 BACKBONE VOICE CABLING REQUIREMENTS

3.4.1 General Requirements

A. All backbone voice cables shall be terminated on 66 blocks per the TIA/EIA 568.2-D 25-Pair Color Code & Binding Groups.
B. Refer to FIGURE 27 13 13 - 3.2-1: Backboard layout for example block layout and placement guidance.
C. Punch-down connections must be made using manufacturer-approved tools and methods to ensure reliability and compliance with ANSI/TIA standards.

3.4.2 Backbone Voice Cabling Requirements

A. The minimum backbone voice cable size shall be 12-pair. Acceptable cable sizes include 12-pair, 25-pair, or 50-pair, based on project requirements.
B. The minimum backbone voice cable size shall be determined using the following formula
(# of classrooms/workspaces) + 5 = Minimum required pairs
- *Example: An IDF serving 18 classrooms/workspaces requires a 25-pair cable (18 + 5 = 22; next standard size is 25-pair).*
- *Example: An IDF serving 39 classrooms/workspaces requires a 50-pair cable (39 + 5 = 49; next standard size is 50-pair).*

C. All backbone voice cables shall be Category 5 or higher, using solid copper conductors.
D. All backbone voice cabling shall be labeled per Section 27 05 53 - Identification for Communications Systems.

3.4.3 Mounting & Layout

A. Mounting Height:
1. 66 blocks shall be installed no lower than 3 feet AFF and no higher than 7 feet AFF.
2. Mount blocks to ensure ergonomic accessibility for both installation and maintenance.

B. D-Ring Cable Management:
1. Install D-rings at the top and bottom of each column of 66 blocks.
2. Limit columns to three 66 blocks before adding a D-ring spacer for additional support and cable management.

C. Coordination for Large Installations:
1. For installations exceeding four 66 blocks, coordinate with the District ITS Project Manager for exact block layout.
2. Ensure the layout maintains space efficiency and accessibility for future modifications.

3.4.4 Termination Practices

A. Block Preparation:
1. 66 blocks shall be installed with standoff brackets to accommodate 25-pair cables.
2. Label all blocks and associated cables per Section 27 05 53 - Identification for Communications Systems.

B. Bridging Clip Requirements:
1. Use metal bridging clips exclusively for voice terminations.

2. For low-voltage applications (non-voice), use plastic-coated bridging clips to prevent corrosion and ensure safe handling.

C. Cable Dressing & Management:
1. Cables entering from above shall:
   - Run vertically along the backboard from the top to the bottom, before looping back up to enter the 66 blocks from the bottom.
2. Group all copper backbone cabling separately from horizontal cabling and maintain organization by cable type.

3.5 BACKBONE PA CABLING REQUIREMENTS

3.5.1 General Requirements

A. All backbone PA cables shall be terminated on approved terminal blocks.
B. Refer to FIGURE 27 13 13 - 3.2-1: Backboard layout for example block layout and placement guidance.

3.5.2 Installation Requirements

A. The contractor shall ensure that PA cabling follows manufacturer-recommended distance limitations and adheres to NEC and ANSI/TIA standards for low-voltage wiring.
B. The minimum backbone PA cable size shall be 18/8 (18 AWG, 8 conductor).
C. The contractor is responsible for verifying that the selected cable size is appropriate for the distance and wattage requirements of the PA system.
D. Backbone PA cabling must be designed and installed to ensure no more than 10% voltage drop from the source to the farthest endpoint.
E. All 18/8 cables shall follow the following conductor color code unless otherwise specified:
1. Black
2. Red
3. White
4. Green
5. Blue
6. Yellow
7. Brown
8. Orange

3.5.3 Mounting & Layout

A. Mounting Height:
1. Blocks shall be installed no lower than 3 feet AFF and no higher than 7 feet AFF.
2. Terminal mount blocks to ensure ergonomic accessibility for both installation and maintenance.

B. Coordination for Large Installations:
1. For installations exceeding four terminal blocks, coordinate with the District ITS Project Manager for exact terminal block layout.
2. Ensure the layout maintains space efficiency and accessibility for future modifications.

3.5.4 Termination Requirements

A. PA backbone cables shall be terminated on terminal blocks
1. Euro-style or DIN-style terminal blocks shall be used exclusively; **barrier-style terminal strips are prohibited.**
2. Install terminal blocks in a manner that ensures permanent protection against accidental contact with conductors.
3. Terminal blocks must have integral protective features. Terminal blocks that use of removable plastic covers are prohibited.

B. **66 or 110 punch-down blocks shall not be used for PA cabling terminations**.
C. Block Preparation:

1. Terminal blocks shall be installed to the backboard
2. Label all terminal blocks and associated cables per Section 27 05 53 - Identification for Communications Systems.

D. Cable Dressing & Management:
1. Cables entering from above shall:
   - Run vertically along the backboard from the top to the bottom, before looping back up to enter the terminal blocks from the bottom.

3.6 BACKBONE INTRUSION ALARM CABLING REQUIREMENTS

3.6.1 General Requirements

A. All backbone intrusion alarm cables shall be terminated on approved terminal blocks located within the security panel.
B. Refer to FIGURE 27 13 13 - 3.2-1: Backboard layout for example block layout and placement guidance.

3.6.2 Installation Requirements

A. The contractor shall ensure that intrusion alarm cabling follows manufacturer-recommended distance limitations and adheres to NEC and ANSI/TIA standards for low-voltage wiring.
B. The minimum backbone intrusion alarm cable size shall be 18/8 (18 AWG, 8 conductor).
C. The contractor is responsible for verifying that the selected cable size is appropriate for the distance and other requirements of the intrusion alarm system.
D. All 18/8 cables shall follow the following conductor color code unless otherwise specified:
1. Black
2. Red
3. White
4. Green
5. Blue
6. Yellow
7. Brown
8. Orange

3.6.3 Mounting & Layout

A. Mounting Height:
1. Blocks shall be installed no lower than 3 feet AFF and no higher than 7 feet AFF.
2. Terminal mount blocks to ensure ergonomic accessibility for both installation and maintenance.

B. Coordination for Large Installations:
1. For installations exceeding four terminal blocks, coordinate with the District ITS Project Manager for exact terminal block layout.
2. Ensure the layout maintains space efficiency and accessibility for future modifications.

3.6.4 Termination Requirements

A. Intrusion alarm backbone cables shall be terminated on terminal blocks
1. Euro-style or DIN-style terminal blocks shall be used exclusively; **barrier-style terminal strips are prohibited.**
2. Install terminal blocks in a manner that ensures permanent protection against accidental contact with conductors.
3. Terminal blocks must have integral protective features. Terminal blocks that use of removable plastic covers are prohibited.

B. **66 or 110 punch-down blocks shall not be used for PA cabling terminations**.
C. Block Preparation:
1. Terminal blocks shall be installed to the backboard

2. Label all terminal blocks and associated cables per Section 27 05 53 - Identification for Communications Systems.

D. Cable Dressing & Management:
1. Cables entering from above shall:
- Run vertically along the backboard into the intrusion alarm panel.

3.7 BACKBONE CABLING REQUIREMENTS FOR OTHER SYSTEMS

3.7.1 General Requirements

A. Backbone cabling for systems not explicitly covered under Section 27 13 13 shall meet the specific operational requirements of each system while maintaining compliance with NEC, ANSI/TIA, and manufacturer standards.
B. The contractor shall submit system design plans for review and obtain written approval from the District ITS Project Manager prior to construction.

3.7.2 Installation Requirements

A. All backbone cabling shall be:
B. Installed in accordance with Section 3.1 – General Execution Requirements.
C. Routed separately from horizontal cabling and follow separate pathway requirements unless otherwise approved.
D. Grouped with other backbone cables (fiber optic, copper, PA) only if all cables within the pathway meet the same rating and installation requirements.
E. The contractor is responsible for:
- Verifying cable size, voltage drop, and distance limitations to ensure system performance.
- Ensuring no more than 10% voltage drop from the source to the farthest endpoint, unless otherwise specified by system design.
- Adhering to manufacturer-recommended best practices for grounding, shielding, and interference mitigation.

3.7.3 Termination Requirements

A. Backbone cabling for other systems shall be terminated on manufacturer-approved terminal blocks or connectors appropriate for the system type.
B. 66 and 110 punch-down blocks shall not be used, unless explicitly approved by the Project Manager.
C. All terminations shall be secure, protected from accidental contact, and labeled per Section 27 05 53 - Identification for Communications Systems.

3.8 TESTING & CLOSEOUT DOCUMENTATION

3.8.1 Testing Requirements

A. All copper backbone cabling shall be tested in accordance with 27 05 86 - Testing of Communications Systems and ANSI/TIA-568.2-D standards.
B. The contractor shall provide test results and certification reports for all backbone copper cabling.
C. All backbone cabling shall be tested based on its intended application and system requirements.
D. General Testing (Applies to All Backbone Cabling)
1. Continuity testing shall be performed to verify correct wiring and pair integrity.
2. Wiremap testing shall confirm proper pair termination and sequence.
E. Voice Backbone Cable Testing
1. Voice backbone cables shall be tested per 3.8.1.1 General Testing requirements.
2. Attenuation, Near-End Crosstalk (NEXT), and Return Loss testing are NOT required for voice backbone cabling.
F. Other Backbone Cable Testing (Applies to All Non-Voice Backbone Cabling)
1. All cables shall be tested per 3.8.1.1 General Testing requirements.

2. Voltage drop testing shall be performed to ensure no more than 10% voltage drop from the source to the farthest endpoint.
3. Resistance testing shall be performed for all non-voice backbone cables:
4. End-to-end resistance shall not exceed manufacturer specifications for the installed cable type and gauge.
5. If measured resistance exceeds allowable limits, the contractor shall correct and retest before acceptance.

3.8.2 Closeout Documentation Requirements

A. The contractor shall provide as-built documentation, including:
   1. Cable routing diagrams indicating actual installed pathways.
   2. Termination schedules listing all backbone cable IDs and locations.
   3. Labeling details following 27 05 53 - Identification for Communications Systems.
B. The closeout package must be reviewed and approved by the District ITS Project Manager prior to final acceptance.

END OF SECTION

SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 Description

A. This section specifies the minimum requirements for fiber optic backbone cabling supporting telecommunications infrastructure.

1.1.2 Compliance

A. The contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety.
B. All backbone cabling work shall comply with Section 27 13 00 - Communications Backbone Cabling, unless otherwise specified in this section.

1.1.3 Scope

A. The fiber optic backbone cabling system includes:
1. Inside Plant (ISP) and Outside Plant (OSP) fiber optic cabling between MDFs, BDFs, and IDFs.
2. Interbuilding and intrabuilding fiber optic cabling, including all terminations, splicing, and testing.

1.2 SUBMITTALS

1.2.1 Provide all required submittals in accordance with 27 05 50 - Communications Submittal Requirements.

1.2.2 Submittals shall include, but not be limited to:

A. Shop drawings, including fiber cable routing, termination points, and connection details.
B. As-built documentation, including fiber optic strand assignments, splice diagrams, and labeling details.
C. Test results and certification reports per 27 05 86 - Testing of Communications Systems.

PART 2 - PRODUCTS

2.1 GENERAL

2.1.1 Approved Materials & Compliance

A. All fiber optic cabling, termination hardware, enclosures, and accessories shall be Leviton or equivalent and eligible for a lifetime system warranty.
B. All pre-approved components are listed in 27 06 50 – Communications Equipment & Materials Schedule.
C. Substitutions must be approved in writing by the ITS Department Project Manager prior to procurement.

2.2 FIBER OPTIC CABLE REQUIREMENTS

2.2.1 All cables must comply with:

A. ANSI/TIA-568.3-D – Optical Fiber Cabling Standard.
B. ANSI/TIA-492-AAAC (OM3), AAAD (OM4), and AAAB (OS2).
C. NFPA 70 (NEC) Article 770 – Plenum, Riser, and OSP Installation.
D. NFPA 262 and UL 1666 – Fire Safety Requirements.
E. EN 50173; ISO/IEC 11801; ANSI/ICEA S-104-696; ANSI/ICEA S-83-596.
F. NFPA 130; Telcordia GR-20 (OSP fiber); Telcordia GR-409 (indoor fiber).

2.2.2 Fiber Ratings:

A. All fiber optic cables used indoors shall be Plenum-rated (CMP).
B. All fiber optic cables used outdoors or underground shall be Plenum OSP or Plenum Indoor/Outdoor-rated.

C. Armored fiber cables must meet the same rating requirements as non-armored fiber and provide rodent protection (e.g., interlocking armor or non-metallic rodent-resistant sheathing).

2.2.3 Performance Requirements:

A. Single-Mode Fiber Requirements (OS2):
   1. Fiber must support transmission at:
      - 1310nm
      - 1550nm
   2. Maximum attenuation:
      - ≤ 0.4 dB/km @ 1310nm
      - ≤ 0.3 dB/km @1550 nm

B. Multi-Mode Fiber Requirements (OM3, OM4, OM5):
   1. Fiber must support transmission at:
      - 850nm
      - 1300nm
   2. Maximum attenuation:
      - ≤ 1.0 dB/km @ 1300nm
      - ≤ 3.0 dB/km @ 850nm

2.2.4 Plenum (CMP) Indoor Fiber Optic Cable

A. Application: Used for indoor backbone fiber runs.
B. Construction:
   1. Tight-buffered fiber construction for indoor backbone applications.
   2. 900-micron subunits for easy termination.
   3. Aramid yarn strength members for enhanced tensile strength.
   4. Plenum-rated outer jacket for compliance with NFPA 70 (NEC) Article 770.
   5. Glass-reinforced (GRP) anti-buckling member included for fiber counts of 24-144
C. Sheath Color:
   1. OS2 (Single-mode): Yellow
   2. OM3/OM4 (Multimode): Aqua
   3. OM5 (Multimode): Lime Green
D. Max Outer Diameters:
   1. 6 fibers – 0.19 in (4.73 mm)
   2. 12 fibers – 0.23 in (5.72 mm)
   3. 24 fibers – 0.30 in (7.7 mm)
   4. 36 fibers – 0.57 in (14.52 mm)
   5. 48 fibers – 0.61 in (15.62 mm)
   6. 72 fibers – 0.74 in (18.7 mm)
   7. 96 fibers – 0.95 in (23.98 mm)
   8. 144 fibers – 0.99 in (25.08 mm)

2.2.5 Indoor/Outdoor Plenum Fiber Optic Cable

A. Application: Used for backbone runs that transition from outdoors to indoor plenum spaces.
B. Construction:
   1. Tight-buffered fiber construction designed for both indoor and outdoor environments.
   2. 900-micron subunits for easy termination.
   3. UV- and moisture-resistant outer jacket for exposure to environmental conditions.
   4. Dry water-blocked cable core for moisture protection.
   5. Glass-reinforced (GRP) anti-buckling member included for fiber counts of 24-144.
   6. Jacket is:
      - Fungus-resistant, sunlight-resistant per UL 444 Clause 7.22.

- Suitable for use in conduit below the frost line.
- Plenum-rated outer jacket for compliance with NFPA 70 (NEC) Article 770.
- Designed to transition from outdoor to indoor plenum spaces without requiring splicing.

C. Jacket Rating: Plenum-rated (CMP), fungus-resistant, sunlight-resistant per UL 444 Clause 7.22. Suitable for use in conduit below frost line.
D. Glass-reinforced (GRP) anti-buckling member shall be included in cables with 24-144 fiber counts.
E. Sheath Color:
   1. OS2 (Single-mode): Yellow
   2. OM3/OM4 (Multimode): Aqua
   3. OM5 (Multimode): Lime Green
F. Max Outer Diameters:
   1. 6 fibers – 0.25 in (6.27 mm)
   2. 12 fibers – 0.27 in (6.82 mm)
   3. 24 fibers – 0.37 in (9.35 mm)
   4. 48 fibers – 0.65 in (16.5 mm)
   5. 72 fibers – 0.81 in (20.46 mm)

2.2.6 Plenum OSP (Outside Plant) Fiber Optic Cable

A. Application: Used for underground or aerial backbone fiber runs between buildings, while meeting plenum fire ratings for indoor transitions.
B. Construction:
   1. Loose-tube fiber construction for improved protection in outdoor environments.
   2. Water-blocked cable core using dry water-blocking technology for moisture resistance.
   3. Glass-reinforced (GRP) anti-buckling member included for fiber counts of 24-144
   4. Jacket is:
      - Jacket rated for direct burial or aerial installation.
      - Fungus-resistant, sunlight-resistant per UL 444 Clause 7.22.
      - Suitable for use in conduit below the frost line.
      - Plenum-rated outer jacket for compliance with NFPA 70 (NEC) Article 770.
      - Designed to transition from outdoor to indoor plenum spaces without requiring splicing.
C. Sheath Color:
   1. All Fiber Types: Black
   2. OS2 (Single-mode): Yellow
   3. OM3/OM4 (Multimode): Aqua
   4. OM5 (Multimode): Lime Green
D. Max Outer Diameters:
   1. 6 fibers – 0.54 in (13.86 mm)
   2. 12 fibers – 0.58 in (14.63 mm)
   3. 24 fibers – 0.64 in (16.28 mm)
   4. 48 fibers – 1.01 in (25.74 mm)

2.2.7 Armored Fiber Optic Cable (Rodent-Resistant)

A. Application: Used in areas requiring additional protection against rodents, crush resistance, and extreme environments while maintaining plenum or OSP compliance.
B. Construction:
   1. Available in both loose-tube and tight-buffered constructions, depending on the application.
   2. Glass-reinforced (GRP) anti-buckling member included for fiber counts of 24-144
   3. Rodent-resistant design with interlocking aluminum armor (plenum) or corrugated steel tape armor (OSP).
   4. Complies with NFPA 70 (NEC) Article 770.
   5. Indoor armored:
      - Plenum-rated (CMP) with interlocking aluminum armor for enhanced mechanical protection.

6. Outdoor armored:
    - OSP-Plenum or OSP Indoor/Outdoor rated with corrugated steel tape armor for enhanced mechanical protection.
    - Water-blocked cable core for moisture resistance in outdoor environments.
    - Jacket Properties:
        ◊ Fungus-resistant, sunlight-resistant per UL 444 Clause 7.22.
        ◊ Suitable for use in conduit below the frost line.
        ◊ Designed to transition from outdoor to indoor plenum spaces without requiring splicing.

C. Jacket Rating:
1. Armored Plenum-rated (CMP) for indoor applications.
2. Armored Plenum OSP-rated for underground/aerial runs.

D. Rodent Protection:
1. Must include interlocking armor or non-metallic rodent-resistant sheathing.

E. Sheath Color:
1. All Fiber Types: Black
2. OS2 (Single-mode): Yellow
3. OM3/OM4 (Multimode): Aqua
4. OM5 (Multimode): Lime Green

F. Max Outer Diameters:
1. 6 fibers – 0.69 in (17.38 mm)
2. 12 fibers – 0.69 in (17.38 mm)
3. 24 fibers – 0.76 in (19.25 mm)
4. 48 fibers – 1.06 in (26.84 mm)

2.3 MTP TRUNK CABLES

2.3.1 Application

A. Provides high-density backbone fiber connectivity between LIUs, cassettes, and network equipment.
B. Used to interconnect factory-terminated MTP cassettes, fusion splice cassettes, and other equipment.
C. All MTP trunk cables shall be compatible with the fiber optic cassettes listed in 2.5.
D. All MTP trunk cables shall use Universal Polarity and be compatible with Leviton Universal Polarity cassettes.
E. MTP trunk cables shall only be used under specific circumstances and must be approved by the ITS department project manager prior to use.
F. Shall be pre-terminated and pre-tested, with test documentation available upon request.

2.3.2 Construction & Features

A. MTP trunk cables shall be available in Base-8, Base-12, and Base-24 configurations to support a range of fiber applications.
B. MTP connectors shall mate to key up/key down adapters to ensure consistent polarity alignment.
C. All cables shall be factory-terminated and custom-built in any length with a standard breakout length of 0.5m, with other lengths configurable.
D. Cable Jacket Rating:
1. Indoor Installations: Plenum-rated (OFNP).
2. Outdoor/Underground Installations: Must be Plenum OSP-rated or Plenum Indoor/Outdoor-rated.
3. Armored MTP Trunks: Must meet the same plenum/OSP rating requirements as non-armored trunks and include rodent protection.

E. Cable Jacket Colors:
1. OS2 Single-mode MTP-UPC: Yellow
2. OM3/OM4 Multimode MTP-UPC: Aqua
3. OM5 Multimode MTP-UPC: Lime Green
4. OSP or Indoor/Outdoor Jackets: Black (with appropriate labeling).

F. Connector Colors (Per ANSI/TIA-568.3-D):
   1. OS2 Single-mode LC-UPC and MTP-UPC: Blue
   2. OM3/OM4 Multimode LC-UPC and MTP-UPC: Aqua
   3. OM5 Multimode LC-UPC and MTP-UPC: Lime Green

G. G. MTP Connector Boot Colors (For Fiber Count Identification):
   1. 8-fiber MTP: Gray
   2. 12-fiber MTP: Black
   3. 24-fiber MTP: Red

H. Pulling eyes shall be available as an option to protect fibers during installation.

I. MTP trunk cables shall include strain relief and bend-radius control mechanisms to protect fiber integrity.

2.3.3 Connector Interfaces

A. MTP-UPC connectors only

2.3.4 Performance Requirements

A. MTP trunk cables shall meet the following minimum return loss requirements:
   1. Single-mode (OS2): ≥ 60 dB
   2. Multimode (OM4/OM5): ≥ 20 dB

B. Base-8, Base-12, and Base-24 fiber configurations shall be supported while maintaining ultra-low-loss performance for data center and backbone applications.

2.3.5 Installation Requirements

A. Must support tool-less installation into LIUs, cassettes, and other equipment.

B. Shall allow for multiple trunk cables to be connected in a channel without polarity mismatches.

C. All cables shall be labeled to ensure proper identification during installation and maintenance, including:
   1. Trunk label on each end (showing fiber count, polarity, length, and serial number).
   2. Leg label on each breakout fiber for easy identification.

2.4 FIBER OPTIC PATCH PANELS & ENCLOSURES (LIU)

2.4.1 Application

A. Provides fiber termination, splicing, and patching capability for backbone fiber cabling within MDF, BDF, and IDF locations.

2.4.2 Enclosure Requirements

A. Main Distribution Frame (MDF) & Building Distribution Frame (BDF):
   1. Shall support a minimum of 24 slots for fiber splice cassettes.
   2. Shall be a high-density rack-mounted enclosure compatible with standard 19-inch EIA racks.
   3. Shall provide front and rear access for ease of fiber management.
   4. Shall allow for both patching and splicing in a single chassis.
   5. Must support fusion splice modules with internal fiber routing protection.
   6. Shall allow for tool-less installation of fusion splice cassettes.
   7. Enclosures with sliding trays shall be available in 2RU, 3RU, and 4RU versions that accommodate termination of up to 192, 288, or 384 fibers respectively (using LC connectors).
   8. Individual sliding trays shall have a forward stop and be completely removable.

B. Intermediate Distribution Frame (IDF):
   1. Shall support a minimum of 3 slots for fusion splice cassettes.
   2. Shall be a compact rack-mounted enclosure compatible with standard 19-inch EIA racks.
   3. Shall provide front and rear access for ease of fiber management.
   4. Must support only fusion splice cassettes for secure termination of backbone fibers.
   5. 1RU and 2RU versions shall have the ability to retrofit to High Density via replacement of the sliding tray.

6. The enclosure shall accept a conversion adapter bracket to accommodate higher-density fusion splice cassettes.

C. Wall-Mounted LIU (Special Cases Only – Requires Approval)
1. A wall-mounted LIU shall only be used in limited special situations and must be approved by the ITS Department Project Manager.
2. Shall be used for low-density fiber installations where rack-mounted LIUs are not feasible.
3. Shall be compatible with:
   - Factory-terminated HDS cassettes
   - HDX fusion splice cassettes
4. Shall support interconnect or cross-connect applications while minimizing wall space usage.
5. Must be lockable, with a key/lock kit available for security.
6. Must provide fiber routing, slack storage, and bend-radius protection for:
   - Tight-buffered fiber
   - Backbone cables
   - Fusion-spliced fibers
7. Must support strain relief and dust protection, including:
   - Removable cable entry/exit grommets
   - Optional cable strain-relief mounting kit
8. Shall not be used for MDF, BDF, or IDF installations.

2.4.3 Construction & Features

A. Material:
1. Shall be constructed of 16-gauge steel or aluminum with a powder-coated finish for durability and corrosion resistance.

B. Cable Management:
1. Shall include strain relief brackets, fiber routing spools, and bend-radius control.
2. Shall provide top, bottom, or rear cable entry for flexible routing.
3. Rear fiber cable management rings shall be stackable and configurable in ¼, ½, or full ring arrangements to simplify cable routing and organization.
4. Fiber cable routing and protection shall include patch cord cable managers at entry/exit points, multiple tie-down points for rear cable management, optional dust brush guards at rear cable entry points, and a cable strain-relief kit for incoming backbone fiber.

C. Sliding Trays & Component Access:
1. All LIUs shall have sliding trays.
2. Individual sliding trays shall have a forward stop and be completely removable.
3. Sliding tray shall remove completely from the enclosure to facilitate field terminations and splicing.
4. Installation and removal of all sliding trays and fusion splice cassettes shall be achieved via one-handed operation.

D. Splicing Support:
1. Shall accommodate fusion splice trays with support for 12, 24, or 48 fibers per tray.
2. Splice trays shall be designed for heat-shrink splice sleeves (40mm or 60mm lengths).
3. Must provide fiber slack storage and bend radius protection.

E. Labeling & Identification:
1. Must include port labeling compliant with ANSI/TIA-606-D.
2. Must feature machine-printed, permanent labels for easy port identification.

F. Enclosure Design & Security Features:
1. Enclosures shall have removable front and rear covers for better access to the interior of the enclosure.
2. Enclosures shall include removable rubber grommets that allow for pre-terminated fiber trunk installation, protection of cable, and minimized dust build-up.
3. Enclosures shall include front and rear latching doors (optional locking mechanism available).
4. Must allow for secured access to fiber terminations and splices.

5. Rack-mount optical fiber enclosure shall provide bend-radius control throughout the enclosure, as well as storage space for slack cabling.

2.5 FIBER OPTIC CASSETTES

2.5.1 Fusion Splice Cassettes

A. Application
1. Provides a modular, high-density solution for fiber termination within LIUs specified in 2.4.
2. Designed for on-site field splicing of fiber terminations.
3. Used for direct fiber splicing inside LIUs for permanent fiber connections.
4. Shall be pre-loaded and routed with respective color-coded fiber pigtail assemblies.
5. Provided pigtail assemblies shall be preconfigured to allow for termination to loose tube, tight-buffered, or ribbon fiber cables without modification or replacement.

B. Construction & Features
1. Available in 12-fiber LC-UPC and 36-fiber MTP configurations for OS2, OM4, and OM5 fiber types.
2. Cassette housing shall be polycarbonate for durability and lightweight construction.
3. Splice module shall provide slack storage and bend radius protection for:
   - Incoming backbone fibers
   - 900 µm tight-buffered fibers
   - Fusion-spliced fibers
4. Incoming 250 µm or ribbon backbone fibers shall be protected by a braided mesh sleeve.
5. Shall support heat-shrink fusion splice sleeves (40mm or 60mm lengths).
6. Shall include the following splice protection materials:
   - Heat-shrink style splice sleeves
   - Ribbon splice sleeve
   - Braided mesh sleeve
   - Tie wraps
7. LC adapters shall use ceramic ferrules and shall provide an IP5X-rated internal shutters, compliant with IEC 60529, that open and close automatically with the insertion and removal of LC connectors.

C. Connector Interfaces
1. Shall support LC-UPC and MTP-UPC adapters
2. Connector ports shall be color-coded per ANSI/TIA-568.3-D:
   - OS2 Single-mode LC-UPC: Blue
   - OM3/OM4 Multimode LC-UPC: Aqua
   - OM5 Multimode LC-UPC: Lime Green

D. Performance Requirements:
1. Maximum insertion loss:
   - Single-mode (OS2) LC-UPC: ≤ 0.35 dB
   - Single-mode (OS2) MPO: ≤ 0.75 dB
   - Multimode (OM3/OM4) LC-UPC: ≤ 0.25 dB
   - Multimode (OM3/OM4) MPO: ≤ 0.50 dB
2. Return loss:
   - Single-mode: ≥ 50 dB
   - Multimode: ≥ 30 dB

E. Installation Requirements:
1. Shall allow for fusion splicing inside the cassette without requiring additional components.
2. Must include strain relief and bend-radius control mechanisms.

2.5.2 Factory-Terminated Cassettes

A. Application
1. Designed for pre-terminated fiber trunk systems where factory-controlled termination is required within LIUs specified in 2.4.

2. Used for high-density fiber patching without field splicing.
3. Shall be pre-terminated and pre-tested, with test documentation available upon request.

B. Construction & Features
1. Pre-loaded with LC-UPC or MTP-UPC terminations for rapid deployment.
2. Available in Base-8, Base-12, and Base-24 MTP configurations.
3. MTP connectors shall mate to key up/key down adapters on the rear of the cassette.
4. LC adapters shall use ceramic ferrules and provide an IP5X-rated internal shutters, compliant with IEC 60529, that open and close automatically with the insertion and removal of an LC connector.
5. Cassettes shall include an integrated fiber slack manager for proper routing.
6. Cassette housing shall be flame-retardant, high-impact plastic or powder-coated steel.
7. Must include pre-installed dust caps to prevent contamination.

C. Connector Interfaces
1. Factory-terminated cassettes shall support LC-UPC or MTP-UPC terminations only.
2. MTP cassettes shall use universal polarity and must be compatible with existing Leviton Universal Polarity cassettes and shall allow for multiple cassettes to be connected in a channel.
3. Connector ports shall be color-coded per ANSI/TIA-568.3-D:
   - OS2 Single-mode LC-UPC: Blue
   - OM3/OM4 Multimode LC-UPC: Aqua
   - OM5 Multimode LC-UPC: Lime Green

D. Performance Requirements
1. Multimode Cassettes:
   - Base-12 MTP-to-LC: ≤ 0.35 dB insertion loss
   - Base-24 MTP-to-LC: ≤ 0.50 dB insertion loss
   - Base-12 MTP-to-MTP: ≤ 0.55 dB insertion loss
   - Base-24 MTP-to-MTP: ≤ 0.75 dB insertion loss
2. Single-Mode Cassettes:
   - Base-12 MTP-to-LC: ≤ 0.50 dB insertion loss
   - Base-24 MTP-to-LC: ≤ 0.50 dB insertion loss
   - Base-24 MTP-to-MTP: ≤ 0.75 dB insertion loss
3. Return Loss:
   - LC-UPC (Single-mode): ≥ 50 dB
   - Multimode LC-UPC: ≥ 30 dB

E. Installation Requirements
1. Must include strain relief and bend-radius control mechanisms.

PART 3 - EXECUTION

3.1 GENERAL EXECUTION REQUIREMENTS

3.1.1 Compliance with Standards

A. The contractor is responsible for complying with all applicable requirements of Section 27 13 00 – Communications Backbone Cabling and all Division 27 and Division 28 sections.
B. All installation work shall conform to industry standards, including but not limited to:
1. NEC (NFPA 70), including Article 770 for optical fiber circuits.
2. ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard.
3. BICSI Telecommunications Distribution Methods Manual (TDMM), latest edition.

3.1.2 General Installation Requirements

A. All work shall be performed in accordance with Section 27 13 00 – Communications Backbone Cabling, unless otherwise specified in this section.
B. All fiber cabling and associated hardware shall be installed per manufacturer recommendations and industry best practices.

3.1.3 General Labeling Requirements

A. All terminations and cables shall be labeled per:
   1. 27 05 53 – Identification for Communications Systems.
   2. 27 13 00 Section 3.5 – Labeling Requirements for backbone
B. Labels shall be machine-printed, durable, and permanently affixed.

3.2 BACKBONE FIBER INSTALLATION

3.2.1 General Requirements

A. All service loops, cable pulling procedures, and cable lubricant usage shall comply with 27 13 00, Part 3.
B. Pull string or mule tape shall be installed or reinstalled after cable pulling, in accordance with 27 05 28 and 27 05 43
C. Cable Handling
   1. Fiber optic cables shall not be bent beyond their minimum bend radius, kinked, crushed, or otherwise deformed during installation.
   2. Any cables damaged during installation shall be replaced in their entirety with new cable.
   3. Fiber optic backbone cables shall not exceed the maximum pulling tension specified by the manufacturer.
   4. Monitor cable pull tensions to ensure that the manufacturer's recommended values are not exceeded.
   5. Bend radius shall meet or exceed the following minimum requirements:
      - Unloaded cables: 10 times the cable outer diameter.
      - Loaded cables (during installation): 15 times the cable outer diameter.
      - Armored fiber cables: Follow manufacturer specifications.

3.2.2 Backbone Fiber Cabling Rating & Type Selection:

A. Fiber optic backbone cables shall be selected based on installation location and environmental conditions.
B. All fiber cables shall meet the rating and protection requirements defined in Part 2
C. Cable Rating & Type Requirements:
   1. Plenum-Rated (CMP) Indoor Fiber:
      - May only be used for fiber backbone runs that are entirely within a building.
      - Shall not be used in any exterior or underground pathways.
   2. Indoor/Outdoor Plenum-Rated Fiber:
      - Required any time a fiber cable utilizes exterior or underground pathways.
      - May **not** be used in pathways that are suspected to be damaged or contain debris that cannot be cleaned or cleared.
   3. Plenum/OSP-Rated Fiber:
      - May be used anywhere Indoor/Outdoor Plenum-rated fiber is allowed.
      - Required for fiber installed in underground conduits that are suspected to be damaged or contain debris that cannot be cleaned or cleared.
      - Permitted for temporary aerial installations, such as interim housing during a major construction project, with prior written approval from the ITS Department Project Manager.
   4. Armored Fiber (Plenum or OSP-Rated, as required):
      - Used by design in locations requiring additional mechanical or rodent protection, including:
        ◊ Areas subject to rodent activity.
        ◊ High-traffic areas requiring crush resistance.
      - Armored fiber shall meet the same installation location requirements as its non-armored equivalent.
   5. Prohibited Cable Types:
      - Unrated fiber optic cables shall not be used in any installation.
      - Riser-rated (CMR) fiber optic cables are strictly prohibited.

- Any other cable type not explicitly listed in this section requires written justification and prior approval from the ITS Department Project Manager.

3.2.3 Backbone Fiber Cabling Pathway and Routing Requirements:

A. All pathway & firestopping work shall comply with:
   1. 27 05 28 – Pathways for Communications Systems
   2. 27 05 43 – Underground Ducts & Raceways.
B. Fiber backbone cabling shall be installed in a neat and professional manner, with proper cable management, support, and separation from other systems as required.
C. All backbone fiber shall be routed separately from horizontal cabling to simplify maintenance and reduce the risk of damage.
D. Backbone fiber cabling may be grouped with other backbone cables, including copper, fiber optic, and PA backbone cables, as long as all cables within the pathway meet the same rating and installation requirements.
E. Fiber optic cables shall not be installed in any pathways shared with cables where the conductor voltage is exceeds 100V. This includes Type 1 power circuits and circuits for clocks/bells.
   1. Exceptions due to special circumstances require ITS project manager approval prior to construction.
F. Minimum bend radius and maximum pulling tensions shall be maintained per Division 27, ANSI/TIA-568.3-D and manufacturer specifications.

3.3 FACTORY-TERMINATED CABLE INSTALLATION

3.3.1 General Requirements

A. Use of factory-terminated cables must be approved in writing by the ITS Department Project Manager prior to construction.
   1. Factory-terminated cables shall only be used under specific circumstances to meet a defined project requirement.
B. All factory-terminated cable installations shall comply with the requirements in:
   1. 3.2 Backbone Fiber Installation. (All general fiber installation rules apply to MTP cables.)
   2. 27 13 00 – Communications Backbone Cabling Installation.
   3. ANSI/TIA-568.3-D and manufacturer installation requirements.

3.3.2 Factory-Terminated Cable Standards

A. All factory-terminated cables shall:
   1. Be terminated on an MTP connector.
   2. Be Base-24 polarity, unless a different polarity is required by design and approved by ITS Department Project Manager.
   3. Be compatible with universal polarity MTP cassettes listed in Part 2

3.3.3 Factory-Terminated Connector Protection & Handling

A. Connectors shall remain capped with dust covers until final termination.
B. Factory-terminated connectors shall not be used for pulling fiber through conduits unless specifically designed for that purpose.
C. Pulling grips or reinforced pulling eyes shall be used if pre-terminated cables must be routed through conduit.
D. Strain relief must be provided at entry and exit points of all fiber optic enclosures.

3.4 FIBER CABLE ROUTING & MANAGEMENT

3.4.1 General Routing Requirements

A. All fiber backbone cables shall be routed and managed in a neat and professional manner.

1. Cables shall be supported using approved cable management systems such as ladder racks, J-hooks, innerduct, or fiber guides.
2. Velcro ties shall be used to bundle and secure fiber cables. Plastic zip ties are not permitted.
3. Fiber cables shall be routed in a manner that minimizes exposure to mechanical damage.
4. In standard racks, fiber shall be routed along the back sides of racks, not directly down the center.
5. For wall-mounted or hinged racks, fiber shall be routed along the hinge side, with a slack loop to prevent strain when opening the rack. Cable and slack must not interfere with rack movement.

B. Pathway & Space Restrictions:
1. Fiber optic cables shall not be routed through active equipment space within racks or cabinets.
2. Cables shall not obstruct access to equipment, power, or ventilation airflow.

3.4.2 Cable Protection & Bend Radius Compliance

A. All fiber routing shall maintain proper bend radius requirements:
1. Unloaded cables: 10 times the cable outer diameter.
2. Loaded cables (during installation): 15 times the cable outer diameter.
3. Armored fiber cables shall maintain minimum bend radius per manufacturer's published specifications.

B. Strain relief shall be provided at all fiber entry/exit points to enclosures, racks, and LIUs.

3.4.3 Fiber Slack & Service Loop Management

A. Fiber slack and service loops shall be managed per 27 13 00 – Communications Backbone Cabling Installation.
B. Slack loops shall be properly dressed using fiber management trays, cable guides, or spools.
C. No bare fiber loops shall be left external to a fusion splice cassette.

3.4.4 Factory-Terminated Cable Routing

A. Factory-terminated fiber cables shall comply with all routing and management rules in this section.
B. Pre-terminated trunks shall not be excessively coiled within enclosures, cabinets, or racks.
C. Factory-terminated cables shall be properly strain-relieved at LIUs and termination points.

3.4.5 Strain Relief & Cable Management

A. Strain Relief Requirements:
1. Fiber cables shall be strain-relieved at all entry and exit points to prevent stress on connectors and splices.
2. Strain relief shall be provided at every LIU, splice enclosure, or cabinet entry point.

B. Cable Management Best Practices:
1. Velcro straps shall be used instead of zip ties to prevent excessive pressure on fiber strands.
2. Lacing bars shall be used to restrain cables, prevent strain, and maintain the minimum bend radius.

3.5 FIBER SPLICING & TERMINATION

3.5.1 General Requirements

A. All fiber terminations shall be fusion-spliced and housed in fusion splice cassettes.
B. No mid-span splicing of fiber optic cables is permitted, unless explicitly approved in writing by the ITS Department Project Manager, accompanied by justification and detailed splice location documentation.
C. Mechanical splicing is strictly prohibited.
D. All splicing and termination work shall be performed in accordance with:
1. ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard.
2. BICSI ITSIM – Chapter 6, "Cable Termination Practices."
3. Manufacturer specifications for splice cassettes, termination hardware and buffer tube breakout kits.

3.5.2 Pre-Splicing Fiber Preparation

A. Jacket Removal

1. For Tight-Buffered Indoor Fiber: Remove 3 to 6 feet of the outer jacket before entering the LIU.
2. For Loose-Tube Indoor/Outdoor or OSP Fiber: Remove 6 to 10 feet of the outer jacket to allow proper routing into splice trays.
3. For Armored Fiber: Remove outer armor 6 to 10 feet before the termination enclosure but maintain fiber protection until entry.

B. Sub-Unitized Fiber Handling

1. For cables with sub-unitized fibers, the outer jacket must be stripped back immediately upon entering the LIU, exposing the sub-units for routing and termination.
2. Ensure proper strain relief after outer jacket removal.

3.5.3 Splicing & Fiber Handling

A. Splicing Requirements:

1. Only fusion splicing shall be used.
2. All splices shall be enclosed in approved fusion splice cassettes.
3. No bare fiber loops shall be left outside of the fusion splice cassette.
4. All fusion splices shall be protected with heat-shrink splice sleeves.
5. Follow manufacturer installation directions/requirements provided with the fusion splice cassette. Zip ties may be utilized as directed by the manufacture with regards to the fusion splice cartridge.
6. Maximum allowable splice loss:
   - Multimode fiber (OM3, OM4, OM5): ≤ 0.1 dB
   - Single-mode fiber (OS2): ≤ 0.05 dB
7. Minimum fiber exposure length for termination:
   - SDX Enclosures: 60 inches for splice modules, 80 inches for splice trays.
   - HDX Enclosures: 60 inches for splice modules.
   - HDX Patch Panels/Frames: 50-60 inches, depending on mounting method.
8. Spliced fibers shall be properly organized and secured within the splice cassette following manufacturer installation instructions. Refer to ***ERROR! REFERENCE SOURCE NOT FOUND.***, FIGURE 27 13 23 - 2: Trunk Fiber Routing, and FIGURE 27 13 23 - 3: Installed Fiber Example for proper routing and install of fiber within cartridge.
9.

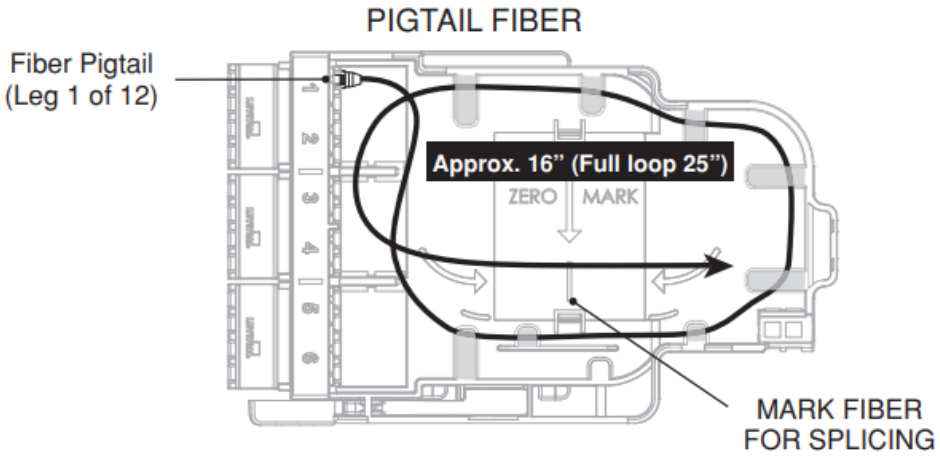


FIGURE 27 13 23 - 1: PIGTAIL ROUTING

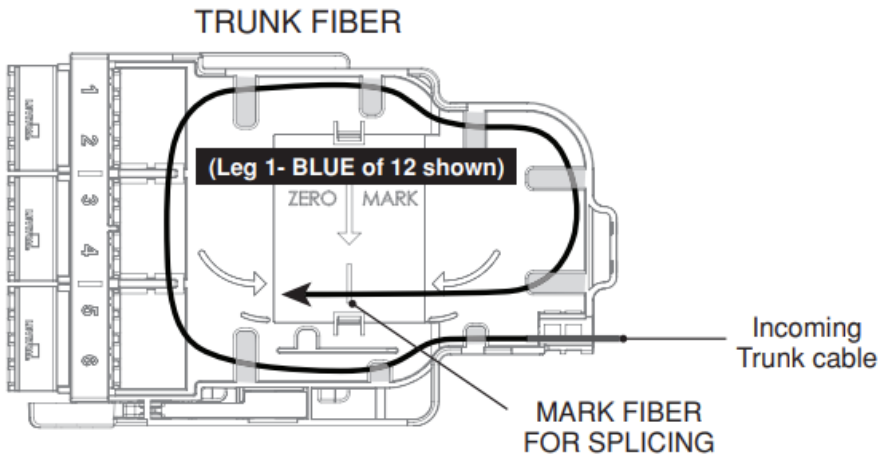


FIGURE 27 13 23 - 2: TRUNK FIBER ROUTING

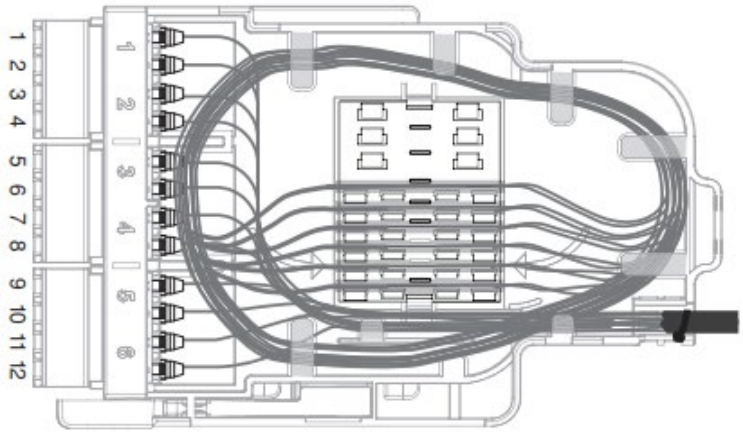


FIGURE 27 13 23 - 3: INSTALLED FIBER EXAMPLE

B. Fiber Dressing & Strain Relief:
   1. All cables entering LIUs or splice enclosures shall be strain-relieved.
   2. Maintain a minimum of 20” of fiber for the last tie down point to facilitate tray movement.
   3. Fiber jacket removal must be performed as close to the termination point as possible to maintain protection.
   4. For cables containing sub-unitized fibers, the outer jacket of the main fiber cable shall be stripped back immediately upon entry into the LIU, exposing the sub-unitized fibers for routing and termination.
   5. Armored fiber must have its outer armor removed before routing into the LIU or splice cassette Within LIUs, fibers shall be neatly routed and secured using factory-provided cable management. Refer to
   6. FIGURE 27 13 23 - 4: Fiber Routing in HDX Enclosure and FIGURE 27 13 23 - 5: Fiber Routing in SDX Enclosure for proper routing of fiber within the LIU.

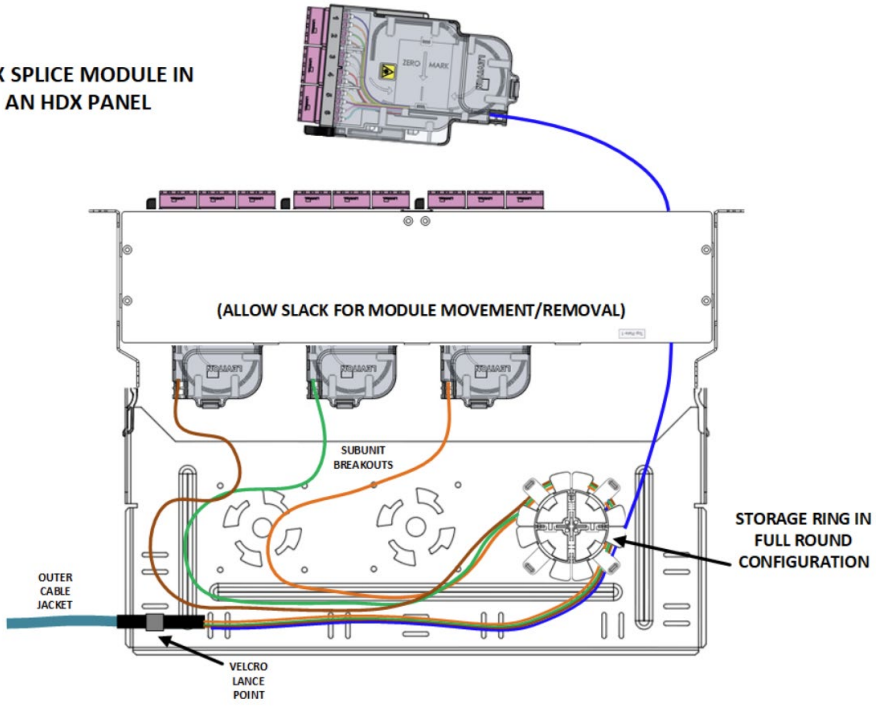


FIGURE 27 13 23 - 4: Fiber Routing in HDX Enclosure

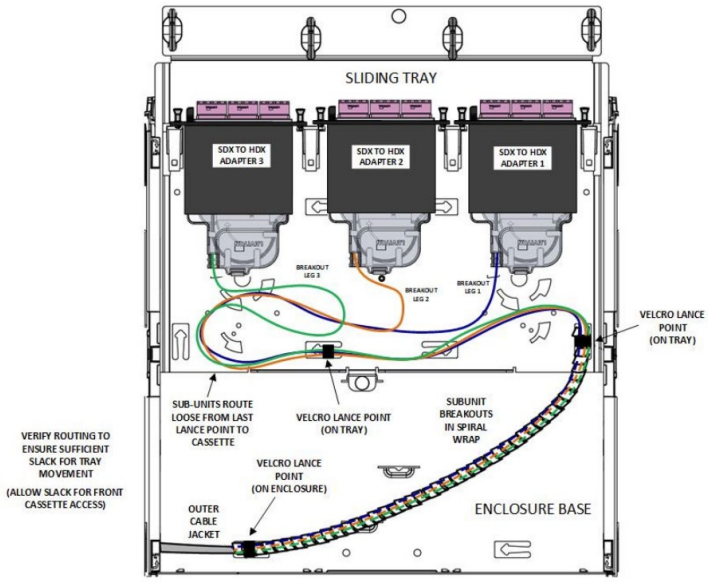


FIGURE 27 13 23 - 5: FIBER ROUTING IN SDX ENCLOSURE

3.5.4 Termination Requirements

A. All fiber terminations shall use factory-polished LC-UPC connectors.
B. Factory-terminated MTP connectors shall meet the insertion loss requirements specified in 2.5.
C. All terminated connectors shall be visually inspected for cleanliness prior to testing and activation.
D. All terminated fibers shall be tested per 3.6 – Testing & Acceptance.

3.5.5 Prohibited Practices

A. Mechanical splicing is not permitted under any circumstances.
B. No bare or exposed fiber shall be left outside of an LIU, splice cassette, or termination enclosure.
C. No field-polished connectors shall be used.
D. Unterminated fiber strands are not allowed—all fibers must be terminated, spliced, or properly stored.

3.5.6 Cleaning & Visual Inspection

A. All fiber end-faces shall be cleaned using manufacturer-approved dry or wet/dry cleaning methods prior to testing and final connection.
B. A fiber inspection scope shall be used to verify cleanliness of all connectors. Dirty, scratched, or damaged end-faces shall be cleaned or replaced.
C. Cleaning and inspection procedures shall follow IPC-8497-1 and IEC 61300-3-35 standards for end-face inspection and pass/fail criteria.

3.5.7 Post-Installation Protection

A. Upon completion of installation and testing, all fiber terminations, patch panels, and LIUs shall be protected from dust, debris, and physical damage using blank panels, dust caps, or other suitable enclosures.
B. Patch cords shall not be installed until all construction activity in the space has ceased and the environment is deemed ready for service activation.
C. No active equipment shall be connected to fiber panels until final test results have been accepted by the ITS Department Project Manager.

3.6 TESTING

3.6.1 All fiber optic backbone cabling shall be tested and certified per 27 05 86 – Testing & Certification of Structured Cabling.

3.6.2 Testing shall verify compliance with:

A. ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard
B. Manufacturer requirements for loss budgets, insertion loss, and termination quality
C. Project-specific performance criteria as outlined in 27 05 86 - Testing & Certification of Structured Cabling

3.6.3 The contractor shall coordinate fiber testing with the District ITS Project Manager per 27 05 86.

3.6.4 All test results shall be documented and submitted in accordance with 27 05 50 – Communications Documentation & Submittals.

3.7 SYSTEMS ACCEPTANCE AND CLOSEOUT

3.7.1 The fiber backbone system shall not be considered complete until:

A. All fiber strands have been successfully tested and certified per Section 27 05 86.
B. All labeling, documentation, and GIS data are complete and approved.
C. Manufacturer warranty registration is submitted and accepted.
D. All final test results and certification reports are provided to the District ITS Department Project Manager.

3.7.2 The Contractor shall:

A. Provide final fiber test results and GIS location data prior to scheduling the final punch walk.
B. Furnish test equipment necessary for the District to verify contractor-provided certification results.
C. Make available the same fiber testing equipment used for certification, including Optical Time Domain Reflectometer (OTDR) and loss measurement equipment, at no additional cost for District verification.
D. Participate in a formal punch walk with the District ITS Department Project Manager.
E. Correct any deficiencies identified during the punch walk and resubmit for re-inspection at no cost to the District.

3.7.3 At the District's discretion, contractor's test equipment shall be verified against previously certified District-installed fiber strands to confirm calibration and accuracy.

END OF SECTION

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This Section defines general installation standards, shared workmanship requirements, and best practices applicable to all horizontal communications cabling. It supports and complements the system-specific requirements of the following sections:

A. 27 15 01.15 – Access Control Communications Conductors and Cables
B. 27 15 01.17 – Intrusion Detection Communications Conductors and Cables
C. 27 15 01.46 – Paging Communications Horizontal Cabling
D. 27 15 13 – Communications Copper Horizontal Cabling
E. 27 15 23 – Communications Optical Fiber Horizontal Cabling

1.1.2 All work must comply with District standards, contract documents, and applicable industry codes and standards.

1.1.3 In the event of conflict between District standards and referenced industry standards, the District standard shall govern, provided it meets or exceeds minimum industry standards, code and regulatory requirements.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a list of all Division 27 and Division 28 sections, refer to Section 27 00 00 part

1.2.2 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.2.3 Related Requirements:1.1.3. If Section 27 00 00 was not provided, contact the District ITS Department Project Manager to obtain a complete copy of the Division 27 and Division 28 sections.

1.2.4 Specific Related Sections

A. Section 27 00 00 – Communications
B. Section 27 11 00 - Communications Equipment Room Fittings
C. Section 27 05 28 – Pathways for Communications Systems
D. Section 27 05 43 - Underground Ducts & Raceways for Communications Systems
E. Section 27 05 50 – Communications Documentation & Submittals
F. Section 27 05 53 – Identification for Communications Systems
G. Section 27 06 50 – Communications Equipment & Materials Schedule

1.3 REFERENCES

1.3.1 The installation shall comply with the latest editions of the following standards unless otherwise noted in the District standards. In the event of a conflict between these standards and the District's requirements, the District's standards shall take precedence, provided they meet or exceed the minimum requirements set forth by applicable codes and regulations.

A. ANSI/TIA-568.0 and 568.1, 568.2-D (copper), and 568.3-D (fiber)
B. ANSI/TIA-569-E – Telecommunications Pathways and Spaces
C. ANSI/TIA-606-D – Administration of Telecommunications Infrastructure
D. ANSI/TIA-607-D – Grounding and Bonding for Communications
E. BICSI ITSIM and TDMM
F. NFPA 70 (NEC), including Article 800 and Article 770 as applicable

G. Local codes and authorities having jurisdiction (AHJ)

1.4 SUBMITTALS

1.4.1 Submittals for horizontal cabling shall be included as part of each applicable system-specific section and shall be documented in accordance with the requirements of Section 27 05 50 – Communications Documentation & Submittals, as well as the individual requirements specified within each system-specific Section.

1.5 QUALITY ASSURANCE

1.5.1 All work shall be performed by technicians trained and certified by the manufacturer of the structured cabling system, where such certification is required for system warranty.

1.5.2 Installation practices shall comply with BICSI and ANSI/TIA best practices.

1.6 WARRANTY

1.6.1 Warranties shall be provided as defined in system-specific sections. Where applicable, an end-to-end manufacturer's performance warranty shall be secured and registered with the manufacturer.

PART 2 - PARTS

2.1 CABLE PULLING LUBRICANTS

A. All cable pulling lubricants must be non-wax-based, non-conductive, and safe for use with Category-rated copper cables and fiber optic cables.
B. Approved lubricants must be water-based or polymer-based and specifically designed for low-voltage communication cables.
C. **The following lubricants are strictly prohibited**:
   1. Wax-based lubricants, including Ideal Yellow 77 or equivalent.
   2. Any lubricant that leaves a sticky residue or can cause cable jacket deterioration over time.
   3. Oil-based lubricants that may degrade cable insulation.
D. All lubricants must be manufacturer-approved for the cable type being installed.

2.2 OSP CABLE REQUIREMENTS

2.2.1 Waterproofing: All OSP cables must be gel-filled or use dry water-blocking technology.

2.2.2 Rodent Protection: Where required, provide armored cables with interlocking steel tape.

2.2.3 UV Resistance: Jackets for cables in outdoor enclosures must be UV-resistant and direct burial-rated where applicable.

2.3 CABLE MANAGEMENT COMPONENTS

2.3.1 Zip Ties:

A. Prohibited for all data cabling and low-voltage wiring installations, except where specifically required by a manufacturer's installation guide, such as:
   1. Securing fiber cables within fusion splice cassettes.
B. When zip ties are permitted, they must:
   1. Be non-conductive and UL-listed.
   2. Not be over-tightened to prevent damage to cable jackets.

2.3.2 Hook-and-Loop (Velcro) Cable Ties

A. General Requirements:
   1. Must be non-conductive, durable, and reusable.
   2. Minimum width: 3/4 inch to provide adequate support without damaging cable jackets.
   3. UV-resistant if used in outdoor environments.

2.3.3 D-Rings:

A. Not approved for use with copper data cables or fiber optic cables.
B. May only be used for low-voltage control wiring, PA system cables, or non-data cable management.
C. Metal or plastic D-rings, with smooth edges to prevent cable abrasion.

2.3.4 J-Hooks:

A. Must comply with Section 27 05 28 - Pathways for Communications Systems.
B. Fill ratio, support spacing, and installation methods must meet the requirements outlined in Section 27 00 00 part **Error! Reference source not found. Error! Reference source not found.**.
C. UL-listed, with rounded edges, and appropriate sizing for the cable type and quantity.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Compliance with Standards:

All installations must comply with:

1. Applicable building codes, industry standards, and manufacturer guidelines.
2. All Division 27 sections.

3.1.2 Coordination with Other Trades:

Coordinate with Electrical, Mechanical, and General Contractors to avoid conflicts with other systems. Verify that pathways and cable routes are clear and accessible before installation.

3.2 PATHWAY INSTALLATION:

3.2.1 All pathways for systems under Division 27 and Division 28 shall be installed in accordance with:

A. Section 27 05 28 – Pathways for Communications Systems
B. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems

3.2.2 Conduits entering buildings must be sealed to prevent water ingress, using firestopping materials where required.

3.2.3 All conduits and sleeves shall be:

A. Provided with plastic bushings to protect cable from abrasion.
B. Firestopped at the termination of all conduits and sleeves trade size 1-1/2 or larger, or where required by the Authority Having Jurisdiction (AHJ).

3.2.4 Surface-mounted cable installations shall only be permitted when explicitly approved by the District ITS Department Project Manager.

A. All raceways must be installed plumb, level, and secured in a clean, professional manner.

3.3 MINIMUM BEND RADIUS

3.3.1 Unshielded Cable

A. Follow manufacturer recommendations or a minimum bend radius shall be 4 times the cable diameter, whichever is greater, unless otherwise specified.

3.3.2 Shielded Cable or Composite Bundles:

A. Follow manufacturer recommendations or a minimum of 8 times the cable diameter, whichever is greater, unless otherwise specified.

3.3.3 Bends must not be forced or flattened and must be supported during routing around corners or obstacles.

3.4 CABLE INSTALLATION REQUIREMENTS

A. General Pathway Requirements:
   1. All horizontal cabling, including fiber optic and copper cables, shall be installed in dedicated pathways specifically designated for horizontal cabling.
   2. Dedicated conduits shall be used exclusively for horizontal cabling and may contain both fiber optic and copper cables within the same conduit, provided all fill ratio and separation requirements are met and all cables within the conduit are exclusively part of the horizontal cabling system.
   3. All pathways utilized shall comply with the requirements specified in:
      - 27 05 28 - Pathways for Communications Systems (for interior pathways).
      - 27 05 43 - Underground Ducts and Raceways for Communications Systems (for OSP and underground pathways).
   4. All cable installs will comply with the max pathway fill ratios specified in Section 27 00 00

B. Cable Routing Requirements:
   1. Cables shall be routed parallel to walls, ceilings, and structural elements. Running cables diagonally is prohibited.
   2. Cables must be neatly dressed at termination points, with slack managed appropriately.
   3. On backboards, cables shall be routed vertically or horizontally, maximizing available space and avoiding obstruction of equipment or pathways for future installations.
   4. Cables installed in open ceiling environments or on backboards shall be organized and supported using approved cable management devices, ensuring a clean and serviceable installation.

C. Pre-Installation Verification:
   1. Before any cable pulling begins, the contractor shall:
      - Verify the current fill ratio and calculate the required fill ratio for the project scope across all pathway sections utilized, including, but not limited to: conduits, J-hooks, sleeves, raceways, and cable trays.
      - Verify that all conduits have bushings installed prior to pulling cable.
      - Confirm that the combined fill ratio will not exceed the maximum allowed as outlined in Section 27 00 00 Part **Error! Reference source not found. Error! Reference source not found.**
      - Ensure that all abandoned cables have been removed from pathways before cable pulling begins.
      - Inspect all pull boxes and junction boxes to ensure they are clear of debris, and that unused conduits are capped or sealed.

3.5 LABELING REQUIREMENTS FOR HORIZONTAL CABLING

3.5.1 All horizontal cabling (fiber optic and copper) shall be labeled per Section 27 05 53 – Identification for Communications Systems.

3.5.2 Labels shall be machine-printed, durable, and permanently affixed at:

A. Both ends of the cable.
B. All splice/transition points.

3.6 SERVICE LOOP REQUIREMENTS

3.6.1 Service loops shall be installed to support future maintenance, re-termination, or repair of horizontal communications cabling.

A. The required service loop length shall be in addition to the cable length necessary to reach the termination point.
B. Service loops shall be measured after all terminations, rework, and punch list corrections are complete and must meet the specified minimum lengths at the time of final inspection.
C. Service loop cable shall not be used to compensate for misrouting, installation errors, field modifications, or construction punch list corrections.

D. If any portion of a service loop is used or compromised during the course of construction, the contractor shall undertake whatever corrective action is required to restore the full required loop length prior to final acceptance, while maintaining full compliance with all applicable Division 27 and Division 28 requirements.

3.6.2 Service Loop Standards:

A. Provide service loops as required by the specific cable type and as defined in the following Sections:
   1. 27 15 01.15 – Access Control Communications Conductors and Cables
   2. 27 15 01.17 – Intrusion Detection Communications Conductors and Cables
   3. 27 15 01.46 – Paging Communications Horizontal Cabling
   4. 27 15 13 – Communications Copper Horizontal Cabling
   5. 27 15 23 – Communications Optical Fiber Horizontal Cabling
B. Service loops must be:
   1. Neatly dressed and secured using Velcro ties.
   2. Mounted on backboards, within cable trays, or above ceiling tiles in occupied/shared spaces.

3.6.3 Pull Boxes & Underground Structures:

A. Above Ground Pull Boxes:
   1. Minimum of 1 complete loop of cable slack in each pull box.
B. Underground Structures:
   1. Minimum of 1 complete loop of cable slack in vaults, handholes, and maintenance holes.
   2. Cable to be neatly dressed in around the permitter of the structure, and attached to cable management arms if installed.

3.6.4 Additional Mounting Requirements:

A. Service loops installed above ceiling tiles must be property supported and shall not rest on ceiling tiles.
B. Service loops must be located within the room the cables are terminating in unless otherwise approved by the ITS Department Project Manager.
C. Utilize J-hooks, cable trays, or Velcro straps to support loops properly.

3.7 CABLE PULLING PROCEDURES

A. Pre-Pulling Requirements:
   1. Confirm the pathway is prepared per 3.4 Cable Installation Requirements and is ready for cable pulling.
   2. If the specified fill ratio cannot be achieved, submit a Request for Information (RFI) to the District ITS Project Manager.
B. Cable Pulling Lubricants:
   1. Cable pulling lubricant shall be used for all installations to reduce friction and prevent cable damage.
   2. Apply lubricant in accordance with 3.8 Cable Pulling Lubricant Usage & Cleanup, ensuring compatibility with all cable types.
   3. Only use approved lubricants as specified, avoiding over-application to prevent residue build-up in conduits.
C. Pulling Techniques:
   1. Cable pulling tension and bend radius shall not exceed the lesser of:
      - The maximums specified in this section, or
      - The manufacturer's requirements for each specific cable type.
   2. Maximum Pull Tension:
      - Copper cables: Not to exceed 25 lbs (110 N) unless a lower limit is specified by the manufacturer.
      - Fiber optic cables: Not to exceed 600 lbs (2670 N) or as per manufacturer's guidelines, whichever is more restrictive.
   3. Bend Radius Compliance:
      - Maintain a minimum bend radius of 4 times the cable diameter for UTP/STP copper cables.

- For fiber optic cables, maintain a minimum bend radius of 20 times the cable diameter during installation.
- Follow the more stringent requirement if the manufacturer's specifications are more restrictive than the above.

4. Techniques to Avoid Cable Damage:
   - Use appropriate pulling tools, including grips, swivels, and pull socks to distribute tension evenly.
   - Prevent cable twisting and kinking during the pulling process.
   - Monitor pulling speed to avoid excessive strain on cables.

3.8 CABLE PULLING LUBRICANT USAGE & CLEANUP

3.8.1 Approved Lubricants

A. Only District-approved, non-wax-based, non-sticky cable pulling lubricants shall be used.
   1. Acceptable lubricants must be:
      - Water-based and residue-free after drying.
      - Compatible with copper and fiber optic cables per manufacturer recommendations.
      - UL-listed and compliant with ANSI/TIA and NEC requirements.

3.8.2 Prohibited Lubricants

A. Wax-based lubricants (e.g., Yellow 77) are strictly prohibited due to residue buildup that hinders future cable pulls.
B. Silicone-based lubricants that leave excessive residue are also not permitted.

3.8.3 Application Guidelines

A. Apply lubricant per cable manufacturer and lubricant manufacturer recommendations.
B. Use only the amount necessary to facilitate smooth pulling—over-application is not permitted.
C. Do not apply lubricant directly to fiber optic connectors or exposed copper terminations.

3.8.4 Cleanup Requirements

A. After cable installation, all excess lubricant must be removed from pathways, pull boxes, and handholes.
B. Contractor shall ensure that lubricants do not pool inside conduits or vaults.
C. Any spills must be cleaned immediately to prevent slip hazards or damage to adjacent equipment.

3.9 POST-INSTALLATION CABLE PROTECTION

3.9.1 Cables shall be protected from mechanical damage during remaining construction phases.

3.9.2 Cables shall not be used for pulling, hanging, or bracing materials at any time.

END OF SECTION

SECTION 27 15 01.15 - ACCESS CONTROL COMMUNICATIONS CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section defines product and installation requirements for communications cabling used to support Access Control systems. It includes conductor types, cable ratings, pathway guidelines, service loop expectations, and workmanship standards applicable to all horizontal access control cabling.
B. This Section works in conjunction with the shared installation standards defined in:
   1. Section 27 15 00 - Communications Horizontal Cabling
   2. Division 28 – Electronic Safety and Security

1.1.2 All work must comply with District standards, contract documents, and applicable industry codes and standards.

1.1.3 In the event of conflict between District standards and referenced industry standards, the District standard shall govern, provided it meets or exceeds minimum industry standards, code and regulatory requirements.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a list of all Division 27 and Division 28 sections, refer to Section 27 00 00 part

1.2.2 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.2.3 Related Requirements:1.1.3. If Section 27 00 00 was not provided, contact the District ITS Department Project Manager to obtain a complete copy of the Division 27 and Division 28 sections.

1.2.4 Specific Related Sections

A. Section 27 00 00 – Communications
B. Section 27 05 28 – Pathways for Communications Systems
C. Section 27 05 43 - Underground Ducts & Raceways for Communications Systems
D. Section 27 05 50 – Communications Documentation & Submittals
E. Section 27 05 53 – Identification for Communications Systems
F. Section 27 06 50 – Communications Equipment & Materials Schedule
G. Section 27 11 00 - Communications Equipment Room Fittings
H. Section 27 15 00 - Communications Horizontal Cabling
I. Section 28 10 00 – Access Control

1.3 REFERENCES

1.3.1 The installation shall comply with the latest editions of the following standards unless otherwise noted in the District standards. In the event of a conflict between these standards and the District's requirements, the District's standards shall take precedence, provided they meet or exceed the minimum requirements set forth by applicable codes and regulations.

A. ANSI/TIA-569-E – Telecommunications Pathways and Spaces
B. ANSI/TIA-606-D – Administration of Telecommunications Infrastructure
C. ANSI/TIA-607-D – Grounding and Bonding for Communications
D. BICSI ITSIM and TDMM
E. NFPA 70 (NEC), including Article 800 and Article 770 as applicable

F. Local codes and authorities having jurisdiction (AHJ)

1.4 SUBMITTALS

1.4.1 Submittals for access control cabling shall documented in accordance with the requirements of Section 27 05 50 – Communications Documentation & Submittals, as well as the individual requirements specified within this Section.

1.4.2 General Submittals

A. The following items are commonly required and are provided here for clarity. This list is not exhaustive and does not override or limit the full requirements defined in Section 27 05 50:
   1. Product data sheets for access control cabling
   2. Pathway fill calculations for conduits, sleeves, and J-hooks used for access control cable routing
   3. Labeling samples for cable identification per Section 27 05 53

1.4.3 Access Control-Specific Submittals

A. The following submittals are required specifically for access control cabling and are not otherwise detailed in Section 27 05 50:
   1. Verification that all proposed cable types meet or exceed the minimum requirements specified in this Section, as well as all applicable manufacturer and device operating requirements. This includes confirming that cable gauge, conductor count, shielding, and insulation are appropriate for the intended application, including but not limited to door contacts, readers, strikes, request-to-exit sensors, control panels.
   2. Jacket color confirmation to verify compliance with District cabling standards or approved color-coding schemes as listed in Section 27 06 50.
   3. As-built documentation showing the final location of each cable endpoint shall be provided if the cabling contractor is not also responsible for installing the access control devices. Endpoint locations shall be shown in relation to doors, equipment rooms, or device mounting surfaces as applicable.

1.5 QUALITY ASSURANCE

1.5.1 All work shall be performed by technicians trained and qualified in low-voltage cabling installation.

1.5.2 Installation practices shall comply with BICSI and ANSI/TIA best practices.

1.6 WARRANTY

1.6.1 Warranties shall be provided as defined in system-specific sections. Where applicable, an end-to-end manufacturer's performance warranty shall be secured and registered with the manufacturer.

PART 2 - PARTS

2.1 GENERAL

2.1.1 All cabling shall comply with the requirements outlined in this Section and all applicable standards listed in Part 1. At a minimum, this includes:

A. NEC (NFPA 70), Article 725 – Power-Limited Circuits
B. ANSI/TIA-568 and BICSI standards for cable routing and handling
C. Applicable UL listings (CMP, CMR, CL2, CL3, OSP, etc.)

2.1.2 Only 100% copper conductors shall be used.

2.1.3 Cable jackets shall be plenum-rated (CMP) unless installed outdoors or underground, in which case plenum/OSP or plenum/Indoor-Outdoor cable shall be used.

2.1.4 Jacket color shall not be Red, Blue or Purple

2.1.5 Use of composite cable (multi-function bundled access control wire) is preferred where appropriate.

2.2 PRE-APPROVED MATERIALS

2.2.1 Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved cable types and manufacturers.

2.2.2 Products listed in 27 06 50 do not require additional approval.

2.2.3 Any proposed substitutions, or products or cable types not explicitly listed in Section 27 05 60, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 The following cable types and installation components are strictly prohibited:

A. Copper-clad aluminum (CCA) cables
B. Non-rated or non-plenum-rated cable.
C. Yellow 77 or other wax-based pulling lubricants
D. Zip ties or other non-releasable fasteners for permanent cable bundling
E. Unshielded cables where manufacturer requires shielding

2.4 TYPICAL CABLE TYPES

2.4.1 Composite Access Control Bundles (preferred):

A. 22-3pr, 18-4c, 18-6c
   1. 22-3pr: Three twisted pairs of 22 AWG conductors
   2. 18-4c: Four conductor 18 AWG cable
   3. 18-6c: Six conductor 18 AWG cable
B. 18-3pr, 16-4c, 18-6c
   1. 18-3pr: Three twisted pairs of 18 AWG conductors
   2. 16-4c: Four conductor 16 AWG cable
   3. 18-6c: Six conductor 18 AWG cable

2.4.2 Individual Access Control Cables:

A. 18/2: Two conductor 18 AWG cable
B. 18/4: Four conductor 18 AWG cable
C. 18/6: Six conductor 18 AWG cable
D. 18/8: Eight conductor 18 AWG cable
E. 22/2: Two conductor 22 AWG cable
F. 22/4: Four conductor 22 AWG cable
G. 22/5: Five conductor 22 AWG cable

2.5 SPLICE COMPONENTS

2.5.1 When splicing is approved in accordance with Part 3, only splice enclosures and materials that meet the following requirements shall be used:

A. Indoor Above-Ground Applications:
   1. Enclosure shall be rated for low-voltage splicing and listed for indoor use.
   2. Terminal strips shall be Euro-style, rated for low-voltage use, and UL-listed for Class 2/Class 3 circuits.
   3. Enclosures must provide mechanical protection and strain relief.
B. Outdoor and Underground Applications:
   1. Splice enclosures must be specifically listed for outdoor or underground environments.
   2. All components shall be water-resistant, tamper-resistant, and suitable for direct burial if applicable.
   3. Enclosure and sealing components shall be designed for use with the cable types being spliced.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Install all cabling in accordance with:

A. Section 27 15 00 – Communications Horizontal Cabling
B. All applicable Division 27 sections
C. All applicable building codes and regulations
D. NEC Article 725 – Power-Limited Circuits
E. ANSI/TIA, BICSI, and manufacturer installation guidelines

3.1.2 Coordination with Other Trades:

A. Coordinate routing of access control cabling with electrical, mechanical, fire protection, and general trades
B. Verify that all raceways, penetrations, and cable routes are accessible and clear prior to installation
C. Ensure that cable pathways do not conflict with lighting, ductwork, piping, or structural systems

3.1.3 Conflict Reporting

A. The Contractor shall immediately report any condition that may prevent full compliance with the requirements of Division 27, Division 28, or the project's approved specifications.
B. All such conflicts shall be submitted in writing via a formal Request for Information (RFI) to the District ITS Project Manager.
C. No corrective work shall proceed without written direction or approval.

3.1.4 Verification Before Installation:

A. Confirm that all required pathways are installed and compliant with fill ratio limits
B. Inspect conduits, sleeves, and supports to ensure bushings are installed and all abandoned cables have been removed

3.2 PATHWAY INSTALLATION

3.2.1 All pathways supporting access control cabling shall be installed in accordance with:

A. Section 27 05 28 – Pathways for Communications Systems
B. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems

3.2.2 Conduits entering buildings shall be sealed to prevent water ingress, using firestopping materials where required by code or specification.

3.2.3 Final routing of access control cabling to the door:

A. Cabling may pass through door frames or door jambs where required by system layout or architectural constraints.
B. When routing through walls or door jambs, care shall be taken to prevent abrasion or mechanical damage to the cable. Protective measures, such as grommets or sleeves, shall be used where practicable.
C. Penetrations shall not compromise fire ratings and must comply with AHJ requirements.

3.2.4 All conduits and sleeves shall be:

A. Provided with plastic bushings to protect cable from abrasion.
B. Firestopped at the termination of all conduits and sleeves trade size 1-1/2 or larger, or where required by the Authority Having Jurisdiction (AHJ).

3.2.5 Surface-mounted cable installations shall only be permitted when explicitly approved by the District ITS Department Project Manager.

A. Only metallic surface raceways (e.g., steel or aluminum) shall be used.

B. Plastic raceways are strictly prohibited.
C. All raceways must be installed plumb, level, and secured in a clean, professional manner.

3.3 SERVICE LOOPS

3.3.1 All access control cabling shall comply with the service loop requirements outlined in Section 27 15 00 – Communications Horizontal Cabling.

3.3.2 Minimum service loop lengths shall be as follows:

A. Access control panels:
   1. Provide a minimum of 10 feet of service loop for each cable terminated at the panel or controller, unless otherwise approved.
B. Doors:
   1. Provide a minimum of 3 feet of service loop above the door.
C. Exterior pedestrian gates:
   1. Provide a minimum of 3 feet of service loop located in the nearest accessible pull box, or inside the building at the point where the cable exits, whichever is closer.
D. Vehicle gates:
   1. Provide a minimum of 10 feet of service loop in the nearest accessible pull box, or inside the building at the point where the cable exits, whichever is closer.

3.3.3 All service loops shall meet the following requirements:

A. Loops shall be neatly dressed and secured using Velcro ties or other approved methods.
B. Loops shall be properly supported and shall not rest on ceiling tiles or other finished surfaces.
C. Loops shall be installed in accessible locations that remain reachable after construction is complete.

3.3.4 As-built documentation shall identify the final service loop location for each cable endpoint. This is mandatory when the cabling contractor is not installing the associated access control devices.

3.4 SPLICES

3.4.1 Splicing of access control cabling is prohibited unless explicitly approved in writing by the District ITS Department Project Manager.

A. Note: Termination of field cabling to manufacturer-provided pigtails at access control devices (e.g., card readers) shall not be considered a splice under this Section, provided the connection is made at the device and in accordance with manufacturer instructions. These terminations shall be governed by the requirements specified in Section 28 10 00 – Access Control System.

3.4.2 When splicing is approved, it shall only be permitted under the following condition:

A. Cable repair due to damage, where re-pulling the cable is not practical and prior written approval has been obtained from the ITS Department Project Manager.

3.4.3 3.4.3 When approved, splices shall be performed using methods appropriate to their installation environment:

A. Indoor above-ground splices:
   1. Splices shall be performed using either:
      - A terminal strip mounted inside a suitable enclosure, or
      - A splice enclosure specifically designed for low-voltage cable splicing.
   2. All indoor above-ground splice methods and materials shall be submitted for review and approval by the District ITS Department Project Manager prior to installation.
B. Outdoor above-ground splices:
   1. Splices shall only be performed using products specifically designed for outdoor or underground installations.

2. All underground splice kits, materials, and methods shall be submitted for review and approval by the District ITS Department Project Manager prior to use.

C. Underground splices:

1. Splices shall only be performed using products specifically designed for outdoor or underground installations.
2. All underground splice kits, materials, and methods shall be submitted for review and approval by the District ITS Department Project Manager prior to use.

3.4.4 All splices must be documented in the as-built drawings and approved by the District ITS Department Project Manager prior to final acceptance.

3.5 CABLE TERMINATION

3.5.1 Horizontal access control cabling shall be terminated in accordance with manufacturer specifications and all applicable requirements of Division 27.

3.5.2 Final terminations of access control cabling to system devices, including connection to readers, request-to-exit devices, door position switches, electric locks, and access control panels, shall be governed by Section 28 10 00 – Access Control System.

3.5.3 The cabling contractor shall coordinate with the access control system integrator to ensure that:

A. All cables are properly routed to the required termination points.
B. Sufficient slack is provided at each endpoint per Section 3.3 – Service Loops.
C. No field terminations are performed by the cabling contractor unless specifically authorized in the project scope or approved by the ITS Department Project Manager.

3.5.4 All unused cable pairs shall be properly dressed, secured, and labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.5.5 All shielded cables and cables with a drain wire shall be terminated and grounded in accordance with manufacturer specifications and industry best practices.

A. Shielding and drain wires shall be grounded only at the access control panel side to prevent ground loops.
B. Shield/drain connections shall be made at the designated ground point within the access control enclosure or per system design.
C. Under no circumstances shall shielding or drain wires be left unterminated, floating, or cut off unless specifically approved by the District ITS Department Project Manager.

3.6 LABELING AND IDENTIFICATION

3.6.1 All access control cabling shall be labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.6.2 Labels shall be machine-printed, durable, and permanently affixed at both ends of every cable.

3.6.3 Each cable shall be labeled with its unique identifier, consistent with project drawings and approved submittals.

3.6.4 Labeling format shall vary based on cable type:

A. Composite Access Control Cables shall be labeled using the following format:
1. [Building Identifier] – [Location Code] – [Panel]/[Channel]/[Device ID]
2. Location Code shall indicate where the device is installed:
   - Room-Based Locations: Use the full room number (e.g., 101)
   - Interior Common Areas: Use descriptive identifiers (e.g., HAL1 for Hallway, LOB1 for Lobby)
   - Exterior Areas or Gates: Use identifiers like EXT1, GATE1, etc.
3. Panel/Channel/Device ID reflects the access control system configuration.
4. Example: A-101 – 10/2/5 (Panel 10, Channel 2, Device 5 in Room 101 of Building A)

B. Individual (Non-Composite) Access Control Cables shall be labeled using the following format:
   1. [Building Identifier] – [Location Code] – [Cable Use] – [Panel]/[Channel]/[Device ID]
   2. Location Code shall indicate where the device is installed:
      - Room-Based Locations: Use the full room number (e.g., 101)
      - Interior Common Areas: Use descriptive identifiers (e.g., HAL1 for Hallway, LOB1 for Lobby)
      - Exterior Areas or Gates: Use identifiers like EXT1, GATE1, etc.
   3. Cable Use indicates function (e.g., Reader, Strike, REX).
   4. Follow the same Location Code and Panel/Channel/Device ID conventions described above.
   5. Example: A-GATE1 – Strike – 12/1/3 (Strike cable for Gate 1 in Building A, connected to Panel 12, Channel 1, Device ID 3)

3.6.5 If the cabling contractor is not installing the access control devices, the cable end at the device location shall be clearly tagged with its intended function and final connection point.

3.6.6 Labeling scheme must match submittals and as-built documentation

3.7 TESTING AND ACCEPTANCE

3.7.1 All access control cabling shall be tested for continuity and proper termination prior to final acceptance.

3.7.2 Testing shall verify that:

A. All conductors are continuous and correctly terminated with no opens, shorts, or crossed wires.
B. Cable polarity and color coding are maintained throughout.
C. Any shielding or drain wires (if used) are properly grounded and continuous.
D. Resistance across individual conductors is within manufacturer-recommended or industry-accepted tolerances.
E. All splices (if approved) are properly enclosed and maintain electrical continuity.

3.7.3 Test methods shall be appropriate for the cable type and installation conditions and shall be submitted for review if requested by the District ITS Department Project Manager.

3.7.4 A summary report of testing results shall be included in the as-built documentation package. Reports shall identify cable ID, test method used, and pass/fail status.

3.8 PANEL DOCUMENTATION MAP

3.8.1 A laminated map shall be provided and mounted inside each access control enclosure or cabinet.

3.8.2 The map shall display:

A. Each connected access control device (e.g., reader, strike, door contact, REX).
B. The assigned device name, location, and system ID.
C. Cable ID consistent with submittals and as-built drawings.
D. The associated panel, channel, and device ID (e.g., 10/2/5).

3.8.3 The map must be laminated, labeled with project and panel information, and mounted on the interior of the access control cabinet door or adjacent backboard.

END OF SECTION

SECTION 27 15 01.17 - INTRUSION DETECTION COMMUNICATIONS CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section defines product and installation requirements for communications cabling used to support Intrusion Detection systems. It includes conductor types, cable ratings, pathway guidelines, service loop expectations, and workmanship standards applicable to all horizontal intrusion detection cabling.
B. This Section works in conjunction with the shared installation standards defined in:
   1. Section 27 15 00 - Communications Horizontal Cabling
   2. Division 28 – Electronic Safety and Security

1.1.2 All work must comply with District standards, contract documents, and applicable industry codes and standards.

1.1.3 In the event of conflict between District standards and referenced industry standards, the District standard shall govern, provided it meets or exceeds minimum industry standards, code and regulatory requirements.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a list of all Division 27 and Division 28 sections, refer to Section 27 00 00 part

1.2.2 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.2.3 Related Requirements:1.1.3. If Section 27 00 00 was not provided, contact the District ITS Department Project Manager to obtain a complete copy of the Division 27 and Division 28 sections.

1.2.4 Specific Related Sections

A. Section 27 00 00 – Communications
B. Section 27 05 28 – Pathways for Communications Systems
C. Section 27 05 43 - Underground Ducts & Raceways for Communications Systems
D. Section 27 05 50 – Communications Documentation & Submittals
E. Section 27 05 53 – Identification for Communications Systems
F. Section 27 06 50 – Communications Equipment & Materials Schedule
G. Section 27 11 00 - Communications Equipment Room Fittings
H. Section 27 15 00 - Communications Horizontal Cabling
I. Section 28 30 00 – Security Detection, Alarm, and Monitoring

1.3 REFERENCES

1.3.1 The installation shall comply with the latest editions of the following standards unless otherwise noted in the District standards. In the event of a conflict between these standards and the District's requirements, the District's standards shall take precedence, provided they meet or exceed the minimum requirements set forth by applicable codes and regulations.

A. ANSI/TIA-569-E – Telecommunications Pathways and Spaces
B. ANSI/TIA-606-D – Administration of Telecommunications Infrastructure
C. ANSI/TIA-607-D – Grounding and Bonding for Communications
D. BICSI ITSIM and TDMM
E. NFPA 70 (NEC), including Article 800 and Article 770 as applicable

F. Local codes and authorities having jurisdiction (AHJ)

1.4 SUBMITTALS

1.4.1 Submittals for intrusion detection cabling shall documented in accordance with the requirements of Section 27 05 50 – Communications Documentation & Submittals, as well as the individual requirements specified within this Section.

1.4.2 General Submittals

A. The following items are commonly required and are provided here for clarity. This list is not exhaustive and does not override or limit the full requirements defined in Section 27 05 50:
   1. Product data sheets for intrusion detection cabling
   2. Pathway fill calculations for conduits, sleeves, and J-hooks used for intrusion detection cable routing
   3. Labeling samples for cable identification per Section 27 05 53

1.4.3 Intrusion Detection-Specific Submittals

A. The following submittals are required specifically for access control cabling and are not otherwise detailed in Section 27 05 50:
   1. Verification that all proposed cable types meet or exceed the minimum requirements specified in this Section, as well as all applicable manufacturer and device operating requirements. This includes confirming that cable gauge, conductor count, shielding, and insulation are appropriate for the intended application, including but not limited to door contacts, motion detectors, glass break sensors, alarm panels, and keypads.
   2. Jacket color confirmation to verify compliance with District cabling standards or approved color-coding schemes as listed in Section 27 06 50.
   3. As-built documentation showing the final location of each cable endpoint shall be provided if the cabling contractor is not also responsible for installing the intrusion detection devices. Endpoint locations shall be shown relative to visible room features or intended device mounting positions.

1.5 QUALITY ASSURANCE

1.5.1 All work shall be performed by technicians trained and qualified in low-voltage cabling installation.

1.5.2 Installation practices shall comply with BICSI and ANSI/TIA best practices.

1.6 WARRANTY

1.6.1 Warranties shall be provided as defined in system-specific sections. Where applicable, an end-to-end manufacturer's performance warranty shall be secured and registered with the manufacturer.

PART 2 - PARTS

2.1 GENERAL

2.1.1 All cabling shall comply with the requirements outlined in this Section and all applicable standards listed in Part 1. At a minimum, this includes:

A. NEC (NFPA 70), Article 725 – Power-Limited Circuits
B. ANSI/TIA-568 and BICSI standards for cable routing and handling
C. Applicable UL listings (CMP, CMR, CL2, CL3, OSP, etc.)

2.1.2 Only 100% copper conductors shall be used.

2.1.3 Cable jackets shall be plenum-rated (CMP) unless installed outdoors or underground, in which case plenum/OSP or plenum/Indoor-Outdoor cable shall be used.

2.1.4 Jacket color shall not be Red, Blue or Purple

2.1.5 Use of composite cable (multi-function bundled access control wire) is preferred where appropriate.

2.2 PRE-APPROVED MATERIALS

2.2.1 Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved cable types and manufacturers.

2.2.2 Products listed in 27 06 50 do not require additional approval.

2.2.3 Any proposed substitutions, or products or cable types not explicitly listed in Section 27 05 60, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 The following cable types and installation components are strictly prohibited:

A. Copper-clad aluminum (CCA) cables
B. Non-rated or non-plenum-rated cable.
C. Yellow 77 or other wax-based pulling lubricants
D. Zip ties or other non-releasable fasteners for permanent cable bundling
E. Unshielded cables where manufacturer requires shielding

2.4 TYPICAL CABLE TYPES

2.4.1 Individual Access Control Cables:

A. 18/2: Two conductor 18 AWG cable
B. 18/4: Four conductor 18 AWG cable
C. 18/6: Six conductor 18 AWG cable
D. 18/8: Eight conductor 18 AWG cable
E. 22/2: Two conductor 22 AWG cable
F. 22/4: Four conductor 22 AWG cable
G. 22/5: Five conductor 22 AWG cable

2.5 SPLICE COMPONENTS

2.5.1 When splicing is approved in accordance with Part 3, only splice enclosures and materials that meet the following requirements shall be used:

A. Indoor Above-Ground Applications:
   1. Enclosure shall be rated for low-voltage splicing and listed for indoor use.
   2. Terminal strips shall be **Euro-style**, rated for low-voltage use, and UL-listed for Class 2/Class 3 circuits.
   3. Enclosures must provide mechanical protection and strain relief.
B. Outdoor and Underground Applications:
   1. Splice enclosures must be specifically listed for outdoor or underground environments.
   2. All components shall be water-resistant, tamper-resistant, and suitable for direct burial if applicable.
   3. Enclosure and sealing components shall be designed for use with the cable types being spliced.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Install all cabling in accordance with:

A. Section 27 15 00 – Communications Horizontal Cabling
B. All applicable Division 27 sections
C. All applicable building codes and regulations
D. NEC Article 725 – Power-Limited Circuits
E. ANSI/TIA, BICSI, and manufacturer installation guidelines

3.1.2 Coordination with Other Trades:

A. Coordinate routing of access control cabling with electrical, mechanical, fire protection, and general trades
B. Verify that all raceways, penetrations, and cable routes are accessible and clear prior to installation
C. Ensure that cable pathways do not conflict with lighting, ductwork, piping, or structural systems

3.1.3 Conflict Reporting

A. The Contractor shall immediately report any condition that may prevent full compliance with the requirements of Division 27, Division 28, or the project's approved specifications.
B. All such conflicts shall be submitted in writing via a formal Request for Information (RFI) to the District ITS Project Manager.
C. No corrective work shall proceed without written direction or approval.

3.1.4 Verification Before Installation:

A. Confirm that all required pathways are installed and compliant with fill ratio limits
B. Inspect conduits, sleeves, and supports to ensure bushings are installed and all abandoned cables have been removed

3.2 PATHWAY INSTALLATION

3.2.1 All pathways supporting intrusion detection cabling shall be installed in accordance with:

A. Section 27 05 28 – Pathways for Communications Systems
B. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems

3.2.2 Conduits entering buildings shall be sealed to prevent water ingress, using firestopping materials where required by code or specification.

3.2.3 Final routing of intrusion detection cabling to door contacts:

A. Cabling may pass through door frames or door jambs where required by system layout or architectural constraints.
B. When routing through walls or door jambs, care shall be taken to prevent abrasion or mechanical damage to the cable. Protective measures, such as grommets or sleeves, shall be used where practicable.
C. Penetrations shall not compromise fire ratings and must comply with AHJ requirements.

3.2.4 All conduits and sleeves shall be:

A. Provided with plastic bushings to protect cable from abrasion.
B. Firestopped at the termination of all conduits and sleeves trade size 1-1/2 or larger, or where required by the Authority Having Jurisdiction (AHJ).

3.2.5 Surface-mounted cable installations shall only be permitted when explicitly approved by the District ITS Department Project Manager.

A. Only metallic surface raceways (e.g., steel or aluminum) shall be used.
B. Plastic raceways are strictly prohibited.
C. All raceways must be installed plumb, level, and secured in a clean, professional manner.

3.3 SERVICE LOOPS

3.3.1 All intrusion detection cabling shall comply with the service loop requirements outlined in Section 27 15 00 – Communications Horizontal Cabling.

3.3.2 Minimum service loop lengths shall be as follows:

A. intrusion detection panels:

1. Provide a minimum of 10 feet of service loop for each cable terminated at the panel or controller, unless otherwise approved.

B. Devices (e.g., door contacts, motion detectors, glass-break sensors):
1. Provide a minimum of 3 feet of service loop at the device above the T-bar ceiling.

C. Exterior pedestrian gates:
1. Provide a minimum of 3 feet of service loop located in the nearest accessible pull box, or inside the building at the point where the cable exits, whichever is closer.

D. Vehicle gates:
1. Provide a minimum of 10 feet of service loop in the nearest accessible pull box, or inside the building at the point where the cable exits, whichever is closer.

3.3.3 All service loops shall meet the following requirements:

A. Loops shall be neatly dressed and secured using Velcro ties or other approved methods.
B. Loops shall be properly supported and shall not rest on ceiling tiles or other finished surfaces.
C. Loops shall be installed in accessible locations that remain reachable after construction is complete.

3.3.4 As-built documentation shall identify the final service loop location for each cable endpoint. This is mandatory when the cabling contractor is not installing the associated access control devices.

3.4 SPLICES

3.4.1 Splicing of access control cabling is prohibited unless explicitly approved in writing by the District ITS Department Project Manager.

A. Note: Termination of field cabling to manufacturer-provided pigtails at devices (e.g., motion detector, door position switch, etc.) shall not be considered a splice under this Section, provided the connection is made at the device and in accordance with manufacturer instructions. These terminations shall be governed by the requirements specified in Section 28 10 00 – Access Control System.

3.4.2 When splicing is approved, it shall only be permitted under the following condition:

A. Cable repair due to damage, where re-pulling the cable is not practical and prior written approval has been obtained from the ITS Department Project Manager.

3.4.3 When approved, splices shall be performed using methods appropriate to their installation environment:

A. Indoor above-ground splices:
1. Splices shall be performed using either:
- A terminal strip mounted inside a suitable enclosure, or
- A splice enclosure specifically designed for low-voltage cable splicing.
2. All indoor above-ground splice methods and materials shall be submitted for review and approval by the District ITS Department Project Manager prior to installation.

B. Outdoor above-ground splices:
1. Splices shall only be performed using products specifically designed for outdoor or underground installations.
2. All underground splice kits, materials, and methods shall be submitted for review and approval by the District ITS Department Project Manager prior to use.

C. Underground splices:
1. Splices shall only be performed using products specifically designed for outdoor or underground installations.
2. All underground splice kits, materials, and methods shall be submitted for review and approval by the District ITS Department Project Manager prior to use.

3.4.4 All splices must be documented in the as-built drawings and approved by the District ITS Department Project Manager prior to final acceptance.

3.5 CABLE TERMINATION

3.5.1 Horizontal intrusion detection cabling shall be terminated in accordance with manufacturer specifications and all applicable requirements of Division 27.

3.5.2 Final terminations of intrusion detection cabling to system devices, including connection to motion sensors, glass-break detectors, door contacts, alarm panels, etc., or point to 28 30 00 – Security Detection

3.5.3 The cabling contractor shall coordinate with the intrusion detection integrator to ensure that:

A. All cables are properly routed to the required termination points.
B. Sufficient slack is provided at each endpoint per Section 3.3 – Service Loops.
C. No field terminations are performed by the cabling contractor unless specifically authorized in the project scope or approved by the ITS Department Project Manager.

3.5.4 All unused cable pairs shall be properly dressed, secured, and labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.5.5 All shielded cables and cables with a drain wire shall be terminated and grounded in accordance with manufacturer specifications and industry best practices.

A. Shielding and drain wires shall be grounded only at the access control panel side to prevent ground loops.
B. Shield/drain connections shall be made at the designated ground point within the access control enclosure or per system design.
C. Under no circumstances shall shielding or drain wires be left unterminated, floating, or cut off unless specifically approved by the District ITS Department Project Manager.

3.6 LABELING AND IDENTIFICATION

3.6.1 All intrusion detection cabling shall be labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.6.2 Labels shall be machine-printed, durable, and permanently affixed at both ends of every cable.

3.6.3 Each cable shall be labeled with its unique identifier, consistent with project drawings and approved submittals.

3.6.4 Labeling format shall vary based on cable type:

A. Individual (Non-Composite) Intrusion Detection Cables shall be labeled using the following format:
   1. [Building Identifier] – [Location Code] – [Cable Use] – [Panel]/[Device ID]
   2. Location Code shall indicate where the device is installed:
      - Room-Based Locations: Use the full room number (e.g., 101)
      - Interior Common Areas: Use descriptive identifiers (e.g., HAL for Hallway, LOB for Lobby)
      - Exterior Areas or Gates: Use identifiers like EXT1, GATE1, etc.
   3. Cable Use shall indicate the device type (e.g., Motion, Contact, GlassBreak, etc.).
   4. Panel/Device ID reflects the alarm panel and the associated device identifier.
   5. Example:
      - *B-101 – Motion – 5/12 (Motion detector in Room 101 of Building B, connected to Panel 5, Device ID 12)*

3.6.5 If the cabling contractor is not installing the access control devices, the cable end at the device location shall be clearly tagged with its intended function and final connection point.

3.6.6 Labeling scheme must match submittals and as-built documentation

3.7 TESTING AND ACCEPTANCE

3.7.1 All access control cabling shall be tested for continuity and proper termination prior to final acceptance.

3.7.2 Testing shall verify that:

A. All conductors are continuous and correctly terminated with no opens, shorts, or crossed wires.
B. Cable polarity and color coding are maintained throughout.
C. Any shielding or drain wires (if used) are properly grounded and continuous.
D. Resistance across individual conductors is within manufacturer-recommended or industry-accepted tolerances.
E. All splices (if approved) are properly enclosed and maintain electrical continuity.

3.7.3 Test methods shall be appropriate for the cable type and installation conditions and shall be submitted for review if requested by the District ITS Department Project Manager.

3.7.4 A summary report of testing results shall be included in the as-built documentation package. Reports shall identify cable ID, test method used, and pass/fail status.

3.8 INTRUSION DEVICE MAP

3.8.1 A laminated map shall be provided and mounted inside each intrusion detection system control panel.

3.8.2 The map shall include:

A. Location of each sensor or device (e.g., motion, glass break, door contact).
B. Device name, function, and ID number per as-built documentation.
C. Cable identifier and panel termination information.

3.8.3 The map must be laminated and mounted inside the intrusion detection panel door or enclosure in a clear, accessible location.

END OF SECTION

SECTION 27 15 01.46 - PAGING COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section defines product and installation requirements for communications cabling used to support Paging systems, including both analog (e.g., 70V speaker) and IP-based paging devices. It includes conductor types, cable ratings, pathway guidelines, service loop expectations, and workmanship standards applicable to all horizontal paging cabling.

B. This Section works in conjunction with the shared installation standards defined in:

1. Section 27 15 00 - Communications Horizontal Cabling
2. Section 27 15 13 – Communications Copper Horizontal Cabling (for IP-based paging)
3. Section 27 50 00 – Distributed Communications and Paging Systems

1.1.2 All work must comply with District standards, contract documents, and applicable industry codes and standards.

1.1.3 In the event of conflict between District standards and referenced industry standards, the District standard shall govern, provided it meets or exceeds minimum industry standards, code and regulatory requirements.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a list of all Division 27 and Division 28 sections, refer to Section 27 00 00 part

1.2.2 The Contractor shall provide a complete, functional, turnkey system for all Division 27 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.2.3 Related Requirements:1.1.3. If Section 27 00 00 was not provided, contact the District ITS Department Project Manager to obtain a complete copy of the Division 27 and Division 28 sections.

1.2.4 Specific Related Sections

A. Section 27 00 00 – Communications
B. Section 27 05 28 – Pathways for Communications Systems
C. Section 27 05 43 - Underground Ducts & Raceways for Communications Systems
D. Section 27 05 50 – Communications Documentation & Submittals
E. Section 27 05 53 – Identification for Communications Systems
F. Section 27 06 50 – Communications Equipment & Materials Schedule
G. Section 27 11 00 - Communications Equipment Room Fittings
H. Section 27 15 00 - Communications Horizontal Cabling
I. Section 27 15 13 – Communications Copper Horizontal Cabling
J. Section 27 50 00 – Distributed Communications and Paging Systems

1.3 REFERENCES

1.3.1 The installation shall comply with the latest editions of the following standards unless otherwise noted in the District standards. In the event of a conflict between these standards and the District's requirements, the District's standards shall take precedence, provided they meet or exceed the minimum requirements set forth by applicable codes and regulations.

A. ANSI/TIA-569-E – Telecommunications Pathways and Spaces
B. ANSI/TIA-606-D – Administration of Telecommunications Infrastructure
C. ANSI/TIA-607-D – Grounding and Bonding for Communications

D. BICSI ITSIM and TDMM
E. NFPA 70 (NEC), including Article 800 and Article 770 as applicable
F. Local codes and authorities having jurisdiction (AHJ)

1.4 SUBMITTALS

1.4.1 Submittals for intrusion detection cabling shall documented in accordance with the requirements of Section 27 05 50 – Communications Documentation & Submittals, as well as the individual requirements specified within this Section.

1.4.2 General Submittals

A. The following items are commonly required and are provided here for clarity. This list is not exhaustive and does not override or limit the full requirements defined in Section 27 05 50:
   1. Product data sheets for intrusion detection cabling
   2. Pathway fill calculations for conduits, sleeves, and J-hooks used for intrusion detection cable routing
   3. Labeling samples for cable identification per Section 27 05 53

1.4.3 Paging System-Specific Submittals

A. The following submittals are required specifically for access control cabling and are not otherwise detailed in Section 27 05 50:
   1. Verification that proposed paging cable types meet all electrical and mechanical requirements of the paging devices they serve, including:
      - Speaker impedance, voltage rating, and shielding (for analog systems)
      - Submittals for IP-based paging cables shall comply with the requirements in Section 27 15 13 – Communications Copper Horizontal Cabling.
   2. Jacket color confirmation to verify compliance with District cabling standards or approved color-coding schemes as listed in Section 27 06 50.
   3. As-built documentation showing the final location of each cable endpoint shall be provided if the cabling contractor is not also responsible for installing the intrusion detection devices. Endpoint locations shall be shown relative to visible room features or intended device mounting positions.

1.5 QUALITY ASSURANCE

1.5.1 All work shall be performed by technicians trained and qualified in low-voltage cabling installation.

1.5.2 Installation practices shall comply with BICSI and ANSI/TIA best practices.

1.6 WARRANTY

1.6.1 Warranties shall be provided as defined in system-specific sections. Where applicable, an end-to-end manufacturer's performance warranty shall be secured and registered with the manufacturer.

PART 2 - PARTS

2.1 GENERAL

2.1.1 All cabling shall comply with the requirements outlined in this Section and all applicable standards listed in Part 1. At a minimum, this includes:

A. NEC (NFPA 70), Article 725 – Power-Limited Circuits
B. ANSI/TIA-568 and BICSI standards for cable routing and handling
C. Applicable UL listings (CMP, CMR, CL2, CL3, OSP, etc.)

2.1.2 Only 100% copper conductors shall be used.

2.1.3 Cable jackets shall be plenum-rated (CMP) unless installed outdoors or underground, in which case plenum/OSP or plenum/Indoor-Outdoor cable shall be used.

2.1.4 Jacket Color:

A. Jacket color for analog cables shall not be Red, Blue or Purple
B. Jacket color and classification for IP-based paging cabling shall comply with the requirements defined in Section 27 15 13 – Communications Copper Horizontal Cabling.

2.1.5 Use of composite cable (multi-function bundled access control wire) is preferred where appropriate.

2.2 PRE-APPROVED MATERIALS

2.2.1 Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved cable types and manufacturers.

2.2.2 Products listed in 27 06 50 do not require additional approval.

2.2.3 Any proposed substitutions, or products or cable types not explicitly listed in Section 27 05 60, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 The following cable types and installation components are strictly prohibited:

A. Copper-clad aluminum (CCA) cables
B. Non-rated or non-plenum-rated cable.
C. Yellow 77 or other wax-based pulling lubricants
D. Zip ties or other non-releasable fasteners for permanent cable bundling
E. Unshielded cables where manufacturer requires shielding

2.4 TYPICAL CABLE TYPES

2.4.1 Analog Paging Cable Types:

A. 18/2 – Two conductor 18 AWG cable
B. 18/4 – Four conductor 18 AWG cable
C. 18/8 – Eight conductor 18 AWG cable
D. 16/2 – Two conductor 16 AWG cable
E. 16/4 – Four conductor 16 AWG cable
F. 16/8 – Eight conductor 16 AWG cable
G. 14/2 – Two conductor 14 AWG cable
H. 14/4 – Four conductor 14 AWG cable
I. 14/8 – Eight conductor 14 AWG cable

2.4.2 IP Paging Cable Types:

A. All IP-based paging systems shall utilize Category 6A cabling.
B. Refer to Section 27 15 13 – Communications Copper Horizontal Cabling for all structured cabling requirements.

2.5 SPLICE COMPONENTS

2.5.1 When splicing is approved in accordance with Part 3, only splice enclosures and materials that meet the following requirements shall be used:

A. Indoor Above-Ground Applications:
   1. Enclosure shall be rated for low-voltage splicing and listed for indoor use.
   2. Terminal strips shall be Euro-style, rated for low-voltage use, and UL-listed for Class 2/Class 3 circuits.
   3. Enclosures must provide mechanical protection and strain relief.
B. Outdoor and Underground Applications:
   1. Splice enclosures must be specifically listed for outdoor or underground environments.

2. All components shall be water-resistant, tamper-resistant, and suitable for direct burial if applicable.
3. Enclosure and sealing components shall be designed for use with the cable types being spliced.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Install all cabling in accordance with:

A. Section 27 15 00 – Communications Horizontal Cabling
B. All applicable Division 27 sections
C. IP-based paging devices and associated cabling shall comply with Section 27 15 13 – Communications copper horizontal cabling.
D. All applicable building codes and regulations
E. NEC Article 725 – Power-Limited Circuits
F. ANSI/TIA, BICSI, and manufacturer installation guidelines

3.1.2 All analog speaker cabling shall be home-run from each device location directly to the designated MDF, BDF, or IDF. Looping, daisy-chaining, or pass-through wiring is not permitted under any circumstances.

3.1.3 Coordination with Other Trades:

A. Coordinate routing of access control cabling with electrical, mechanical, fire protection, and general trades
B. Verify that all raceways, penetrations, and cable routes are accessible and clear prior to installation
C. Ensure that cable pathways do not conflict with lighting, ductwork, piping, or structural systems

3.1.4 Conflict Reporting

A. The Contractor shall immediately report any condition that may prevent full compliance with the requirements of Division 27, Division 28, or the project's approved specifications.
B. All such conflicts shall be submitted in writing via a formal Request for Information (RFI) to the District ITS Project Manager.
C. No corrective work shall proceed without written direction or approval.

3.1.5 Verification Before Installation:

A. Confirm that all required pathways are installed and compliant with fill ratio limits
B. Inspect conduits, sleeves, and supports to ensure bushings are installed and all abandoned cables have been removed

3.2 PATHWAY INSTALLATION

3.2.1 All pathways supporting intrusion detection cabling shall be installed in accordance with:

A. Section 27 05 28 – Pathways for Communications Systems
B. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems

3.2.2 Conduits entering buildings shall be sealed to prevent water ingress, using firestopping materials where required by code or specification.

3.2.3 All conduits and sleeves shall be:

A. Provided with plastic bushings to protect cable from abrasion.
B. Firestopped at the termination of all conduits and sleeves trade size 1-1/2 or larger, or where required by the Authority Having Jurisdiction (AHJ).

3.2.4 Surface-mounted cable installations shall only be permitted when explicitly approved by the District ITS Department Project Manager.

A. All raceways must be installed plumb, level, and secured in a clean, professional manner.

3.3 SERVICE LOOPS

3.3.1 All intrusion detection cabling shall comply with the service loop requirements outlined in Section 27 15 00 – Communications Horizontal Cabling.

3.3.2 Minimum service loop lengths shall be as follows:

1. Analog Speakers
   - 10' of service loop at the consolidation point or termination location, such as an MDF, BDF, or IDF.
   - 3' of service loop at each speaker or paging device
2. IP Speakers
   - Follow requirements outlined in Section 27 15 13 – Communications Copper Horizontal Cabling

3.3.3 All service loops shall meet the following requirements:

A. Loops shall be neatly dressed and secured using Velcro ties or other approved methods.
B. Loops shall be properly supported and shall not rest on ceiling tiles or other finished surfaces.
C. Loops shall be installed in accessible locations that remain reachable after construction is complete.

3.3.4 As-built documentation shall identify the final service loop location for each cable endpoint. This is mandatory when the cabling contractor is not installing the associated access control devices.

3.4 SPLICES

3.4.1 Splicing of analog PA cabling is prohibited unless explicitly approved in writing by the District ITS Department Project Manager.

A. Note: Termination of field cabling to manufacturer-provided pigtails at devices shall not be considered a splice under this Section, provided the connection is made at the device and in accordance with manufacturer instructions. These terminations shall be governed by the requirements specified in Section 27 50 00 – Distributed Communications and Monitoring Systems.

3.4.2 Splicing of IP-based paging cabling is strictly prohibited. All IP cabling must be continuous from end to end without splices.

3.4.3 When splicing is approved, it shall only be permitted under the following condition:

A. Cable repair due to damage, where re-pulling the cable is not practical and prior written approval has been obtained from the ITS Department Project Manager.

3.4.4 When approved, analog cabling splices shall be performed using methods appropriate to their installation environment:

A. All splice methods and materials shall be submitted for review and approval by the District ITS Department Project Manager prior to installation.
B. Indoor above-ground splices:
   1. Splices shall be performed using either:
      - A terminal strip mounted inside a suitable enclosure, or
      - A splice enclosure specifically designed for low-voltage cable splicing.
C. Outdoor above-ground splices:
   1. Splices shall only be performed using products specifically designed for outdoor or underground installations.
D. Underground splices:
   1. Splices shall only be performed using products specifically designed for outdoor or underground installations.

3.4.5 All splices must be documented in the as-built drawings and approved by the District ITS Department Project Manager prior to final acceptance.

3.5 CABLE TERMINATION

3.5.1 All analog paging cabling shall be terminated in accordance with manufacturer specifications and all applicable requirements of Division 27.

3.5.2 Final terminations of analog paging cabling at devices (e.g., speakers, volume controls, amplifiers) shall be governed by Section 27 50 00 – Audio-Video Communications.

3.5.3 Analog paging cable home runs shall terminate at the designated MDF, BDF, or IDF on Euro-style terminal strips mounted within the wall mount IDF enclosure or on a contractor-provided backboard, as defined in Section 27 11 00.

3.5.4 IP-based paging devices (e.g., IP speakers, IP horns) shall be cabled and terminated in accordance with Section 27 15 13 – Communications Copper Horizontal Cabling.

3.5.5 The cabling contractor shall coordinate with the paging system integrator to ensure that:

A. All cables are properly routed to the required termination points.
B. Sufficient slack is provided at each endpoint per Section 3.3 – Service Loops.
C. No field terminations are performed by the cabling contractor unless specifically authorized in the project scope or approved by the ITS Department Project Manager.

3.5.6 All unused cable pairs shall be properly dressed, secured, and labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.5.7 All shielded cables and cables with a drain wire shall be terminated and grounded in accordance with manufacturer specifications and industry best practices.

A. Shielding and drain wires shall be grounded only at the MDF, BDF, or IDF to prevent ground loops.
B. Shield/drain connections shall be made at the designated ground point within the access control enclosure or per system design.
C. Under no circumstances shall shielding or drain wires be left unterminated, floating, or cut off unless specifically approved by the District ITS Department Project Manager.

3.6 LABELING AND IDENTIFICATION

3.6.1 All access control cabling shall be labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.6.2 Labels shall be machine-printed, durable, and permanently affixed at both ends of every cable.

3.6.3 Each cable shall be labeled with its unique identifier, consistent with project drawings and approved submittals.

3.6.4 Labeling format shall vary based on cable type:

A. Analog Paging Cables shall be labeled using the following format:
   1. [Building Identifier] – [Location Code] – [Speaker ID] – [Termination Location] – [Description (if not a speaker)]
   2. Location Code shall indicate where the device is installed:
      - Room-Based Locations: Use the full room number (e.g., A-101)
      - Interior Common Areas: Use descriptive identifiers (e.g., A-HAL for Hallway, A-LOB for Lobby, etc.)
      - Exterior Areas: Use A-EXT1, A-EXT2, etc., as appropriate
   3. The Termination Location shall reflect the MDF, BDF, or IDF where the cable terminates.
   4. The final portion of the label is only required if the device is not a standard speaker (e.g., volume control).
   5. Examples:
      - *A-101–1–IDF1 (Speaker 1 in Room A-101 terminating in IDF1)*
      - *A-HAL–2–IDF1 (Speaker 2 in Hallway of Building A terminating in IDF1)*
      - *A-LOB–1–IDF1–VolumeControl (Volume control in Lobby terminating in IDF1)*

- *A-EXT–1–IDF1 (Exterior speaker 1 on Building A terminating in IDF1)*

B. IP Paging Cables shall be labeled in accordance with the requirements of Section 27 15 13 – Communications Copper Horizontal Cabling.

3.6.5 If the cabling contractor is not installing the access control devices, the cable end at the device location shall be clearly tagged with its intended function and final connection point.

3.6.6 Labeling scheme must match submittals and as-built documentation

3.7 TESTING AND ACCEPTANCE

3.7.1 All analog paging cabling shall be tested for continuity and proper termination prior to final acceptance.

3.7.2 Testing shall verify that:

A. All conductors are continuous and correctly terminated with no opens, shorts, or crossed wires.
B. Cable polarity and color coding are maintained throughout.
C. Any shielding or drain wires (if used) are properly grounded and continuous.
D. Resistance across individual conductors is within manufacturer-recommended or industry-accepted tolerances.
E. All splices (if approved) are properly enclosed and maintain electrical continuity.

3.7.3 IP-based paging cabling shall be tested and certified in accordance with Section 27 15 13 – Communications Copper Horizontal Cabling and Section 27 05 86 – Testing and Certification of Structured Cabling.

3.7.4 Test methods for analog systems shall be appropriate to the application and cable type and must be submitted for review if requested by the District ITS Department Project Manager.

3.7.5 A summary report of testing results shall be included in the as-built documentation package. Reports shall identify cable ID, test method used, and pass/fail status.

END OF SECTION

SECTION 27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This Section defines product and installation requirements for copper communications cabling used to support horizontal structured cabling systems, including Category 6 and Category 6A cables, jacks, patch panels, and faceplates.

1.1.2 The District has standardized on a structured cabling system that includes a lifetime manufacturer's system warranty. Currently, Leviton is the basis of design.

A. All products and installation practices must be compatible with this system warranty.
B. Substituted systems must provide an equivalent manufacturer-backed lifetime system warranty and may not void or conflict with the warranty of any existing District-installed systems.

1.1.3 This section works in conjunction with shared installation standards defined in:

A. Section 27 15 00 – Communications Horizontal Cabling
B. Section 27 05 28 – Pathways for Communications Systems
C. Section 27 05 50 – Communications Documentation & Submittals
D. Section 27 11 00 – Communications Equipment Room Fittings
E. Section 27 50 00 – Audio-Video Communications (for AV integration)
F. Division 27
G. Division 28

1.1.4 All work must comply with District standards, contract documents, and applicable industry codes and standards.

1.1.5 In the event of a conflict between District standards and referenced industry standards, the District standard shall govern, provided it meets or exceeds minimum industry, code, and regulatory requirements.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a full list of applicable sections, refer to Section 27 00 00 – Communications.

1.2.2 Specific Related Sections include but are not limited to:

A. 27 00 00 – Communications
B. 27 05 28 – Pathways for Communications Systems
C. 27 05 43 – Underground Ducts and Raceways for Communications Systems
D. 27 05 50 – Communications Documentation & Submittals
E. 27 05 53 – Identification for Communications Systems
F. 27 06 50 – Communications Equipment & Materials Schedule
G. 27 11 00 – Communications Equipment Room Fittings
H. 27 50 00 – Audio-Video Communications

1.3 REFERENCES

1.3.1 The installation shall comply with the latest editions of the following standards unless otherwise noted in the District standards. In the event of a conflict between these standards and the District's requirements, the District's standards shall take precedence, provided they meet or exceed the minimum requirements set forth by applicable codes and regulations.

A. ANSI/TIA-568.0, 568.1, and 568.2-D – Copper Cabling and Components Standards
B. ANSI/TIA-569-E – Telecommunications Pathways and Spaces

C. ANSI/TIA-606-D – Administration of Telecommunications Infrastructure
D. ANSI/TIA-607-D – Grounding and Bonding for Communications
E. BICSI ITSIM and TDMM
F. NFPA 70 (NEC), including Articles 800 and 725
G. Local authority having jurisdiction (AHJ)

1.4 SUBMITTALS

1.4.1 Submittals for copper horizontal cabling shall be documented per Section 27 05 50 – Communications Documentation & Submittals and additional requirements within this Section.

1.4.2 General Submittals:

A. Product data sheets for copper cabling, jacks, patch panels, faceplates, and termination hardware.
B. Sample labels for jacks and patch panels consistent with Section 27 05 53.
C. Color coding and port designation layouts.
D. Test plans consistent with ANSI/TIA-568.2-D and Section 27 05 86.
E. Warranty documentation and proof of registration with the structured cabling manufacturer covering the lifetime system performance warranty.

1.5 QUALITY ASSURANCE

1.5.1 All work shall be performed by certified technicians trained in copper structured cabling installation and testing.

1.5.2 Technicians shall be certified by the cable system manufacturer where required for warranty.

1.5.3 All components shall be installed in accordance with the manufacturer's guidelines, ANSI/TIA standards, and BICSI best practices.

1.6 SUBMITTALS

1.6.1 Submittals required under this Section shall comply with all requirements outlined in Section 27 05 50 – Communications Documentation & Submittals.

1.6.2 In addition to the requirements outlined in Section 27 05 50, the Contractor shall submit the following:

A. Product data sheets for all cables, jacks, patch panels, faceplates, 66 blocks, and cross-connect hardware.
B. Certification documentation from the cable system manufacturer verifying eligibility for lifetime system warranty.
C. Test plans and sample reports for horizontal cable certification testing.
D. Sample cable labels and faceplate labeling templates consistent with Section 27 05 53 – Identification for Communications Systems.
E. Proposed color coding diagrams for station and cross-connect cabling.
F. GIS data documentation methodology in accordance with Section 27 05 50.

1.6.3 Final closeout submittals must include:

A. Full certification test results for all installed cables.
B. Manufacturer system warranty certificates.
C. GIS system data files documenting installed cable locations and equipment.

1.7 WARRANTY

1.7.1 The Contractor shall furnish warranties as required by the individual specification sections and Division 01.

1.7.2 The District requires a structured cabling system covered under a lifetime system performance warranty from the cable and connectivity manufacturer.

A. The proposed system shall include permanent link and channel performance guarantees for Category 6 and Category 6A installations.

B. Manufacturers must provide formal documentation of lifetime warranty coverage including remediation responsibilities, performance metrics, and certification requirements.
C. Proposed products must be equivalent to the District's current system basis of design (Leviton) and shall not void or conflict with existing manufacturer warranties at any campus or facility.

1.7.3 Final warranty documentation and proof of registration with the manufacturer shall be submitted per Section 27 05 50 – Communications Documentation & Submittals.

PART 2 - PRODUCTS

2.1 GENERAL

2.1.1 All cabling shall comply with the requirements outlined in this Section and all applicable standards listed in Part 1. At a minimum, this includes:

A. NEC (NFPA 70), Article 725 – Power-Limited Circuits
B. ANSI/TIA-568 and BICSI standards for cable routing and handling
C. Applicable UL listings (CMP, CMR, CL2, CL3, OSP, etc.)

2.1.2 The District has standardized on a structured cabling system that includes a lifetime manufacturer's system warranty. Currently, Leviton is the basis of design.

A. Any proposed products must provide a manufacturer-backed lifetime system warranty equivalent to Leviton's.
B. Proposed products shall not void, limit, or conflict with the warranty of any existing District-installed structured cabling systems.

2.1.3 Only 100% copper conductors shall be used.

2.1.4 Cable jackets shall be plenum-rated (CMP) unless installed outdoors or underground, in which case plenum/OSP or plenum/Indoor-Outdoor cable shall be used.

2.2 PRE-APPROVED MATERIALS

2.2.1 Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved cable types and manufacturers.

2.2.2 Products listed in 27 06 50 do not require additional approval.

2.2.3 Any proposed substitutions, or products or cable types not explicitly listed in Section 27 05 60, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 The following cable types and installation components are strictly prohibited:

A. Copper-clad aluminum (CCA) cables
B. Non-rated or non-plenum-rated cable.
C. Yellow 77 or other wax-based pulling lubricants
D. Zip ties or other non-releasable fasteners for permanent cable bundling
E. Unshielded cables where manufacturer requires shielding

2.4 HORIZONTAL CABLING

2.4.1 General Requirements

A. All horizontal cabling shall meet or exceed ANSI/TIA-568.2-D standards for Category 6 or Category 6A performance, as defined in the project documents.
B. All cables shall be 100% solid copper, twisted pair, and suitable for Power over Ethernet (PoE) applications, including IEEE 802.3bt (Type 4).

C. Cable jacket shall be plenum-rated (CMP) for indoor use. Black plenum-rated OSP or indoor/outdoor-rated jacket shall be used for exterior applications.
D. Jacket color shall conform to District standards:
   1. Purple or Blue – Standard for all client and data systems; this is the default color for all horizontal cabling.
   2. Yellow – Standard for all lighting control cables.
   3. Black – Permitted only for use with plenum-rated OSP or plenum-rated indoor/outdoor cable applications.
   4. Other Colors (e.g., Orange, Green) – To be used when specified by the District ITS Department Project Manager as part of the project scope for specific systems such as:
      - Green – AV
      - Orange – Non-client devices (WAPs, cameras, access control, etc.)
      - Other for other specialty installations.
   5. The jacket color must be factory-supplied. Painting, dyeing, or otherwise modifying the cable jacket color in the field is strictly prohibited.

2.4.2 Category 6 UTP Requirements

A. Minimum conductor size: 24 AWG
B. Rated to 250 MHz per ANSI/TIA-568.2-D
C. Electrical performance Third-party (ETL) verified and characterized to 500MHz.
D. Cable shall have Flame Rating of Plenum-NFPA 262, CMP and UL Listed.
E. Cable shall have an operating temperature range of -4^{0} F to 167^{0} F (-20^{0} C to 75^{0} C).
F. The cable shall be classified as Cat 6 UTP construction with no bare drain wire included.
G. The cable shall support up to 100 watts PoE with up to 240 cables in a bundle.
H. Application support:
   1. 100BASE-T, 1000BASE-T
   2. PoE up to IEEE 802.3at (Type 2) @ 90M
   3. HDBaseT

2.4.3 Category 6A UTP Requirements

A. Minimum conductor size: 23 AWG
B. Rated to 500 MHz per ANSI/TIA-568.2-D
C. Electrical performance Third-party (ETL) verified and characterized to 750MHz.
D. Cable shall have Flame Rating of Plenum-NFPA 262, CMP and UL Listed.
E. Cable shall have an operating temperature range of -4^{0} F to 221^{0} F (-20^{0} C to 105^{0} C).
F. Cable construction must support alien crosstalk mitigation without requiring individual cable shielding, unless otherwise specified.
G. The cable shall be classified as Cat 6A UTP construction with no bare drain wire included.
H. The cable shall support up to 100 watts PoE with up to 720 cables in a bundle.
I. Application support:
   1. 100BASE-T, 1000BASE-T, 10GBASE-T
   2. PoE++ / IEEE 802.3bt (Type 4) @ 90M
   3. UPOE+
   4. HDBaseT
J. Shielded or unshielded construction is permitted based on project specifications; however, all installations must maintain manufacturer-recommended separation from noise sources.

2.4.4 Shielded Twisted Pair (STP) Cabling

A. Use of shielded twisted pair cable is not standard and shall only be permitted when explicitly required by system design or site conditions.
B. All STP cabling must fully comply with the applicable requirements of Section 2.4.2 (Category 6) or 2.4.3 (Category 6A), including conductor type, flame rating, and performance characteristics.

C. Shielded cabling shall provide 360-degree shielding and include an integrated drain wire.
D. Shielding shall be continuous end-to-end and properly terminated and grounded in accordance with manufacturer recommendations and Section 3 requirements.
E. Use of STP cabling must be submitted for review and receive written approval from the District ITS Department Project Manager prior to installation.

2.4.5 Compatibility and Warranty

A. All cable must be compatible with the District's standardized cabling system and support the lifetime system warranty.
B. Any non-standard jacks (e.g., those required by integrated system manufacturers) must comply with the exemptions process outlined in Section 2.9.

2.5 JACKS AND TERMINATION HARDWARE

2.5.1 General Requirements

A. All modular jacks shall be compatible with faceplates and patch panels defined in this Section and shall support full system performance for the cable category in use.
B. All jacks shall be installed with integral strain to prevent mechanical damage.
C. All jacks shall be terminated per TIA-568B wiring standard.
D. Color-coding of jacks shall follow District ITS Department standards based on system type:
   1. Red – Fire alarm IP devices
   2. Purple – Client network ports
   3. Orange – Non-client devices (e.g., WAP, cameras, access control)
   4. Green – AV systems
   5. White – Voice
   6. Legacy (for reference only; not permitted for new installations):
      - Blue – Historical Cat5e installs (existing systems only)
      - Orange – Historical Cat5 installs (new orange ports are now for Non-Client Devices)
   7. Shielded jacks shall be used when shielded horizontal cabling is installed.
      - Shielded jacks must be compatible with the cable type and include an integrated ground path.
      - All requirements listed in this Section shall still apply to shielded jacks.
      - Shielded jacks must support proper bonding to patch panels or grounding hardware as part of the system grounding scheme.

2.5.2 Category 6 Jacks

A. Shall meet or exceed ANSI/TIA-568.2-D Category 6 performance specifications.
B. Rated to support bandwidth up to 250 MHz, and independently third-party verified (e.g., ETL/UL).
C. Must support full IEEE 802.3at (Type 2) PoE applications up to 100W.
D. Modular keystone or tool-less punch down style, compatible with standard Leviton faceplates and Leviton high-density panels patch panels.
E. Shall be unshielded unless otherwise specified.

2.5.3 Category 6A Jacks

A. Shall meet or exceed ANSI/TIA-568.2-D Category 6A performance specifications.
B. Rated to support bandwidth up to 500 MHz, and independently third-party verified (e.g., ETL/UL).
C. Must support full IEEE 802.3bt (Type 4) PoE++ applications up to 100W.
D. Modular keystone or tool-less punch down style, compatible with standard Leviton faceplates and Leviton high-density panels patch panels.
E. Shielded or unshielded construction shall match the cable type used; shielded jacks must provide proper termination for drain wire and shielding.

2.5.4 Modular Plug Terminated Link (MPTL) Connectors

A. MPTL connectors shall be permitted for direct termination of horizontal cabling to networked field devices (e.g., WAPs, cameras, security devices) only when pre-approved by the District ITS Department Project Manager.
B. MPTL connectors shall meet the following requirements:
   1. Comply with ANSI/TIA-568.2-D requirements for Modular Plug Terminated Links.
   2. Support Category 6A performance and be compatible with PoE Type 4 (up to 100W continuous).
   3. Be UL listed and plenum rated (UL 2043 certified) for use in air-handling spaces.
   4. Terminate 22–26 AWG solid or stranded conductors, with a cable outer diameter of 0.24 to 0.31 inches (6.0 mm – 8.0 mm).
   5. Use a robust, shielded housing to ensure EMI/RFI protection and alien crosstalk suppression.
   6. Require no specialized termination tool (tool-free termination preferred).
   7. RJ45 MPTL connectors shall not use a pass-through design and shall not utilize standard crimp-style terminations. Connectors must use controlled alignment and contact engagement mechanisms to ensure consistent and reliable electrical performance.
C. Assemblies incorporating pre-terminated connectors with a modular coupler (e.g., plenum-rated patch cord + field coupler) shall also be permitted if:
   1. The coupler and plug are Cat 6A compliant and plenum rated.
   2. The assembly provides strain relief and maintains bend radius requirements.
   3. The plug design incorporates a snagless feature to prevent damage during installation.
D. All MPTL solutions must be third-party tested and certified for use in structured cabling systems and maintain compliance with the District's lifetime warranty program.
E. MPTL connectors are not a substitute for standard jack-based terminations and shall be used only where a jack and faceplate assembly is not practical due to device mounting conditions or accessibility.

2.5.5 Compatibility and Warranty

A. All jacks must be compatible with the District's standardized cabling system and support the lifetime system warranty.
B. Any non-standard jacks (e.g., those required by integrated system manufacturers) must comply with the exemptions process outlined in Section 2.9.

2.6 PATCH PANELS

2.6.1 General Requirements

A. All patch panels shall be modular, rack-mountable keystone panels designed for use with Category 6 or 6A jacks.
B. Patch panels shall be UL-listed and third-party verified to meet or exceed ANSI/TIA-568.2-D performance for the associated category.
C. All patch panels shall support 110-style or tool-less keystone jack terminations as defined in the project scope.
D. Patch panels shall include rear cable management bars and support bend radius compliance per manufacturer specifications.
E. Angled patch panels are not permitted.
F. Patch panels shall be clearly and permanently labeled using vertical numbering:
   1. Odd numbers on the top row (e.g., 1, 3, 5…)
   2. Even numbers on the bottom row (e.g., 2, 4, 6…)
G. Shielded patch panels are required when shielded cable is used.
   1. Shielded panels must be compatible with shielded keystone jacks and include grounding provisions as required.
   2. All other requirements outlined in this Section shall still apply to shielded patch panels.

2.6.2 Configuration

A. Standard Patch Panels

1. 48-port, 2U modular keystone design is required unless otherwise specified.

B. High-Density Patch Panels
1. When high-density panels are required, 48-port, 1U modular keystone panels shall be used.

C. All patch panels must include appropriate rear cable management and maintain full ANSI/TIA-568 performance standards.

2.6.3 Compatibility

A. Patch panels must be fully compatible with all horizontal cabling, jacks, and structured cabling system components to ensure compliance with the District's system warranty requirements. Compatibility with Leviton's keystone dimensions and mounting geometry is mandatory.
B. Proprietary panel/jack combinations are permitted only if required to maintain the structured cabling system warranty as defined in Section 2.1.

2.7 66 BLOCKS:

2.7.1 General

A. 50-pair 66 blocks with standoff brackets to accommodate 25-pair cables.
B. Blocks must support Category 5e (Cat5e) cabling and be compatible with 66 punch-down tools.
C. Must be UL-listed and meet ANSI/TIA-568.2-D standards.

2.7.2 Accessories:

A. Bridging Clips for cross-connects.
1. Metal bridging clips are required for telephone (voice) terminations.
2. Plastic-coated bridging clips shall be used for all other applications, including low-voltage control systems and data wiring.
3. Clips must maintain secure connections and resist corrosion.
4. Covers to protect terminated cables from dust and damage.

2.8 FACEPLATES AND STATION HARDWARE

2.8.1 All faceplates and associated mounting hardware shall be modular, field-configurable, and designed to support Leviton-style keystone jacks. Products shall meet the following general requirements:

A. Constructed of high-impact, fire-retardant plastic rated UL 94V-0 or stainless steel, as required by project conditions.
B. Include integrated clear label windows or card slots to support permanent station identification.
C. Color to match surrounding finishes where specified; default color shall be white.
D. All components shall be ANSI/TIA-568.0-D compliant and cULus Listed.

2.8.2 Faceplate Configurations

A. Plastic Faceplates
1. Single-gang, straight: 1, 2, 3, 4, or 6 ports
2. Single-gang, angled: 2 or 4 ports
3. Double-gang, straight: 1, 2, 3, 4, 6, 8, or 12 ports

B. Stainless Steel Faceplates
1. Single-gang recessed (telephone-style)
2. Single-gang, straight: 1, 2, 3, 4, or 6 ports
3. Single-gang, angled: 2 or 4 ports
4. Double-gang, straight: 1, 2, 3, 4, 6, 8, or 12 ports
5. Double-gang, angled: 4 or 8 ports

2.8.3 Mounting Brackets

A. Decora-Style Mounting Brackets

1. Available in 1, 2, 3, 4, and 6-port configurations
2. Shall fit within standard Decora wall plate openings
3. Shall support Leviton-style keystone jacks

B. Raceway-Compatible Brackets
1. For use with non-metallic raceway systems
2. Available in straight or angled mounting types
3. Color-matched to raceway system
4. Shall provide strain relief, proper bend radius, and secure jack support
5. Shal be available in straight and angled configurations
6. Compatible with Leviton-style keystone jack format

C. Faceplates with Integrated Low Voltage Mounting Brackets
1. Intended for retrofit locations where standard electrical boxes are not provided
2. Must support 2- or 4-port configurations
3. Features shall include:
- Integrated mounting arms or clips for wallboard installation
- Compatibility with standard Leviton-style keystone jacks
- Clear ID window above each port
- UL 94V-0 rated plastic construction
- Full ANSI/TIA and cULus compliance
- District ITS Department Project Manager approval required prior to use

2.8.4 Biscuit Boxes and Surface-Mount Boxes

A. Biscuit boxes and surface-mount boxes are only approved for installation in the following conditions, unless explicit written approval is provided by the District ITS Department Project Manager:
1. Above the ceiling, mounted to structural components or ceiling grid.
2. Inside a device enclosure or panel (e.g., access control panel, CCTV camera bell box, or equipment housing).

B. Available configurations shall include 1, 2, 4, 6, and 12-port formats and must be compatible with standard Leviton-style keystone jacks.

C. Biscuit boxes and surface-mount enclosures shall:
1. Provide integrated strain relief
2. Include provisions for labeling and port identification
3. Be constructed of high-impact, fire-retardant plastic rated UL 94V-0

2.8.5 Specialty Mounting Hardware

A. Above-Ceiling Brackets – Shall provide secure mounting of keystone jacks above ceiling tiles with support for labeling and strain relief

B. Box Adapters – Shall allow recessed jack mounting inside electrical boxes, where the electrical box opening will be concealed by other means such as a clock or a speaker. Adapters shall provide strain relief for the cable and protect terminations from mechanical stress or damage.

C. All specialty items must be:
1. Compatible with Leviton-style keystone format
2. UL 94V-0 rated and ANSI/TIA-568.0-D compliant

2.8.6 Compatibility

A. Faceplates and mounting hardware shall be fully compatible with the District's structured cabling system and must support the system warranty. Compatibility with Leviton's keystone mounting geometry is mandatory.

2.9 PATCH CORDS

2.9.1 Patch cords shall be factory-terminated and certified, Category 6 or 6A, and match the performance of the structured cabling system. Field-terminated patch cords are not permitted.

2.9.2 Patch cords shall comply with ANSI/TIA-568.2-D and be constructed with stranded copper conductors and modular plugs suitable for PoE applications up to Type 4 (90W).

2.9.3 Patch cords shall utilize snagless boots to prevent tab breakage and ensure reliable connections during insertion and removal.

2.9.4 Patch cord jacket color shall match the corresponding jack color and system type:

A. Red – Fire alarm IP devices
B. Purple – Client network ports
C. Orange – Non-client devices (WAPs, cameras, access control, etc.)
D. Green – AV

2.9.5 Patch cords shall be provided in the following lengths based on rack layout:

A. 1-foot patch cords shall be used where patch panels and switches are mounted directly above or below each other in the same rack.
B. Where patch panels and switches are grouped separately, patch cords shall be the minimum length required to cleanly and efficiently reach the switch port without excess slack.

2.9.6 Patch cords shall not be field-terminated, altered, or modified. Only factory-assembled cords shall be used.

2.10 CROSS-CONNECT WIRE (TIE-CABLE)

2.10.1 Cross-connect cables shall be:

A. Category 5e rated or better
B. 24AWG or better
C. Sold copper conductors only; aluminum, CCA, and other materials are prohibited
D. Rated for use within telecom rooms
E. Compatible with 66 blocks.

2.10.2 Cross-connect cables color shall match the corresponding system type. All cross-connect cables shall be color-coded as follows:

1. Blue – Horizontal station cabling (standard work area cabling)
2. Orange – Demarcation points for Central Office connections
3. Red – Data circuits including T1, PRI, or dedicated WAN circuits
4. Brown – Public Address (PA) system cross-connects
5. Green – Access control switches and door contacts
6. Yellow – Other low-voltage or auxiliary systems

2.11 EXCEPTIONS FOR MANUFACTURER-SPECIFIC SYSTEMS

2.11.1 The requirements in Sections 2.1 through 2.8 shall apply to all communications horizontal cabling components unless otherwise exempted below.

2.11.2 Cabling and termination hardware that are part of a complete, proprietary system (e.g., Extron control systems, integrated AV bundles) may be exempted from the standard color and performance specifications defined in this Section under the following conditions:

A. The manufacturer’s proprietary components must be required to maintain system functionality or warranty eligibility.
B. All such components must be plenum-rated and UL-listed for use in communications installations.
C. Installation of proprietary cables and jacks must still comply with all physical installation standards and workmanship requirements defined in:
   1. Section 27 15 00 – Communications Horizontal Cabling
   2. Section 27 05 28 – Pathways for Communications Systems

3. Section 27 05 50 – Communications Documentation & Submittals

2.11.3 Use of any proprietary components must be clearly identified in project submittals, and the District ITS Department Project Manager must grant written approval prior to installation.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 All copper horizontal cabling shall be installed in accordance with:

A. Section 27 15 00 – Communications Horizontal Cabling
B. Applicable standards listed in Part 1 of this Section
C. All relevant Division 27 sections
D. Manufacturer's installation recommendations and guidelines

3.1.2 The Contractor shall:

A. Coordinate with other trades to ensure pathways are clear and that cable routes avoid sources of EMI/RFI or physical interference (e.g., lighting, HVAC, electrical).
B. Confirm that all penetrations are sleeved and sealed per code requirements, including firestopping where applicable.
C. Ensure that cabling is not installed in pathways shared with power circuits, unless compliant with NEC separation requirements.
D. Verify that all materials have been approved per submittals and pre-installation review.

3.1.3 All cabling installations shall maintain:

A. Proper bend radius and pulling tension as defined by ANSI/TIA-568.2-D and manufacturer specifications.
B. Proper support and strain relief using J-hooks, cable trays, or approved fasteners at intervals not exceeding 5 feet.
C. Dedicated horizontal pathways free of abandoned cabling and in compliance with fill ratio requirements in Section 27 00 00.

3.1.4 If shielded cable is used:

A. Shielding shall be bonded and grounded only at the telecommunications room (IDF/MDF/BDF).
B. Shield continuity and proper termination must be verified through testing.

3.2 TESTING & CERTIFICATION

3.2.1 All horizontal cabling installations shall be tested and certified in accordance with Section 27 05 86 – Testing of Communications Systems.

3.2.2 When specified in the contract documents the complete channel link shall be tested and certified in accordance with Section 27 05 86 – Testing of Communications Systems.

3.2.3 Testing shall verify compliance with ANSI/TIA standards, manufacturer performance specifications, and all applicable system warranty requirements. Certification test results shall be included in the project closeout documents.

3.3 PATHWAY INSTALLATION

3.3.1 All pathways for systems under Division 27 and Division 28 shall be installed in accordance with:

A. Section 27 05 28 – Pathways for Communications Systems
B. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems

3.3.2 Conduits entering buildings must be sealed to prevent water ingress, using firestopping materials where required.

3.3.3 All conduits and sleeves shall be:

A. Provided with plastic bushings to protect cable from abrasion.
B. Firestopped at the termination of all conduits and sleeves trade size 1-1/2" or larger, or where required by the Authority Having Jurisdiction (AHJ).

3.3.4 Surface-mounted cable installations shall only be permitted when explicitly approved by the District ITS Department Project Manager.

A. All raceways must be installed plumb, level, and secured in a clean, professional manner.

3.4 HORIZONTAL CABLE

3.4.1 All horizontal cable shall be routed using approved pathway systems in accordance with:

A. Section 27 05 28 – Pathways for Communications Systems
B. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems
C. Section 27 00 00 – Communications General Requirements, including fill ratios and separation requirements.

3.4.2 Cable shall be installed in accordance with ANSI/TIA-568.0-E, manufacturer's recommendations, and best industry practices.

3.4.3 **The permanent link shall not exceed 90 meters (295 feet) in total length**, inclusive of horizontal cable and any patch cords or connectors within the channel, in accordance with ANSI/TIA-568.0-E.

A. No exceptions to this requirement shall be made unless:
1. Written approval is obtained from the District ITS Department Project Manager, **and**
2. The cabling manufacturer certifies that the proposed solution maintains full system performance and warranty.

3.4.4 Cables shall be installed in continuous lengths from origin to destination (no splices) except for consolidation points approved by the ITS Department Project Manager.

3.4.5 Where transition points or consolidation points are allowed, they shall be in accessible locations and housed in an enclosure intended and suitable for the purpose.

3.4.6 Horizontal cables shall be neatly bundled and dressed in groups of no more than 50 cables to their respective termination device. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

A. Each terminating device (e.g., patch panel, outlet, faceplate) shall be served by an individual bundle separated and dressed back to the point of entrance into the rack, cabinet, or room.
B. Cable bundles shall not be painted.
C. Hook-and-loop fasteners shall be used; nylon or plastic cable ties are prohibited for permanent cable bundling.
D. Each cable shall be clearly labeled on the cable jacket immediately behind the termination device, with the label visible without disturbing the bundle or removing fasteners.
E. Labels obscured within bundles or requiring fastener removal shall be rejected.
F. All labeling shall comply with:
1. Sections 27 15 00 – Communications Horizontal Cabling
2. 27 05 53 – Identification for Communications Systems
3. 27 15 13 – Communications Copper Horizontal Cabling

3.4.7 The bundle size recommendations of ANSI/TIA TSB-184-A shall be followed as it pertains to current or future support for POE applications.

3.4.8 For Category 6 installations cable bundles shall not be strictly combed and tightly fastened together but rather installed in a randomized, loose, and un-bundled fashion to reduce harmonics.

3.4.9 Cable shall be installed above fire-sprinkler systems and shall not be attached to the fire-sprinkler system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

3.4.10 Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the District.

3.4.11 Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA-568.0-E, manufacturer's recommendations, and best industry practices.

3.4.12 Service Loops (slack)

A. When cables are being installed, service loops shall be provided at both ends to accommodate future changes in the structured cabling system. Service loops should be included in all length calculations to ensure that the permanent link does not exceed 90 m (295 ft). The amount of cable slack required will depend on the size and layout of the connecting hardware.
B. Horizontal copper cabling shall comply with all service loop requirements defined in Section 27 15 00 – Communications Horizontal Cabling.
C. Minimum service loop lengths for communications copper horizontal cabling shall be as follows:
   1. At the MDF, BDF, or IDF:
      - Provide a minimum of 10 feet of service loop for each cable, neatly coiled and secured in the cable management system or on the backboard.
   2. At the station/device location:
      - Provide a minimum of 3 feet of service loop, or amount specified in construction documents, whichever is greater, in the ceiling above the outlet, unless otherwise specified by the ITS Department Project Manager.
      - Provide a minimum of 12 inches of service loop beyond the outlet or device termination point.
      - Where Modular Plug Terminated Link (MPTL) connections are utilized, a minimum of 3 feet of service loop shall be provided at the device end.

3.5 HORIZONTAL CABLING – ANALOG VOICE

3.5.1 General

A. Horizontal cabling used to support analog voice devices shall comply with all requirements for Category 6 cabling as defined in Section 3.4 – Horizontal Cabling.

3.5.2 Station Termination

A. At the station end, analog voice cables shall terminate on white Leviton-style Category 6 keystone jacks.
B. All pairs shall be terminated following T568B wiring standard, with no untwisted pairs beyond 0.5 inches.

3.5.3 IDF Termination

A. At the IDF, analog voice cables shall terminate onto designated 66-blocks.
B. All four pairs shall be terminated, following TIA-568B color code order:
   1. Blue pair
   2. Orange pair
   3. Green pair
   4. Brown pair
C. Cable pairs may be untwisted by no more than 1 inch at the point of termination onto the 66-block.
D. Terminations shall be properly dressed and secured to maintain bend radius and strain relief.
E. Tie cables and cross-connects shall follow material and color-coding standards outlined in Section 2.10.

3.5.4 Identification

A. All analog voice outlets and associated cabling shall be labeled per Section 27 05 53 – Identification for Communications Systems.

3.5.5 Compliance

A. Installation of analog voice cabling shall comply with all other workmanship and testing standards defined for copper horizontal cabling in this Section and Section 27 15 00 – Communications Horizontal Cabling.

3.6 SPLICES

3.6.1 Splicing of communications copper horizontal cabling is strictly prohibited.

3.6.2 All cable runs shall be continuous from the patch panel to the outlet or termination device without interruption.

3.6.3 In the event of cable damage or installation error, the affected cable shall be replaced in its entirety.

3.6.4 Modular Plug Terminated Link (MPTL) terminations, are not considered splices and may be used only when:

A. Approved in writing by the District ITS Department Project Manager.
B. Installed in accordance with ANSI/TIA-568.2-D and the manufacturer's specifications.
C. Used as part of the original system design, not as a repair or field modification.

3.7 CABLE TERMINATION

3.7.1 General Termination Requirements

A. All terminations shall meet ANSI/TIA-568.2-D standards.
B. Jacks shall be terminated using T568B pinout configuration unless otherwise directed.
C. Cable jacket shall remain as close to the point of termination as possible, minimizing untwist per manufacturer requirements (typically no more than 0.5 inch).
D. Bend radius and strain relief shall be maintained per manufacturer installation guidelines.
E. Jacks shall be compatible with the horizontal cabling type and rated for the category being installed (e.g., Cat 6 or Cat 6A).

3.7.2 Category 6 Termination

A. All terminations shall comply with the Leviton eXtreme Cat 6 UTP product specification.
B. Use of approved impact or toolless punch-down tools as required by jack type.
C. Only jacks and hardware specifically rated for Cat 6 and certified for use with the cable type shall be used.
D. Maintain twist within 0.5 inch of the termination point.
E. Ensure conductor color codes and pair sequence are maintained throughout.

3.7.3 Category 6A Termination

A. All terminations shall comply with the Leviton SST Cat 6A UTP product specification.
B. Termination shall ensure internal circuit isolation and minimal alien crosstalk.
C. Only jacks and hardware specifically rated for Cat 6A and certified for use with the cable type shall be used.
D. Maintain separation from power cabling as per TIA standards and manufacturer recommendations.
E. Cable jacket shall be retained as far into the connector as possible to ensure shielding of pairs.

3.7.4 Modular Plug Terminated Links (MPTL)

A. MPTL terminations shall only be used where explicitly approved by the District ITS Department Project Manager.
B. Only factory-assembled MPTL cords or tool-free modular plug designs tested and approved for field installation may be used.
C. MPTL modular plugs shall:
   1. Be rated for the category of cable being installed (Cat 6 or Cat 6A)

2. Not use pass-through or standard RJ-45 crimp-style terminations
3. Provide strain relief and maintain manufacturer bend radius
4. Be UL listed and compliant with ANSI/TIA-568.2-D
5. MPTL connectors must maintain full warranty eligibility under the District's structured cabling system.

3.7.5 Non-Keystone Patch Panel Terminations (Legacy Systems)

A. Termination on existing non-keystone patch panels is permitted only if:
   1. The panel is rated for the category of cable being installed
   2. The system warranty is not voided
   3. Termination follows manufacturer specifications
B. Installation of new non-keystone patch panels is strictly prohibited.

3.8 PATCH PANELS

3.8.1 All patch panels shall be keystone-style and compatible with the Leviton keystone jack format.

3.8.2 Patch panels shall be 48-port, 2U modular unless otherwise noted and approved by the ITS Department Project Manager. Where high-density designs are required, 48-port, 1U modular panels may be used as specified.

3.8.3 Patch panels shall be rack-mounted and mechanically secured using a minimum of four (4) screws. The use of angled patch panels is not permitted.

A. Patch panel location and mounting height shall follow the equipment layout specified in 3.2 Equipment Layout of Section 27 11 16 – Communications Racks, Cabinets, and Enclosures.
B. Rack screws shall be machine-threaded and compatible with the rack's mounting design.
C. For racks utilizing cage nuts, M5 cage nuts and screws shall be used unless otherwise specified by the District ITS Department Project Manager.

3.8.4 All cables shall be neatly dressed into the patch panel using proper cable management techniques. Bundles shall be routed cleanly, with no excessive slack or tight bends.

3.8.5 The patch panel cable support bracket shall be installed and used to support and secure all incoming horizontal cables. Cables shall not be left hanging or unsupported.

3.8.6 Patch Panel Port Reservation

A. For the first patch panel installed in each IDF or BDF, the first six (6) ports shall be reserved for infrastructure systems supporting the IDF operations.
B. For the first patch panel installed in each MDF, the first six (12) ports shall be reserved for infrastructure systems supporting the IDF operations.
C. Port reservation requirements may be adjusted at the direction of the ITS Department Project Manager.

3.8.7 Patch panels must be permanently labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.8.8 Shielded patch panels shall be used when shielded cable is installed. Grounding and bonding shall follow manufacturer instructions and TIA/EIA-607.

3.9 FACEPLATES AND STATION HARDWARE

3.9.1 Faceplates and station hardware shall be securely mounted to a suitable outlet box or low-voltage mounting bracket. Mounting directly to wall openings without a box or bracket is strictly prohibited unless the faceplate or station hardware is expressly designed and rated for such installations.

3.9.2 All mounting screws shall be machine-threaded and appropriate for the device box or mounting bracket being used. Use of wood screws, drywall screws, or other improper fasteners is not permitted.

3.9.3 All faceplates and station hardware shall be installed plumb, level, and securely mounted to wall boxes or approved surface raceway brackets.

3.9.4 Faceplate color shall match the finish of the room when specified. If not specified, the default color shall be white.

3.9.5 All faceplates shall include integrated label windows for port identification and shall be labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.9.6 All installed hardware shall be compatible with the cabling system, and installed per manufacturer instructions to ensure proper performance, support of bend radius, and strain relief.

3.9.7 Faceplates and jacks shall be installed flush with finished wall surfaces. Any visible gaps, misalignments, or crooked installations shall be corrected prior to acceptance.

3.9.8 When using angled or specialty faceplates, ensure proper orientation and clearance for cabling. Angled faceplates shall be mounted with the port slope angled downward or sideways based on application and ITS Department Project Manager direction.

3.9.9 Modular jacks shall snap securely into faceplate openings with no movement or looseness after installation.

3.9.10 Where jacks are installed into surface-mounted boxes or biscuit boxes:

A. Boxes must be securely fastened to structure or surface.
B. Cable bend radius and slack must be managed to avoid strain or kinks.
C. Boxes shall be labeled and oriented consistently with other outlets in the space.

3.10 BISCUIT BOXES AND SURFACE-MOUNT BOX INSTALLATION REQUIREMENTS

3.10.1 Biscuit boxes and surface-mount enclosures shall only be installed in the following locations unless otherwise approved in writing by the District ITS Department Project Manager:

A. Above accessible ceilings.
B. Inside secured equipment enclosures such as access control panels.
C. Mounted on vertical surfaces in non-public spaces, where no wall box or bracket is feasible and permission has been granted.

3.10.2 All biscuit boxes and surface-mount enclosures shall:

A. Be securely mounted using appropriate mechanical fasteners for the surface material (e.g., drywall anchors, toggle bolts, screws into wood or metal studs).
B. Be rated for the number of jacks and cable types installed.
C. Be compatible with Leviton-style keystone jacks and meet all applicable UL and ANSI/TIA-568.0-D requirements.
D. Include label windows or other provisions to identify connected devices and associated cable IDs.

3.10.3 When installed above accessible ceilings and suspended using support wire, biscuit boxes and mounting brackets shall comply with the following:

A. Only brackets specifically designed to support biscuit boxes or individual keystone jacks may be used.
B. Support must be provided by a dedicated 12 AWG galvanized steel support wire or a shared wire with approved J-hook systems, provided load and spacing requirements are maintained.
C. Support wire shall be independently anchored to structural building elements using a minimum of three (3) full twists at the point of attachment.
D. The vertical drop of the support wire shall extend a minimum of 3 inches below the supported hardware, with the free end bent into a closed loop or hook no smaller than ½ inch in diameter to eliminate sharp edges.

E. Support wire attachment to T-bar ceiling grids, HVAC ductwork, sprinkler systems, lighting fixtures, or other non-load-bearing structures is strictly prohibited, unless specifically allowed by code or the AHJ.

3.10.4 Labeling and Identification

A. All mounted boxes must support identification labels consistent with Section 27 05 53 – Identification for Communications Systems.
B. Labels shall be visible and accessible without removal of the box cover.

3.11 PATCH CORDS

3.11.1 All patch cords used throughout the project—including those in telecommunications rooms, classroom spaces, device enclosures, work areas, or other locations—shall be:

A. Factory-terminated and certified.
B. Category-rated to match the horizontal cabling system (Cat 6 or Cat 6A).
C. Fully compliant with ANSI/TIA-568.2-D and UL-listed.
D. Constructed using stranded copper conductors with snagless molded boots.

3.11.2 Field-terminated, modified, or re-terminated patch cords are strictly prohibited. Only factory-assembled cords are acceptable.

3.11.3 Patch cord electrical and construction requirements:

A. Patch cords shall be equal to or greater than the performance category of the permanent link (e.g., Cat 6A cords shall be used for Cat 6A links).
B. Patch cords shall use stranded copper conductors with a minimum wire gauge of:
   1. 24 AWG for Category 6
   2. 23 AWG for Category 6A
C. Thin (high-flex) patch cords (e.g., 28 AWG) are prohibited unless all the following conditions are met:
   1. Permanent link length does not exceed 80 meters.
   2. Written approval is obtained from the District ITS Department Project Manager prior to install.
D. Patch cords must meet or exceed the transmission requirements defined in:
   1. ANSI/TIA-568.2-D (Category 6)
   2. ISO/IEC 11801-1 (Class E)
   3. EN 50173-1 (Class E)
E. Patch cords must support IEEE 802.3 PoE Types 1, 2, 3, and 4 (up to 100 watts).

3.11.4 Patch cord jacket color shall match the corresponding jack and system function, as specified in Section 2.8.3:

A. Red – Fire alarm IP devices
B. Purple – Client network ports
C. Orange – Non-client devices (WAPs, cameras, access control, etc.)
D. Green – AV
E. Other colors – As approved by the District ITS Department Project Manager.

3.11.5 Patch cord lengths shall be as follows:

A. Client Devices: Provide one (1) 14-foot patch cord for each client network port. These cords shall be delivered to the District for future use.
B. Non-Client Devices: Patch cords shall be provided to match the minimum required length to reach from the patch panel to the device served, with no excessive slack.
C. Communications Rooms:
   1. 1-foot patch cords shall be used when switches and patch panels are directly aligned in the same rack.
   2. Where patch panels and switches are located in different racks or at different heights, patch cords shall be the minimum length necessary to reach the switch port neatly.

3.11.6 Patch cords shall be:

A. Routed cleanly through cable managers to maintain bend radius.
   1. Bundle size and bundle separation must comply with ANSI/TIA TSB-184-A.
B. Installed without sharp bends, kinks, or loops.

3.12 TESTING AND VERIFICATION

3.12.1 All installed communications copper horizontal cabling shall be tested and verified in accordance with:

A. Section 27 05 86 – Testing of Communications Systems.
B. Manufacturer's specifications for certification and warranty compliance.
C. ANSI/TIA-568.2-D standards for copper media.

3.12.2 Contractor shall:

A. Perform permanent link testing of each horizontal cable.
B. Submit full electronic test results organized by cable ID and room location.
C. Retest and replace any cable that fails testing at no additional cost to the District.

3.13 SYSTEMS ACCEPTANCE AND CLOSEOUT

3.13.1 Systems shall not be considered complete until:

A. All cabling has passed testing and verification.
B. All labeling and documentation are complete and approved.
C. Manufacturer warranty registration has been submitted and accepted.
D. GIS location data for all station outlets, cross-connects, and communications rooms has been entered into the District's GIS system per Section 27 05 50.
E. All required documentation, test results, warranties, certifications, and closeout submittals are provided in accordance with the submittal requirements outlined in Section 27 05 50 – Communications Documentation & Submittals.

3.13.2 The Contractor shall:

A. Furnish complete copies of manufacturer warranty certificates for the structured cabling system.
B. Submit all final cable test results in an electronic format, clearly labeled and organized, to the ITS Department Project Manager prior to scheduling the final punch walk.
C. Provide all required test equipment necessary for the District to verify contractor-provided certification results.
D. Ensure that the test equipment used for certification is available for the District's use during the punch walk and verification testing at no additional cost.
E. At the District's discretion, the District may request verification of the contractor's test equipment accuracy by testing a previously certified District-owned cable.
F. Participate in a formal punch walk with the District ITS Department Project Manager to review the completed installation, correct deficiencies, and complete final acceptance documentation.
G. Correct any deficiencies identified during the punch walk and resubmit for re-inspection at no additional cost to the District.

3.13.3 No system shall be accepted until all punch walk deficiencies have been corrected, and all required submittals and verification materials have been approved by the District.

END OF SECTION

SECTION 27 15 23 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This Section defines minimum requirements for horizontal optical fiber cabling between telecommunications rooms and station devices or work areas.

1.1.2 Scope includes:

A. Horizontal fiber cabling between IDF/BDF/MDF LIUs and station-side mini LIUs.
B. Station-side LC fiber trunk cabling from mini LIUs to wall outlets or device ports.

1.1.3 Related Sections:

A. 27 05 28 – Pathways for Communications Systems
B. 27 05 50 – Communications Documentation & Submittals
C. 27 05 53 – Identification for Communications Systems
D. 27 05 86 – Testing of Communications Systems
E. 27 13 23 – Communications Optical Fiber Backbone Cabling
F. 27 15 00 – Communications Horizontal Cabling

1.1.4 Conflicts between District standards and industry standards shall defer to the District standards where equal or more stringent.

1.2 SUBMITTALS

1.2.1 Submittals shall comply with Section 27 05 50 – Communications Documentation & Submittals.

1.2.2 Include, at minimum:

A. Fiber routing and termination drawings.
B. Product datasheets for cable, mini LIUs, and LC keystone jacks.
C. Sample test results.
D. Final certified test results and warranty registration documentation.

1.3 QUALITY ASSURANCE

1.3.1 Horizontal fiber installation shall conform to the materials, workmanship, splicing, and handling standards of Section 27 13 23.

1.3.2 Technicians shall be certified for optical fiber installation by the cable manufacturer or an accredited training program.

PART 2 - PRODUCTS

2.1 GENERAL

2.1.1 All equipment and infrastructure shall be reviewed and approved by the District ITS Department Project Manager prior to installation.

2.1.2 All cabling, patching, labeling and equipment shall conform to the standards established in Division 27. Including but not limited to the following sections:

A. Section 27 00 00 – Communications
B. Section 27 13 00 – Communications Backbone Cabling
C. Section 27 13 13 – Communications Copper Backbone Cabling
D. Section 27 15 00 – Communications Horizontal Cabling

E. Section 27 15 13 – Communications Copper Horizontal Cabling

2.1.3 Approved Materials & Compliance

A. All fiber optic cabling, termination hardware, enclosures, and accessories shall be Leviton or equivalent and eligible for a lifetime system warranty.
B. Substitutions must be approved in writing by the ITS Department Project Manager prior to procurement.

2.2 PRE-APPROVED MATERIALS

2.2.1 Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved cable types and manufacturers.

2.2.2 Products listed in 27 06 50 do not require additional approval.

2.2.3 Any proposed substitutions, or products or cable types not explicitly listed in Section 27 05 50, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 The following products are strictly prohibited:

A. Devices not compliant with the National Defense Authorization Act (NDAA)
B. Products lacking manufacturer support or without firmware update capability
C. Devices that conflict with the District's operational or security policies
D. Devices with factory passwords that cannot be changed or disabled

2.4 FIBER OPTIC CABLE REQUIREMENTS

2.4.1 All cables must comply with:

A. ANSI/TIA-568.3-D – Optical Fiber Cabling Standard.
B. ANSI/TIA-492-AAAC (OM3), AAAD (OM4), and AAAB (OS2).
C. NFPA 70 (NEC) Article 770 – Plenum, Riser, and OSP Installation.
D. NFPA 262 and UL 1666 – Fire Safety Requirements.
E. EN 50173; ISO/IEC 11801; ANSI/ICEA S-104-696; ANSI/ICEA S-83-596.
F. NFPA 130; Telcordia GR-20 (OSP fiber); Telcordia GR-409 (indoor fiber).

2.4.2 Fiber Ratings:

A. All fiber optic cables used indoors shall be Plenum-rated (CMP).
B. All fiber optic cables used outdoors or underground shall be Plenum OSP or Plenum Indoor/Outdoor-rated.
C. Armored fiber cables must meet the same rating requirements as non-armored fiber and provide rodent protection (e.g., interlocking armor or non-metallic rodent-resistant sheathing).

2.4.3 Performance Requirements:

A. Single-Mode Fiber Requirements (OS2):
   1. Fiber must support transmission at:
      - 1310nm
      - 1550nm
   2. Maximum attenuation:
      - ≤ 0.4 dB/km @ 1310nm
      - ≤ 0.3 dB/km @1550 nm
B. Multi-Mode Fiber Requirements (OM3, OM4, OM5):
   1. Fiber must support transmission at:
      - 850nm
      - 1300nm
   2. Maximum attenuation:

- ≤ 1.0 dB/km @ 1300nm
- ≤ 3.0 dB/km @ 850nm

2.4.4 Plenum (CMP) Indoor Fiber Optic Cable

A. Application: Used for indoor backbone fiber runs.
B. Construction:
   1. Tight-buffered fiber construction for indoor backbone applications.
   2. 900-micron subunits for easy termination.
   3. Aramid yarn strength members for enhanced tensile strength.
   4. Plenum-rated outer jacket for compliance with NFPA 70 (NEC) Article 770.
   5. Glass-reinforced (GRP) anti-buckling member included for fiber counts of 24-144
C. Sheath Color:
   1. OS2 (Single-mode): Yellow
   2. OM3/OM4 (Multimode): Aqua
   3. OM5 (Multimode): Lime Green
D. Max Outer Diameters:
   1. 6 fibers – 0.19 in (4.73 mm)
   2. 12 fibers – 0.23 in (5.72 mm)
   3. 24 fibers – 0.30 in (7.7 mm)
   4. 36 fibers – 0.57 in (14.52 mm)
   5. 48 fibers – 0.61 in (15.62 mm)
   6. 72 fibers – 0.74 in (18.7 mm)
   7. 96 fibers – 0.95 in (23.98 mm)
   8. 144 fibers – 0.99 in (25.08 mm)

2.4.5 Indoor/Outdoor Plenum Fiber Optic Cable

A. Application: Used for backbone runs that transition from outdoors to indoor plenum spaces.
B. Construction:
   1. Tight-buffered fiber construction designed for both indoor and outdoor environments.
   2. 900-micron subunits for easy termination.
   3. UV- and moisture-resistant outer jacket for exposure to environmental conditions.
   4. Dry water-blocked cable core for moisture protection.
   5. Glass-reinforced (GRP) anti-buckling member included for fiber counts of 24-144.
   6. Jacket is:
      - Fungus-resistant, sunlight-resistant per UL 444 Clause 7.22.
      - Suitable for use in conduit below the frost line.
      - Plenum-rated outer jacket for compliance with NFPA 70 (NEC) Article 770.
      - Designed to transition from outdoor to indoor plenum spaces without requiring splicing.
C. Jacket Rating: Plenum-rated (CMP), fungus-resistant, sunlight-resistant per UL 444 Clause 7.22. Suitable for use in conduit below frost line.
D. Glass-reinforced (GRP) anti-buckling member shall be included in cables with 24-144 fiber counts.
E. Sheath Color:
   1. OS2 (Single-mode): Yellow
   2. OM3/OM4 (Multimode): Aqua
   3. OM5 (Multimode): Lime Green
F. Max Outer Diameters:
   1. 6 fibers – 0.25 in (6.27 mm)
   2. 12 fibers – 0.27 in (6.82 mm)
   3. 24 fibers – 0.37 in (9.35 mm)
   4. 48 fibers – 0.65 in (16.5 mm)
   5. 72 fibers – 0.81 in (20.46 mm)

2.4.6 Plenum OSP (Outside Plant) Fiber Optic Cable

A. Application: Used for underground or aerial backbone fiber runs between buildings, while meeting plenum fire ratings for indoor transitions.
B. Construction:
   1. Loose-tube fiber construction for improved protection in outdoor environments.
   2. Water-blocked cable core using dry water-blocking technology for moisture resistance.
   3. Glass-reinforced (GRP) anti-buckling member included for fiber counts of 24-144
   4. Jacket is:
      - Jacket rated for direct burial or aerial installation.
      - Fungus-resistant, sunlight-resistant per UL 444 Clause 7.22.
      - Suitable for use in conduit below the frost line.
      - Plenum-rated outer jacket for compliance with NFPA 70 (NEC) Article 770.
      - Designed to transition from outdoor to indoor plenum spaces without requiring splicing.
C. Sheath Color:
   1. All Fiber Types: Black
   2. OS2 (Single-mode): Yellow
   3. OM3/OM4 (Multimode): Aqua
   4. OM5 (Multimode): Lime Green
D. Max Outer Diameters:
   1. 6 fibers – 0.54 in (13.86 mm)
   2. 12 fibers – 0.58 in (14.63 mm)
   3. 24 fibers – 0.64 in (16.28 mm)
   4. 48 fibers – 1.01 in (25.74 mm)

2.4.7 Armored Fiber Optic Cable (Rodent-Resistant)

A. Application: Used in areas requiring additional protection against rodents, crush resistance, and extreme environments while maintaining plenum or OSP compliance.
B. Construction:
   1. Available in both loose-tube and tight-buffered constructions, depending on the application.
   2. Glass-reinforced (GRP) anti-buckling member included for fiber counts of 24-144
   3. Rodent-resistant design with interlocking aluminum armor (plenum) or corrugated steel tape armor (OSP).
   4. Complies with NFPA 70 (NEC) Article 770.
   5. Indoor armored:
      - Plenum-rated (CMP) with interlocking aluminum armor for enhanced mechanical protection.
   6. Outdoor armored:
      - OSP-Plenum or OSP Indoor/Outdoor rated with corrugated steel tape armor for enhanced mechanical protection.
      - Water-blocked cable core for moisture resistance in outdoor environments.
      - Jacket Properties:
        ◊ Fungus-resistant, sunlight-resistant per UL 444 Clause 7.22.
        ◊ Suitable for use in conduit below the frost line.
        ◊ Designed to transition from outdoor to indoor plenum spaces without requiring splicing.
C. Jacket Rating:
   1. Armored Plenum-rated (CMP) for indoor applications.
   2. Armored Plenum OSP-rated for underground/aerial runs.
D. Rodent Protection:
   1. Must include interlocking armor or non-metallic rodent-resistant sheathing.
E. Sheath Color:
   1. All Fiber Types: Black
   2. OS2 (Single-mode): Yellow

3. OM3/OM4 (Multimode): Aqua
4. OM5 (Multimode): Lime Green

F. Max Outer Diameters:
1. 6 fibers – 0.69 in (17.38 mm)
2. 12 fibers – 0.69 in (17.38 mm)
3. 24 fibers – 0.76 in (19.25 mm)
4. 48 fibers – 1.06 in (26.84 mm)

2.5 MTP TRUNK CABLES

2.5.1 Application

A. Provides high-density backbone fiber connectivity between LIUs, cassettes, and network equipment.
B. Used to interconnect factory-terminated MTP cassettes, fusion splice cassettes, and other equipment.
C. All MTP trunk cables shall be compatible with the fiber optic cassettes listed in 2.5.
D. All MTP trunk cables shall use Universal Polarity and be compatible with Leviton Universal Polarity cassettes.
E. MTP trunk cables shall only be used under specific circumstances and must be approved by the ITS department project manager prior to use.
F. Shall be pre-terminated and pre-tested, with test documentation available upon request.

2.5.2 Construction & Features

A. MTP trunk cables shall be available in Base-8, Base-12, and Base-24 configurations to support a range of fiber applications.
B. MTP connectors shall mate to key up/key down adapters to ensure consistent polarity alignment.
C. All cables shall be factory-terminated and custom-built in any length with a standard breakout length of 0.5m, with other lengths configurable.
D. Cable Jacket Rating:
1. Indoor Installations: Plenum-rated (OFNP).
2. Outdoor/Underground Installations: Must be Plenum OSP-rated or Plenum Indoor/Outdoor-rated.
3. Armored MTP Trunks: Must meet the same plenum/OSP rating requirements as non-armored trunks and include rodent protection.
E. Cable Jacket Colors:
1. OS2 Single-mode MTP-UPC: Yellow
2. OM3/OM4 Multimode MTP-UPC: Aqua
3. OM5 Multimode MTP-UPC: Lime Green
4. OSP or Indoor/Outdoor Jackets: Black (with appropriate labeling).
F. Connector Colors (Per ANSI/TIA-568.3-D):
1. OS2 Single-mode LC-UPC and MTP-UPC: Blue
2. OM3/OM4 Multimode LC-UPC and MTP-UPC: Aqua
3. OM5 Multimode LC-UPC and MTP-UPC: Lime Green
G. G. MTP Connector Boot Colors (For Fiber Count Identification):
1. 8-fiber MTP: Gray
2. 12-fiber MTP: Black
3. 24-fiber MTP: Red
H. Pulling eyes shall be available as an option to protect fibers during installation.
I. MTP trunk cables shall include strain relief and bend-radius control mechanisms to protect fiber integrity.

2.5.3 Connector Interfaces

A. MTP-UPC connectors only

2.5.4 Performance Requirements

A. MTP trunk cables shall meet the following minimum return loss requirements:

1. Single-mode (OS2): ≥ 60 dB
2. Multimode (OM4/OM5): ≥ 20 dB

B. Base-8, Base-12, and Base-24 fiber configurations shall be supported while maintaining ultra-low-loss performance for data center and backbone applications.

2.5.5 Installation Requirements

A. Must support tool-less installation into LIUs, cassettes, and other equipment.
B. Shall allow for multiple trunk cables to be connected in a channel without polarity mismatches.
C. All cables shall be labeled to ensure proper identification during installation and maintenance, including:
1. Trunk label on each end (showing fiber count, polarity, length, and serial number).
2. Leg label on each breakout fiber for easy identification.

2.6 LC TRUNK CABLES

2.6.1 Application

A. Provides factory-terminated horizontal fiber connectivity between Station LIUs and wall outlets.
B. Used to connect multiple work area ports from the station-side LIU. C. LC Trunk Cables shall:
1. Be factory-terminated and pre-tested.
2. Have LC connectors at both ends.
3. Be available in 1-pair (2 fibers), 2-pair (4 fibers), 4-pair (8 fibers), or 6-pair (12 fibers) configurations.

2.6.2 Construction & Features

A. All LC trunk cables shall:
1. Be factory-terminated and fully tested prior to shipment.
2. Support flexible deployment with custom cable lengths available based on site needs.
3. Maintain a standard breakout length of 0.5 meters at each end unless otherwise specified.
B. Cable Jacket Ratings:
1. Indoor Installations: Must be Plenum-rated (OFNP).
2. Outdoor/Transition Spaces: Must be Plenum OSP-rated or Plenum Indoor/Outdoor-rated.
C. Jacket Colors:
1. OS2 Singlemode: Yellow
2. OM3/OM4 Multimode: Aqua
3. OM5 Multimode: Lime Green
4. Outdoor/Indoor Trunks: Black (with color-coded connectors per fiber type).
D. Connector Housing Colors (per ANSI/TIA-568.3-D):
1. OS2 Singlemode LC-UPC: Blue
2. OM3/OM4 Multimode LC-UPC: Aqua
3. OM5 Multimode LC-UPC: Lime Green E. Pulling Eyes:
E. Pulling eyes shall be available and installed when trunk cables must be routed through conduit pathways. F. Cables shall include integrated strain relief boots and maintain minimum bend radius control.

2.6.3 Connector Interfaces

A. LC-UPC duplex connectors on both ends.
B. LC connectors must:
1. Be factory-polished and inspected.
2. Meet performance requirements for insertion loss and return loss appropriate to OS2, OM4, or OM5 fibers.

2.6.4 Performance Requirements

1. Minimum performance specifications:
- Singlemode (OS2) LC trunks: Return loss ≥ 50 dB.
- Multimode (OM4/OM5) LC trunks: Return loss ≥ 30 dB.

- Insertion Loss: ≤ 0.35 dB per mated LC connector pair.

2.6.5 Installation Requirements

A. LC trunk cables must:
   1. Support tool-less installation into wall plates and patch panels.
   2. Be installed without damaging jacket, connectors, or cable strength members.
   3. Be labeled on both ends including:
   4. Trunk ID
   5. Fiber count
   6. Fiber type (SM/MM)
   7. Polarity marking

B. Cable management shall maintain minimum bend radius and provide strain relief at termination points.

2.7 FIBER OPTIC PATCH PANELS & ENCLOSURES (LIU)

2.7.1 Application

A. Provides fiber termination, splicing, and patching capability for backbone fiber cabling within MDF, BDF, and IDF locations.

2.7.2 Enclosure Requirements

A. Main Distribution Frame (MDF) & Building Distribution Frame (BDF):
   1. Shall support a minimum of 24 slots for fiber splice cassettes.
   2. Shall be a high-density rack-mounted enclosure compatible with standard 19-inch EIA racks.
   3. Shall provide front and rear access for ease of fiber management.
   4. Shall allow for both patching and splicing in a single chassis.
   5. Must support fusion splice modules with internal fiber routing protection.
   6. Shall allow for tool-less installation of fusion splice cassettes.
   7. Enclosures with sliding trays shall be available in 2RU, 3RU, and 4RU versions that accommodate termination of up to 192, 288, or 384 fibers respectively (using LC connectors).
   8. Individual sliding trays shall have a forward stop and be completely removable.

B. Intermediate Distribution Frame (IDF):
   1. Shall support a minimum of 3 slots for fusion splice cassettes.
   2. Shall be a compact rack-mounted enclosure compatible with standard 19-inch EIA racks.
   3. Shall provide front and rear access for ease of fiber management.
   4. Must support only fusion splice cassettes for secure termination of backbone fibers.
   5. 1RU and 2RU versions shall have the ability to retrofit to High Density via replacement of the sliding tray.
   6. The enclosure shall accept a conversion adapter bracket to accommodate higher-density fusion splice cassettes.

C. Wall-Mounted LIU
   1. A wall-mounted LIU shall be used solely for terminating the station-side fiber optic cables unless otherwise specified by the ITS Department Project Manager.
   2. Shall be used for low-density fiber installations where rack-mounted LIUs are not feasible.
   3. Shall be compatible with:
      - Factory-terminated HDS cassettes
      - HDX fusion splice cassettes
   4. Shall support interconnect or cross-connect applications while minimizing wall space usage.
   5. Must be lockable, with a key/lock kit available for security.
   6. Must provide fiber routing, slack storage, and bend-radius protection for:
      - Tight-buffered fiber
      - Backbone cables
      - Fusion-spliced fibers

7. Must support strain relief and dust protection, including:
   - Removable cable entry/exit grommets
   - Optional cable strain-relief mounting kit
8. Shall not be used for MDF, BDF, or IDF installations.

2.7.3 Construction & Features

A. Material:
   1. Shall be constructed of 16-gauge steel or aluminum with a powder-coated finish for durability and corrosion resistance.
B. Cable Management:
   1. Shall include strain relief brackets, fiber routing spools, and bend-radius control.
   2. Shall provide top, bottom, or rear cable entry for flexible routing.
   3. Rear fiber cable management rings shall be stackable and configurable in ¼, ½, or full ring arrangements to simplify cable routing and organization.
   4. Fiber cable routing and protection shall include patch cord cable managers at entry/exit points, multiple tie-down points for rear cable management, optional dust brush guards at rear cable entry points, and a cable strain-relief kit for incoming backbone fiber.
C. Sliding Trays & Component Access:
   1. All LIUs shall have sliding trays.
   2. Individual sliding trays shall have a forward stop and be completely removable.
   3. Sliding tray shall remove completely from the enclosure to facilitate field terminations and splicing.
   4. Installation and removal of all sliding trays and fusion splice cassettes shall be achieved via one-handed operation.
D. Splicing Support:
   1. Shall accommodate fusion splice trays with support for 12, 24, or 48 fibers per tray.
   2. Splice trays shall be designed for heat-shrink splice sleeves (40mm or 60mm lengths).
   3. Must provide fiber slack storage and bend radius protection.
E. Labeling & Identification:
   1. Must include port labeling compliant with ANSI/TIA-606-D.
   2. Must feature machine-printed, permanent labels for easy port identification.
F. Enclosure Design & Security Features:
   1. Enclosures shall have removable front and rear covers for better access to the interior of the enclosure.
   2. Enclosures shall include removable rubber grommets that allow for pre-terminated fiber trunk installation, protection of cable, and minimized dust build-up.
   3. Enclosures shall include front and rear latching doors (optional locking mechanism available).
   4. Must allow for secured access to fiber terminations and splices.
   5. Rack-mount optical fiber enclosure shall provide bend-radius control throughout the enclosure, as well as storage space for slack cabling.

2.8 FIBER OPTIC CASSETTES

2.8.1 Fusion Splice Cassettes

A. Application
   1. Provides a modular, high-density solution for fiber termination within LIUs specified in 2.4.
   2. Designed for on-site field splicing of fiber terminations.
   3. Used for direct fiber splicing inside LIUs for permanent fiber connections.
   4. Shall be pre-loaded and routed with respective color-coded fiber pigtail assemblies.
   5. Provided pigtail assemblies shall be preconfigured to allow for termination to loose tube, tight-buffered, or ribbon fiber cables without modification or replacement.
B. Construction & Features
   1. Available in 12-fiber LC-UPC and 36-fiber MTP configurations for OS2, OM4, and OM5 fiber types.
   2. Cassette housing shall be polycarbonate for durability and lightweight construction.
   3. Splice module shall provide slack storage and bend radius protection for:

- Incoming backbone fibers
- 900 µm tight-buffered fibers
- Fusion-spliced fibers

4. Incoming 250 µm or ribbon backbone fibers shall be protected by a braided mesh sleeve.
5. Shall support heat-shrink fusion splice sleeves (40mm or 60mm lengths).
6. Shall include the following splice protection materials:
   - Heat-shrink style splice sleeves
   - Ribbon splice sleeve
   - Braided mesh sleeve
   - Tie wraps
7. LC adapters shall use ceramic ferrules and shall provide an IP5X-rated internal shutters, compliant with IEC 60529, that open and close automatically with the insertion and removal of LC connectors.

C. Connector Interfaces
1. Shall support LC-UPC and MTP-UPC adapters
2. Connector ports shall be color-coded per ANSI/TIA-568.3-D:
   - OS2 Single-mode LC-UPC: Blue
   - OM3/OM4 Multimode LC-UPC: Aqua
   - OM5 Multimode LC-UPC: Lime Green

D. Performance Requirements:
1. Maximum insertion loss:
   - Single-mode (OS2) LC-UPC: ≤ 0.35 dB
   - Single-mode (OS2) MPO: ≤ 0.75 dB
   - Multimode (OM3/OM4) LC-UPC: ≤ 0.25 dB
   - Multimode (OM3/OM4) MPO: ≤ 0.50 dB
2. Return loss:
   - Single-mode: ≥ 50 dB
   - Multimode: ≥ 30 dB

E. Installation Requirements:
1. Shall allow for fusion splicing inside the cassette without requiring additional components.
2. Must include strain relief and bend-radius control mechanisms.

2.8.2 Factory-Terminated Cassettes

A. Application
1. Designed for pre-terminated fiber trunk systems where factory-controlled termination is required within LIUs specified in 2.4.
2. Used for high-density fiber patching without field splicing.
3. Shall be pre-terminated and pre-tested, with test documentation available upon request.

B. Construction & Features
1. Pre-loaded with LC-UPC or MTP-UPC terminations for rapid deployment.
2. Available in Base-8, Base-12, and Base-24 MTP configurations.
3. MTP connectors shall mate to key up/key down adapters on the rear of the cassette.
4. LC adapters shall use ceramic ferrules and provide an IP5X-rated internal shutters, compliant with IEC 60529, that open and close automatically with the insertion and removal of an LC connector.
5. Cassettes shall include an integrated fiber slack manager for proper routing.
6. Cassette housing shall be flame-retardant, high-impact plastic or powder-coated steel.
7. Must include pre-installed dust caps to prevent contamination.

C. Connector Interfaces
1. Factory-terminated cassettes shall support LC-UPC or MTP-UPC terminations only.
2. MTP cassettes shall use universal polarity and must be compatible with existing Leviton Universal Polarity cassettes and shall allow for multiple cassettes to be connected in a channel.
3. Connector ports shall be color-coded per ANSI/TIA-568.3-D:
   - OS2 Single-mode LC-UPC: Blue

- OM3/OM4 Multimode LC-UPC: Aqua
- OM5 Multimode LC-UPC: Lime Green

D. Performance Requirements
   1. Multimode Cassettes:
      - Base-12 MTP-to-LC: ≤ 0.35 dB insertion loss
      - Base-24 MTP-to-LC: ≤ 0.50 dB insertion loss
      - Base-12 MTP-to-MTP: ≤ 0.55 dB insertion loss
      - Base-24 MTP-to-MTP: ≤ 0.75 dB insertion loss
   2. Single-Mode Cassettes:
      - Base-12 MTP-to-LC: ≤ 0.50 dB insertion loss
      - Base-24 MTP-to-LC: ≤ 0.50 dB insertion loss
      - Base-24 MTP-to-MTP: ≤ 0.75 dB insertion loss
   3. Return Loss:
      - LC-UPC (Single-mode): ≥ 50 dB
      - Multimode LC-UPC: ≥ 30 dB

E. Installation Requirements
   1. Must include strain relief and bend-radius control mechanisms.

2.9 WALL OUTLET TERMINATION

2.9.1 Keystone Jack Requirements

A. Wall outlets shall use LC-type fiber keystone jacks.
B. LC keystone jacks must:
   1. Be internal-shuttered for dust and contamination protection.
   2. Be compatible with standard Leviton-style faceplates and mounting hardware.
   3. Match fiber type color coding per ANSI/TIA-568.3-D:
      - Aqua shutters for OM4 multimode.
      - Blue shutters for OS2 singlemode.
C. Keystone jacks shall maintain proper alignment, strain relief, and polarity control as part of the structured cabling system.
D. Field-term terminated LC jacks are not permitted — only factory pre-terminated trunk assemblies are allowed.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 All horizontal fiber installations shall comply with:

A. Section 27 13 23 – Communications Optical Fiber Backbone Cabling (for fiber material, handling, fusion splicing, and routing requirements).
B. Section 27 05 28 – Pathways for Communications Systems.
C. Section 27 05 50 – Communications Documentation & Submittals.
D. Section 27 05 53 – Identification for Communications Systems.

3.1.2 Installation practices must follow:

A. ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard.
B. BICSI ITSIM and TDMM best practices.
C. Manufacturer guidelines for cable handling, fusion splicing, and connector installation.

3.1.3 Contractor must ensure:

A. All fiber cables are installed without exceeding minimum bend radius and pulling tension.
B. Service loops are included at both ends of the fiber route:

C. Minimum 10 feet of service loop at the IDF LIU and the Station LIU.
D. All labeling and documentation are complete prior to punch walk.

3.2 PERMANENT LINK DEFINITION

3.2.1 The Permanent Link shall extend:

A. From the IDF/BDF/MDF LIU (main fiber enclosure)
B. Through the horizontal pathway
C. To the Station LIU (small ceiling-mounted fiber enclosure above ceiling).

3.2.2 From the Station LIU to the wall outlet:

A. A factory-terminated LC duplex trunk cable shall be routed down the wall cavity.
B. The trunk shall terminate at a Leviton-compatible faceplate using LC keystone jacks.

3.2.3 Fiber pathways from Station LIUs to wall outlets must:

A. Follow all routing, protection, and support requirements per Division 27 standards.
B. Maintain separation from power circuits and high-voltage cabling as required by NEC and ANSI/TIA standards.

3.3 HORIZONTAL FIBER HANDLING & SERVICE LOOPS

3.3.1 Minimum service loop requirements:

A. 10 feet (3 meters) of slack shall be provided at both the IDF/BDF/MDF LIU and the Station LIU.
B. Slack shall be neatly coiled, secured, and protected inside the respective enclosure.

3.3.2 Slack management must:

A. Maintain minimum bend radius for the fiber type.
B. Avoid tight coiling, kinking, or compression against enclosure walls or doors.

3.3.3 Excess slack at wall outlets shall be minimized; no more than 12 inches of slack permitted behind wall plates.

3.4 TESTING & VERIFICATION

3.4.1 Certification testing shall be performed on:

A. IDF/BDF/MDF LIU to Station LIU (fiber permanent link).
B. IDF/BDF/MDF LIU to final Station Outlet port (complete installed trunk connection).

3.4.2 Testing Requirements:

A. Testing must comply with Section 27 05 86 – Testing of Communications Systems.
B. Tests must verify insertion loss and return loss meet performance criteria for installed fiber type (OS2, OM4, or OM5).
C. Both links (LIU to LIU and LIU to Station Port) must individually pass certification prior to system acceptance.

3.4.3 Testing Deliverables:

A. Full electronic test results organized by cable ID and station location.
B. Certification results shall be submitted prior to scheduling final punch walk.
C. Failed links must be repaired or replaced and retested at no additional cost to the District.

3.5 SYSTEM ACCEPTANCE & CLOSEOUT

3.5.1 Systems shall not be considered complete until:

A. All fiber links are certified and test results approved.

B. All labeling is verified and matches the As-Built documentation.
C. Required service loops are verified at all locations.
D. All station ports and wall plates are installed, tested, and properly labeled.
E. GIS mapping data for Station LIUs and station outlets is submitted per Section 27 05 50.

3.5.2 Final Closeout Deliverables:

A. Certification test results.
B. Updated cable routing and labeling diagrams.
C. Warranty registration documentation (if applicable).

3.5.3 Contractor shall provide necessary test equipment during punch walk at no additional cost to the District.

END OF SECTION

SECTION 27 20 00 - DATA COMMUNICATION

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section specifies the furnishing, installation, configuration, and documentation of active data communications equipment and associated components, including:

A. Network switches (core, distribution, edge).
B. Wireless access points (WAPs).
C. Firewalls and security appliances.
D. Media converters and wireless bridges (when approved).
E. Related IP networking devices for VLAN, routing, or policy enforcement.

1.1.2 The Contractor shall provide a complete, functional, turnkey data communications system. This includes furnishing, installing, labeling, configuring, and documenting all materials, cabling, devices, equipment, and accessories required to deliver a fully operational, District-approved solution, unless specifically noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.1.3 All patch panel ports associated with data communications shall be patched on a one-to-one basis with switch ports. Where a new patch panel is installed, a corresponding switch shall also be installed unless otherwise specified in the contract documents or approved in writing by the District ITS Project Manager.

1.1.4 The District has standardized on the following systems as the basis of design:

A. Systems:
   1. Cisco for all routing and switching infrastructure
   2. Aerohive (now Extreme Networks) for wireless access point systems
B. All equipment proposed must be fully compatible with the existing District network architecture and operational requirements.
C. If a proposed system is incompatible with the District's current infrastructure, the Contractor shall be responsible for replacing or upgrading all impacted District equipment to ensure full compatibility.
D. All substituted systems shall include an equal or superior manufacturer-backed warranty and shall not void any existing District warranties and must be approved by the ITS Department Project Manager.

1.1.5 The District's network infrastructure is governed by a design philosophy focused on high reliability, manageability, and long-term sustainability. All systems must integrate with the District's existing operational model, and equipment must be configured to ensure consistency, lifecycle support, and ease of maintenance. Design decisions shall support scalable performance, standardized architectures, and future-proofing wherever practicable.

1.1.6 This Section must be implemented in conjunction with the shared installation standards and requirements defined in:

A. Section 27 15 00 – Communications Horizontal Cabling
B. Section 27 05 50 – Communications Documentation & Submittals
C. Section 27 11 00 – Communications Equipment Room Fittings
D. Section 27 50 00 – Audio-Video Communications (for AV system integration)
E. Division 27 – Communications
F. Division 28 – Electronic Safety and Security

1.1.7 All work shall comply with District standards, project contract documents, applicable national and local codes, and current industry best practices.

1.1.8 In the event of a conflict between District standards and referenced industry standards or codes, the more stringent requirement shall apply. Clarifications or exceptions must be approved in writing by the District ITS Department Project Manager.

1.2 RELATED SECTIONS

1.2.1 Contractor is responsible for complying with all Division 27 and Division 28 sections and requirements in their entirety. For a complete list of sections, refer to Section 27 00 00 – Communications.

1.2.2 Specific Related Sections include but are not limited to:

A. 27 00 00 – Communications
B. 27 05 50 – Communications Documentation & Submittals
C. 27 05 53 – Identification for Communications Systems
D. 27 06 50 – Communications Equipment & Materials Schedule
E. 27 11 16 – Communications Racks, Cabinets, and Enclosures
F. 27 13 23 – Communications Optical Fiber Backbone Cabling
G. 27 15 14 – Communications Copper Horizontal Cabling
H. 27 15 23 – Communications Optical Fiber Horizontal Cabling
I. 27 50 00 – Audio-Video Communications
J. Division 28 – Electronic Safety and Security

1.3 REFERENCES

1.3.1 The installation and configuration of data communications equipment shall comply with the latest editions of the following standards unless otherwise noted in District standards. Where conflicts exist, the more stringent standard shall govern unless otherwise approved in writing by the District ITS Department Project Manager.

A. ANSI/TIA-569-E – Telecommunications Pathways and Spaces
B. ANSI/TIA-606-D – Administration of Telecommunications Infrastructure
C. ANSI/TIA-607-D – Grounding and Bonding for Communications
D. BICSI ITSIM and TDMM
E. IEEE 802.3 – Ethernet Standards (e.g., 10/100/1000BASE-T, PoE)
F. IEEE 802.11 – Wireless LAN Standards
G. NFPA 70 (NEC), including Articles 800 and 725 as applicable
H. FCC Title 47, Part 15 – Radio Frequency Devices (EMC compliance)
I. Local authority having jurisdiction (AHJ)

1.4 SUBMITTALS

1.4.1 Submittals for data communications shall be documented per Section 27 05 50 – Communications Documentation & Submittals and additional requirements within this Section.

1.4.2 General Submittals:

A. Product data sheets for installed products.
B. Sample labels for equipment consistent with Section 27 05 53.
C. Device Information Including:
    1. Manufacture
    2. Model Number
    3. Host Name
    4. IP Address
    5. Install Location
    6. Serial Number
    7. District Asset Tag Number
D. Final configuration
E. Warranty documentation and proof of registration with manufacturer if required for warranty.

F. Latest Software / Firmware for devices being installed
G. Software licenses and product keys

1.5 QUALITY ASSURANCE

1.5.1 All configuration shall be performed by technicians trained and certified for the equipment they are installing.

1.5.2 Technicians shall be certified by equipment manufacturer where required for warranty.

1.5.3 All components shall be installed and configured in accordance with the manufacturer's guidelines, ANSI/TIA standards, and BICSI best practices.

1.6 WARRANTY AND SOFTWARE SUPPORT REQUIREMENTS

1.6.1 The Contractor shall furnish warranties as required by the individual specification sections and Division 01.

A. The District requires a minimum five (5) year manufacturer warranty on all equipment, regardless of whether it is new, used, or refurbished.
B. The warranty period shall begin on the earlier of the following, unless otherwise approved in writing by the District ITS Department Project Manager:
   1. The date the District issues a Notice of Substantial Completion, or
   2. The date the District issues a Notice of Completion.
C. For the purpose of this specification, substantial completion is defined as the point at which all of the following conditions are met:
   1. All equipment provided under this project has been installed, configured, and tested.
   2. The system or infrastructure is fully operational and capable of being used for its intended purpose.
   3. For projects involving buildings or construction, the District must have the option to occupy and utilize the building or affected space(s), even if final completion or closeout activities are still pending.
   4. The District ITS Department Project Manager has reviewed and approved the network and equipment for use.
D. Product warranties for all furnished equipment shall have a common start and end date, consistent with the effective warranty period defined above.
E. Software licenses, support subscriptions, and associated services for any furnished equipment shall meet the following requirements:
   1. They shall have the same start date as the warranty period.
   2. They shall be active and valid for the full required duration.
   3. They shall extend no less than five (5) years from the date of substantial completion.
   4. They shall be coterminous with the hardware warranty period.
   5. Unless otherwise approved in writing by the District ITS Project Manager, all subscriptions and support services must be provided in full.
F. The District ITS Project Manager reserves the right to reduce or waive the subscription term requirement if the features or services covered by the subscription are not intended to be used by the District.
G. The required five (5) year warranty shall include, at a minimum:
   1. Hardware failure coverage, including advance replacement services.
   2. On-site technical support where required for service or replacement.
   3. Software and firmware updates, including subscription-based or cloud-delivered services, to maintain security, compatibility, and performance for the duration of the five (5) year warranty.
   4. Unless otherwise specified and approved in writing by the ITS Department Project Manager, all warranties shall provide parts-in-hand by the next business day following diagnosis or service request.
H. The Contractor shall be fully responsible for ensuring that the required warranty is provided, including supplementing or extending the manufacturer's default warranty if necessary, to meet the requirements of this Section.

1.6.2 Final warranty documentation and proof of registration with the manufacturer, if required for manufacture warranty, shall be submitted per Section 27 05 50 – Communications Documentation & Submittals.

PART 2 - PARTS

2.1 GENERAL

2.1.1 All products shall comply with the requirements outlined in this Section and all applicable standards listed in Part 1. At a minimum, this includes:

A. NEC (NFPA 70)
B. Applicable UL listings

2.1.2 All products installed must be compatible with existing District systems, or all affected existing District systems must be replaced with an approved replacement option.

2.1.3 Licensing Requirements:

A. Products shall be provided with perpetual licenses unless specifically noted otherwise in this Section.
B. Devices requiring subscriptions for required functionality are not permitted unless approved in writing by the ITS Department Project Manager.
C. For products that have additional features that require a subscription, failure to renew subscription shall only affect non-required/optional functionality.

2.2 PRE-APPROVED MATERIALS

2.2.1 Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved cable types and manufacturers.

2.2.2 Products listed in 27 06 50 do not require additional approval.

2.2.3 Any proposed substitutions, or products or cable types not explicitly listed in Section 27 05 60, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 The following products are strictly prohibited:

A. Devices not compliant with the National Defense Authorization Act (NDAA)
B. Products lacking manufacturer support or without firmware update capability
C. Devices that conflict with the District's operational or security policies
D. Devices with factory passwords that cannot be changed or disabled

2.4 OPTICS/TRANCEIVERS

2.4.1 General Requirements

A. All transceivers shall:
   1. Be manufacturer-certified for the device in which they are installed
   2. Support required link speeds (1G, 10G, 25G, 40G, 100G, etc.)
   3. Comply with IEEE 802.3 standards
   4. Be fully compatible with the District's network switching/routing platforms
   5. Be covered under the manufacturer's warranty and must not void the warranty of any associated hardware
B. Transceivers must match the installed fiber infrastructure, including fiber type (single-mode or multimode), link distance, and connector interface.
C. Optics shall use UPC-polished duplex connectors, with LC or MTP interfaces unless otherwise specified.
D. Specialty optics (e.g., CWDM, DWDM, BiDi) may be required for unique applications such as extended reach or fiber-limited conditions. These shall be reviewed and approved by the District ITS Department Project Manager.

2.4.2 Default Optic Specifications

A. Default Fiber Type
   1. Single-mode optics shall be used as the default for all uplink connections unless the installed permanent horizontal fiber link is multimode.
   2. Multimode optics may be used only where OM3 or OM4 fiber is installed and link lengths remain within supported distances.

B. Default Uplink Speed
   1. 1G (1000BASE-LR) optics shall be used when the IDF or BDF supports 192 or fewer horizontal data outlet terminations (i.e., patch panel ports)
   2. 10G (10GBASE-LR) optics shall be used when the IDF or BDF supports more than 192 horizontal data outlet terminations, or where otherwise required by project scope, network design, or the District ITS Department Project Manager.

C. Deviations from the default fiber type or optic speed must be approved in writing by the District ITS Department Project Manager and documented in the project record.

2.4.3 Single Mode Optical Transceivers:

A. Single mode optics shall be the default method of interconnecting network devices over fiber unless otherwise required by the fiber infrastructure or project scope.
B. All single mode optics shall be duplex, utilize LC or MTP connectors, and use UPC polish unless otherwise specified.
C. Where long-distance, campus-wide, or inter-building connections are required, long-reach (LR), CWDM, or DWDM optics may be specified based on engineering design and approved by the ITS Department Project Manager.
D. All single mode optics must match the optical and connector type of the installed fiber infrastructure.

2.4.4 Multimode Optical Transceivers:

A. Multimode optics shall only be used when the existing or newly installed fiber infrastructure is multimode.
B. All multimode optics shall be duplex, utilize LC or MTP connectors, and use UPC polish unless otherwise specified.
C. Optical type and specifications must match the installed multimode fiber class (OM3, OM4, OM5, etc.) and distance limitations.
D. All multimode optic must match the optical and connector type of the installed fiber infrastructure.

2.4.5 Copper Transceivers (e.g., 1000BASE-T SFP Modules)

A. Copper transceivers shall only be used under special circumstances and must be approved in writing by the District ITS Department Project Manager.
B. Copper transceivers must be manufacturer-certified for use in the installed device and fully covered under the applicable equipment warranty.
C. Maximum link distances shall comply with ANSI/TIA standards for Category cabling.

2.4.6 Twinax (Direct Attach Copper) Cables (DAC):

A. Only passive DAC cables are permitted for use.
B. DAC cables may only be used under limited circumstances and must be explicitly approved in writing by the District ITS Department Project Manager prior to procurement or installation.
C. All DAC cables shall:
   1. Be certified by the equipment manufacturer for compatibility with the connected hardware
   2. Not exceed 5 meters in length
   3. Be fully supported under the device's warranty and management systems

2.5 SWITCHES

2.5.1 General Requirements

A. All switches shall be enterprise-grade and support the following at minimum:

1. SSH and Console Access – Secure remote management and local configuration access.
2. SNMP v1, v2, and v3 – For integration with District monitoring systems.
3. 802.1Q VLAN Tagging and Trunking – Including automatic voice VLAN configuration.
4. VTP (VLAN Trunking Protocol) – Support for VTP version 1, 2, and 3.
5. DHCP Snooping – To prevent unauthorized DHCP servers.
6. Dynamic ARP Inspection (DAI) – For prevention of ARP spoofing attacks.
7. Port Security and MAC Address Limiting – Configurable per port.
8. CDP and/or LLDP – For device discovery and inventory.
9. QoS (Quality of Service) – For traffic prioritization.
10. Granular User Permissions – Role-based access for administrative control.
11. Logging and Syslog Support – Configurable severity and destinations.
12. Spanning Tree – To prevent network loops.

2.5.2 Core Switches

A. Chassis-Based Architecture
   1. Core switches shall utilize a modular chassis design to support scalability and future expansion.
   2. All components including line cards, supervisors, and power supplies shall be hot-swappable.
   3. The current basis of design for the District's core switching platform is the Cisco Catalyst 6500-E Series. Equivalent systems may be proposed only if they are fully compatible with the existing network architecture and meet or exceed all functional and performance requirements outlined in this Section.

B. Power Supplies
   1. Shall support N+1 redundancy.
   2. Power supplies shall be hot-swappable and auto-sensing for 110/220 VAC.

C. Supervisors
   1. Dual supervisor support is required for high availability unless otherwise specified.
   2. Supervisors shall be fully redundant and support in-service software upgrades (ISSU) where applicable.

D. Line Cards – Copper
   1. Copper line cards shall provide 1G and/or 10G RJ-45 ports with PoE/PoE+ capability on all ports.
   2. PoE++ (Type 3 or Type 4) support shall be available if required by project scope.
   3. All line cards must be fully compatible with the existing District infrastructure and core switching systems.

E. Line Cards – Fiber
   1. Fiber line cards shall support 1G, 10G, 25G, or higher SFP/SFP+/QSFP+ ports as required.
   2. All fiber ports shall comply with the transceiver and optical cabling standards in Section 2.4.
   3. Line cards must support single mode and multimode optics as required by the project.
   4. All line cards must be fully compatible with existing fiber optic network design and switching platforms.

F. Layer 3 Functionality and Network Services
   1. Core switches shall provide full Layer 3 routing functionality for both IPv4 and IPv6.
   2. Must support dynamic routing protocols, including EIGRP, OSPF, BGP, and static routing.
   3. Shall support advanced Access Control Lists (ACLs) for security and traffic management.
   4. Must support Quality of Service (QoS) features, including classification, marking, queuing, and congestion avoidance.
   5. Route summarization, redistribution, and ACL-based routing must be supported.

2.5.3 Edge Switches

A. General Requirements
   1. All edge switches shall be 48-port models.
   2. Switches shall be stackable, allowing for a minimum of four (4) switches per stack under a single management domain.
   3. Switches shall support 1G/10G uplinks via SFP+ ports.
   4. All models must be compatible with existing District systems and software platforms.
   5. All switches shall include physical mounting provisions suitable for standard 19-inch equipment racks.

B. Power Supply and Reliability
1. Power supplies shall be internal, hot-swappable, and auto-switching between 110 and 220 VAC.
2. Switches shall support redundant power supply configurations.
3. Fans, if present, shall also be hot-swappable.
4. Switches shall continue full operation during replacement of redundant components.

C. Project-Dependent Functionality
1. Audio Video Bridging (AVB):
   - When specified in the project scope, switches shall support AVB standards (IEEE 802.1AS, 802.1Qav, 802.1Qat).
   - Native support or license-based activation must be declared in the submittal package.
2. Layer 3 Routing:
   - When required, switches shall support Layer 3 routing, including static routing and dynamic protocols such as OSPF.
   - Switches must support inter-VLAN routing and routing interfaces (SVIs).
   - Layer 3 functionality must be license-enabled or included as standard and clearly documented.
3. Specialized Industrial Switches:
   - In environments with extreme dust, dirt, or temperature fluctuations, specialized industrial switches may be specified.
   - These switches must be rated for harsh environmental conditions and capable of reliable operation under such conditions.
   - Minimum requirements for industrial switches:
     ◊ Minimum of 8 ports
     ◊ Minimum of 1G uplinks
     ◊ Stackability is not required
     ◊ Redundant power supplies are not required
     ◊ 10G uplinks are not required unless otherwise specified
   - Use of industrial switches must be approved by the District ITS Department Project Manager based on environmental and application-specific conditions.

2.6 ROUTERS

2.6.1 General Requirements

A. Power
1. Routers shall support auto-switching 110/220 VAC input with a supported voltage range of 100VAC to 250VAC.
2. Power supplies shall be hot-swappable and capable of redundant configurations where required by project scope or network design.

B. Functionality
1. Must support and route both IPv4 and IPv6 traffic natively.
2. Required routing protocol support includes:
   - Enhanced Interior Gateway Routing Protocol (EIGRP)
   - Open Shortest Path First (OSPF)
   - Border Gateway Protocol (BGP)
3. Routers shall support advanced packet filtering, firewall rules, and configurable Access Control Lists (ACLs).
4. Quality of Service (QoS) must be supported for prioritization of voice, video, and critical data traffic.

C. Management and Monitoring
1. Secure access for configuration shall be supported via SSH and direct console connection.
2. A dedicated out-of-band 100Mbps Ethernet management port is required.
3. Dynamic VLAN provisioning shall be supported via VLAN Trunking Protocol (VTP), where applicable.
4. SNMP v1, v2c, and v3 shall be supported for network monitoring and integration with existing network management platforms.

5. Routers must support both local and centralized authentication mechanisms using RADIUS and TACACS+.

2.6.2 Network Routers

A. Network routers shall be enterprise-grade and designed to support core, distribution, or edge applications based on the network topology.
B. B. All routers must support the following baseline features:
   1. High-throughput routing for large-scale campus environments.
   2. Dynamic routing with full support for EIGRP, OSPF, and BGP.
   3. Advanced QoS features to ensure traffic prioritization and bandwidth management.
   4. Access Control Lists (ACLs) for traffic filtering and segmentation.
   5. NAT and PAT capabilities for network edge and inter-VLAN routing scenarios.
   6. Support for IPv6 dual-stack and transition technologies.
   7. Redundant hardware and software features (e.g., high availability protocols like HSRP or VRRP).
C. Routers serving as data center or core aggregation points shall support multiple high-speed WAN or fiber interfaces (10G or greater), modular uplinks, and chassis-based scalability when required.

2.6.3 Voice Routers

A. A. Interface Support
   1. Voice routers shall support the following telephony interfaces as required by project scope:
      - T1/PRI digital trunk interfaces
      - Foreign Exchange Subscriber (FXS) analog ports
      - Foreign Exchange Office (FXO) analog ports
B. Compatibility
   1. Voice routers must be fully compatible with Cisco Unified Communications Manager (CUCM) and operate as certified voice gateways within the existing District voice architecture.
   2. Must support protocols necessary to enable fax transmission and legacy modem functionality over IP, such as T.38 and fallback to G.711 passthrough.
C. Licensing
   1. All necessary licenses for voice functionality—including, but not limited to, DSP resources, Survivable Remote Site Telephony (SRST), and analog/digital telephony services—shall be pre-installed and included in the base equipment cost.
   2. No additional post-installation licensing shall be required to enable full voice feature functionality.
D. Survivability and Emergency Operation
   1. Routers must support Cisco Survivable Remote Site Telephony (SRST) functionality.
   2. Voice routers shall be capable of serving as the site's backup emergency call manager in the event of WAN failure or loss of connectivity to the central voice system.

2.6.4 Voice Gateways

A. Compatibility and Integration
   1. Voice gateways shall be fully compatible with Cisco Call Manager and integrate seamlessly with the District's existing VoIP infrastructure.
   2. Gateways must support Session Initiation Protocol (SIP), H.323, and other required protocols for VoIP interoperability, including legacy systems if applicable.
B. Analog Support
   1. Each voice gateway shall support a minimum of 24 analog telephone lines (FXS ports).
   2. FXS ports must provide adequate loop current and ringing voltage to support accessories such as loud ringers, analog phones, and modems.
C. Fax and Modem Support
   1. Gateways must support T.38 protocol for real-time fax over IP.
   2. Support for G.711 fallback mode is required for compatibility with legacy fax and modem equipment.
D. Physical Interface

1. Gateways shall be equipped with a 25-pair Amphenol connector for connection to analog telephone cabling infrastructure.
2. All analog ports must be accessible and clearly labeled for field termination and service.

E. Power and Redundancy
1. Power supplies must be auto-switching 110/220 VAC.

F. Licensing Requirements
1. All necessary licenses for voice functionality—including, but not limited to, DSP resources, Survivable Remote Site Telephony (SRST), and analog/digital telephony services—shall be pre-installed and included in the base equipment cost.
2. No additional post-installation licensing shall be required to enable full voice feature functionality.

2.7 WIRELESS ACCESS POINTS

2.7.1 General Requirements

A. Wireless Access Points (WAPs) shall provide enterprise-grade, centrally managed Wi-Fi coverage, and shall be designed for compatibility with the District's existing wireless network infrastructure and management systems.

B. All WAPs shall be:
1. Capable of broadcasting multiple SSIDs concurrently to support diverse user groups (e.g., staff, students, guests).
2. Fully compliant with IEEE 802.11ax (Wi-Fi 6) or newer wireless standards.
3. Designed for operation in both indoor and outdoor environments as required by site conditions.

2.7.2 Authentication and Network Segmentation

A. WAPs shall support multiple authentication mechanisms, including:
1. Pre-Shared Key (PSK) authentication for basic access control,
2. 802.1X authentication via RADIUS, with support for dynamic VLAN assignment based on returned RADIUS attributes.

B. Access Points shall be capable of:
1. Assigning wireless clients to specific VLANs based on authentication credentials or user group membership,
2. Enforcing per-SSID firewall rules and access policies to manage traffic between wireless clients and wired network segments.

2.7.3 Management and Integration

A. All WAPs must be centrally managed through the District's existing wireless management platform, supporting:
1. Zero-touch provisioning,
2. Centralized firmware updates,
3. Unified policy enforcement across all sites.

B. The wireless management system shall support:
1. Real-time monitoring of device health and status,
2. Historical usage analytics and performance data,
3. Integration with the District's existing authentication systems and network infrastructure.

C. All proposed access points must be approved for interoperability with the District's wireless controller and management systems prior to procurement.

2.8 MEDIA CONVERTERS

2.8.1 General Requirements

A. The use of media converters shall be strictly limited and shall be permitted only under the following exceptional conditions, subject to written approval by the District ITS Project Manager:

1. Where standard copper Ethernet cabling exceeds the maximum channel length defined by ANSI/TIA-568.2-D (i.e., 100 meters for Category 6/6A) and:
   - Installation of an Intermediate Distribution Frame (IDF) is determined to be impractical or cost-prohibitive by the District; and
   - A dedicated and constant 110/220V AC power source is available at the remote location.
2. Where a conversion between single-mode and multimode fiber is necessary to accommodate existing or legacy infrastructure constraints.
3. Where it is required to convert between Ethernet and other communications protocols, such as RS-485, RS-232, or similar serial data standards, due to the presence of legacy control systems or specialized equipment.

B. Media converters used for any purpose not listed above are expressly prohibited unless approved in writing by the District ITS Project Manager.
C. The Contractor shall submit detailed justification, including site-specific limitations, to obtain approval for any proposed media converter deployment.

2.8.2 Construction and Design Standards

A. Media converters shall be modular in design and support Small Form-factor Pluggable (SFP) or SFP+ transceivers to provide flexible port configurations and future adaptability.
B. Converter chassis (if required) must be rack-mountable and accommodate dual power supplies for redundancy when deployed in intermediate distribution frames (IDFs) or main distribution frames (MDFs).

2.8.3 Electrical and Environmental Requirements

A. Units shall be auto-sensing and support 10/100/1000Base-T and/or 10GBase-T (copper) to 1000Base-LX/10GBase-LR (fiber), as appropriate to the project scope.
B. Media converters shall operate within commercial temperature ranges (0°C to 50°C) and meet all electromagnetic compatibility standards for use in communications environments.
C. Power supplies shall be internal or external, with automatic voltage switching (110V/220V AC), and include surge protection.

2.8.4 Compliance and Certification

A. All media converters and modules must be UL-listed or certified by an NRTL acceptable to the District.
B. Devices shall comply with applicable IEEE standards (802.3, 802.3u, 802.3z, 802.3ab, 802.3ae) and ANSI/TIA performance requirements.

2.8.5 Submittals and Approvals

A. Contractor shall submit complete product data sheets, configuration diagrams, and justification documentation for District ITS Project Manager approval.
B. Include evidence of compliance with power, port type, and environmental specifications as listed above.

2.9 EXTENDED REACH ETHERNET SOLUTIONS

2.9.1 General Requirements

A. Extended Reach Ethernet Solutions shall be permitted only under circumstances where standard copper Ethernet cabling exceeds the maximum channel length defined in ANSI/TIA-568.2-D (i.e., 100 meters for Category 6/6A) and where the installation of a remote telecommunications room (IDF) is impractical or cost-prohibitive.
B. These solutions are intended for use in distributed campus environments, including but not limited to:
   1. Outdoor CCTV cameras.
   2. Wireless access points (WAPs) in open fields.
   3. Perimeter security or lighting poles.
   4. Athletic fields, stadiums, or remote parking structures.

C. All deployments must be explicitly approved in writing by the District ITS Project Manager prior to procurement or installation.
D. Systems shall be pre-engineered, structured cabling solutions integrating power and Ethernet delivery over fiber.

2.9.2 System Requirements

A. Extended Reach Ethernet Solutions shall be capable of delivering both Ethernet data and power over distances up to 1,500 feet using single-mode or multimode fiber infrastructure, depending on project-specific environmental and bandwidth requirements.
B. Systems shall support Power over Ethernet Plus Plus (PoE++), also known as IEEE 802.3bt Type 3, with a minimum power delivery of 60 watts (W) to the remote device at the maximum supported distance of 1,500 feet.
C. Power transmission shall include integrated surge protection and be rated for outdoor use when deployed in environments subject to moisture, temperature variation, and physical exposure.
D. Solutions must be modular in design and utilize pluggable transceivers (e.g., SFP/SFP+) to allow flexibility for future upgrades and changes in network configuration.
E. All system components must operate within commercial or industrial temperature ranges as required by the site conditions, and be compliant with applicable IEEE and ANSI/TIA performance standards.

2.9.3 Cabling Architecture and Integration

A. Fiber cabling shall comply with Section 27 13 23 – Communications Optical Fiber Backbone Cabling.
B. Copper terminations (e.g., remote PoE drops) shall meet all specifications outlined in 27 15 00 – Communications Horizontal Cabling.
C. Rack-mounted and wall-mounted hubs shall integrate with existing equipment racks, patch panels, and grounding systems as defined in 27 11 00 – Communications Equipment Room Fittings.

2.9.4 Submittals

A. Submit manufacturer documentation including:
B. System architecture diagrams.
C. Transceiver specs.
D. Fiber/copper compatibility matrix.
E. Power budget calculations.
F. Include installation manuals, grounding details, and required environmental specifications for remote enclosures.

2.10 FIREWALLS

2.10.1 General Requirements

A. Firewalls shall be considered project-specific design elements and shall be included only when explicitly called for in the project specifications or directed by the District ITS Project Manager.
B. The need for a firewall and its associated specifications—such as throughput capacity, port density, high availability features, and network segmentation—shall be determined and provided by the District ITS Department on a per-project basis.
C. Where firewalls are specified, the product shall:
   1. Meet or exceed the functional requirements issued by the District ITS Project Manager.
   2. Integrate seamlessly into the District's existing security architecture and network infrastructure.
   3. Support configuration for advanced security services, including but not limited to:
      - Intrusion prevention (IPS),
      - Application layer filtering,
      - VPN tunneling,
      - Stateful packet inspection,
   4. All firewall hardware and associated software must be:

- From an enterprise-grade product line intended for educational or institutional networks.
- Supported with a valid security subscription (if applicable) for threat intelligence updates, firmware, and signature database updates.

2.10.2 Submittals and Approvals

A. The Contractor shall submit:
   1. Product data sheets for all proposed firewall hardware and licenses.
   2. A network topology diagram showing proposed integration into the project's communication infrastructure.
   3. Detailed responses to the technical requirements provided by the District ITS Department.
B. All firewall equipment, including hardware, firmware versions, and feature licensing, shall be subject to review and written approval by the District ITS Project Manager prior to procurement or deployment.

2.11 WIRELESS BRIDGES

2.11.1 General Requirements

A. Wireless bridges shall be considered a project-specific solution, deployed only where explicitly required in the project specifications or directed by the District ITS Project Manager.
B. These systems are typically used to extend network connectivity between buildings or sites where fiber installation is not feasible or cost-effective, such as temporary buildings, field installations, or hard-to-reach areas on campus.
C. All functional and technical requirements—including bandwidth, distance, mounting height, line-of-sight conditions, and power—shall be defined and provided by the District ITS Project Manager.
D. Wireless bridge systems must:
   1. Be enterprise-grade, with secure encrypted communication links (e.g., WPA3, AES-128/256).
   2. Support data rates and throughput consistent with gigabit or multigigabit Ethernet connectivity, as required by the application.
   3. Operate in license-free bands (e.g., 5 GHz, 60 GHz) unless otherwise specified and approved.
   4. Include integrated surge protection, weatherproof housings (minimum IP65 rating), and mounting hardware suitable for exterior deployment.

2.11.2 2.11.2 Submittals and Approvals

A. The Contractor shall submit the following documentation for District ITS review and approval:
   1. Detailed product specifications and datasheets.
   2. Line-of-sight calculations or RF path analysis (if applicable).
   3. Proposed mounting locations, power source details, and connection diagrams.
B. All wireless bridge products and associated hardware shall be subject to written approval by the District ITS Project Manager prior to procurement and installation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 The Contractor shall provide a complete, functional, turnkey installation of all active data communications systems as specified under this section. This includes all labor, materials, configuration, testing, labeling, documentation, and commissioning required for a fully operational system.

3.1.2 All work shall be performed in accordance with:

A. District ITS standards and installation guidelines.
B. Relevant TIA/EIA standards, including TIA-568, TIA-606, and TIA-607.
C. Applicable building codes, including the NEC and CEC.
D. Manufacturer's instructions for all furnished equipment.

3.1.3 All devices and systems provided under this section shall:

A. Be new, unused, and current model year unless otherwise specified.
B. Be installed per manufacturer's specifications and with proper environmental and structural support.
C. Include all accessories and licensing required to operate as specified.

3.1.4 Coordinate all device locations, power requirements, and communication pathways with other trades and the District ITS Project Manager before installation begins.

3.1.5 All terminations, connections, and device configurations must be tested, validated, and reviewed with the District ITS Project Manager prior to system acceptance.

3.1.6 Any deviations from the design drawings or product substitutions must be approved in writing by the District ITS Project Manager.

3.1.7 All systems shall be integrated into the District's existing infrastructure as required and verified by successful functional testing.

3.1.8 Power Protection

A. All critical infrastructure devices shall be connected to UPS-backed power circuits. This includes, but is not limited to:
   1. Network routers
   2. Voice routers
   3. Voice gateways
   4. Core switches
   5. Any other network-connected devices supporting critical infrastructure
B. UPS connections shall be installed and verified in accordance with Section 27 11 16 and coordinated with the District ITS Project Manager.
C. This requirement applies to all installations, including MDFs, IDFs, server rooms, and any communications spaces governed by this specification.

3.2 GENERAL INSTALLATION REQUIREMENTS

3.2.1 Standards and Workmanship

A. All equipment shall be installed in a professional and workmanlike manner in accordance with manufacturer recommendations and District ITS standards.
B. All work shall comply with all applicable codes, including NEC and CEC, and follow BICSI, ANSI/TIA, and District best practices.

3.2.2 Device Mounting

A. All devices shall be securely mounted using hardware provided or approved by the manufacturer. No zip ties, adhesives, or unsupported fasteners shall be used for permanent mounting.
B. Mounting hardware and support systems for wall-mounted or ceiling-mounted devices must be anchored to building structure and not to ceiling tiles, trim, or unsupported wallboard.

3.2.3 Equipment Labeling

A. All equipment and power devices governed by this section shall be labeled in accordance with Section 27 05 53 – Identification for Communications Systems.
B. Labels shall be machine-printed, permanent, and clearly visible from the front or primary access side of the device.
C. Labeling shall be completed prior to final walkthrough and acceptance.

3.2.4 Rack Installation and Layout

A. A complete rack layout and elevation drawing shall be submitted for approval by the District ITS Project Manager for all equipment to be installed in MDF, BDF, AV, or server racks.
B. Rack layout submittals shall include:
   1. Rack front elevations with labeled RU assignments for all installed components.
   2. Identification of any equipment to be installed by others (e.g., AV, security).
   3. Power strip placement, grounding bar location, and cable management hardware.
C. Rack-mounted equipment shall be installed using manufacturer-approved mounting hardware specifically designed for the device.
   1. The use of generic shelves or temporary support hardware in place of proper rack ears, rails, or brackets is not permitted.
   2. All equipment shall be installed level and securely fastened to prevent movement, sagging, or vibration.

3.2.5 Cabling and Termination

A. All cabling shall be dressed and secured using Velcro wraps or equivalent reusable fasteners. Avoid cable stress, excessive bend radius, and obstructions to equipment access.
B. All connections must be properly terminated, labeled, and tested prior to activation.

3.2.6 Construction Coordination and Timing

A. Equipment shall not be installed while major construction activities are in progress, including but not limited to:
   1. Demolition
   2. Wall framing or drywall work
   3. Saw cutting or core drilling
   4. Asbestos or lead abatement
B. If early installation is required, the Contractor must submit a formal request with justification and a protection and cleaning plan to the District ITS Project Manager for approval.
C. If early installation is approved, the Contractor shall be fully responsible for:
   1. Protecting the equipment from dust, debris, and physical damage during construction.
   2. Performing a thorough cleaning of all installed equipment and surrounding racks upon completion of adjacent construction.

3.2.7 Cleanliness and Site Maintenance

A. Equipment rooms and IDFs shall remain clean and free of construction debris throughout the project.
B. Dust covers shall be used on installed equipment during ongoing construction work.

3.3 GENERAL CONFIGURATION REQUIREMENTS

3.3.1 General Standards

A. All equipment shall be configured to meet the functional and policy requirements of the District ITS Department.
B. Configuration work shall be coordinated with the District ITS Project Manager prior to implementation.
C. A sample base configuration will be provided to the Contractor by the District ITS Project Manager and shall serve as the template for all initial device configurations.
D. The Contractor shall not connect any device to the live production network without prior written approval from the District ITS Project Manager.

3.3.2 Network Configuration

A. All devices shall be configured with unique hostnames following the District's naming conventions.
   1. Proposed hostnames must be submitted for review and approval.
B. VLANs shall be configured in accordance with District-provided assignments and must match across all relevant switches and access points.

C. IP addressing shall conform to the District's subnetting and address reservation plan provided for the project.

3.3.3 Security and Access Control

A. Default usernames and passwords shall be removed or disabled.
B. District-provided administrative credentials shall be applied to all devices.
C. All unnecessary services (e.g., Telnet, UPnP, unused ports) shall be disabled unless explicitly approved in writing.

3.3.4 Management and Monitoring

A. SNMP settings shall be configured per District specifications to integrate with the central monitoring platform.
B. Time synchronization settings shall be configured using District-designated NTP servers.
C. Syslog and event logging shall be enabled and directed to District-specified log servers.

3.3.5 Documentation and Review

A. Configuration backups for each device shall be provided in plain-text format (.txt or .cfg) as part of the project closeout.
B. All configurations must be reviewed and approved by the District ITS Project Manager prior to final system acceptance.

3.4 SWITCHES

3.4.1 3.4.1 General

A. All switches shall be enterprise-grade, fully managed devices capable of supporting VLANs, QoS, SNMP, and advanced Layer 2/Layer 3 features as required by the project.
B. All switch models and firmware versions must be approved in writing by the District ITS Project Manager prior to procurement.
C. Switches shall be fully compatible with the District's existing network architecture, including integration with centralized network management and monitoring systems.
D. All switches shall include support for PoE/PoE+/PoE++ as required by project needs and device loads.
E. Modular switches must be delivered with all modules, transceivers, and power supplies fully installed and ready for use, unless otherwise approved in the contract documents.

3.4.2 Installation

A. Switches shall be installed in standard 19-inch racks using manufacturer-supplied mounting brackets, rails, or shelf kits.
B. Switches shall not be mounted using generic shelves or temporary supports.
C. Maintain proper vertical spacing and horizontal clearance for ventilation and service access.
D. Power supplies shall be connected to dedicated UPS-protected circuits unless otherwise approved by the District ITS Project Manager.
E. All patch panel ports shall be patched to switch ports on a 1:1 basis.
   1. Patch cables shall be compliant with Section 27 15 13 Part 3.10.
   2. Patch cords shall follow the color scheme defined in Section 27 15 13 Part 3.10.
F. Where a new patch panel is installed, a corresponding new switch shall also be installed unless the contract documents explicitly indicate otherwise or identify the switch as OFCI.

3.4.3 Configuration

A. Switches shall be configured in accordance with Section 3.3 General Configuration Requirements.
B. All VLANs, IP addressing, trunk ports, access ports, and SNMP settings shall be applied according to District direction.
C. Port security settings shall be configured as specified by the District ITS Project Manager.

D. Ports serving Wireless Access Points (WAPs) shall be configured as EtherChannels using LACP. Ports must be assigned in consecutive pairs, with the odd-numbered port acting as the primary link.
E. Ports serving CCTV, access control, and similar security devices shall be configured as IP ARP Inspection trusted ports.
F. All non-standard ports (e.g., WAP, CCTV, Access Control, Intrusion Detection, Facilities Systems) shall include port descriptions following the District's approved naming schema. Descriptions must be applied to both the switch configuration and included in the as-built documentation.

3.4.4 Documentation and Submittals

A. Submit detailed port mapping diagrams showing patch panel-to-switch port relationships.
B. Include IP addresses, VLAN assignments, trunk/access designations, and switch hostnames in the as-built documentation.
C. Submit configuration backups for each switch in plain-text format (.txt) as part of project closeout.
D. Submit proof of firmware version compliance and license activation where applicable.

3.5 WIRELESS ACCESS POINTS

3.5.1 Installation

A. WAPs shall be installed in locations shown on the contract drawings or as directed by the District ITS Project Manager.
B. WAPs shall be ceiling-mounted in the center of the room unless otherwise noted.
C. Mounting hardware shall be manufacturer-approved and appropriate for the ceiling type (e.g., T-bar brackets, surface mounts).
D. Each WAP shall be connected using a Cat6A cable unless otherwise specified.
E. Cables shall be terminated, labeled, and tested in accordance with Division 27 standards.
F. Each WAP shall be connected using two patch cables to adjacent switch ports configured as an EtherChannel.
G. The primary PoE connection shall be patched to the odd-numbered switch port in the EtherChannel pair.
H. In large or complex indoor spaces requiring multiple WAP's such as auditoriums, gymnasiums, libraries, or similar areas:
    1. WAP layout and coverage zones shall be shown on the contract drawings.
    2. Final placement and mounting of WAPs must be reviewed and approved by the District ITS Project Manager prior to construction.
I. For outdoor wireless coverage:
    1. WAPs shall be installed indoors, above the T-bar ceiling or in another environmentally protected interior location.
    2. Each outdoor WAP shall connect to a weather-rated antenna mounted securely on the exterior of the building.
    3. Antennas shall be installed at a minimum of 12 feet above finished floor (AFF), unless otherwise directed by the District ITS Project Manager.

3.5.2 Configuration

A. WAPs shall be configured under the direction of the District ITS Project Manager.
B. Support for multiple SSIDs and VLANs is required.
C. Authentication methods must include PSK and RADIUS-based access.
D. Connections shall be dynamically assigned to VLANs based on RADIUS attributes.
E. Each WAP must support and enforce basic firewall rules as specified by the District.
F. WAPs shall be centrally managed and fully integrated into the District's wireless management system.
G. WAP configuration shall follow the following RF design requirements:
    1. The 2.4 GHz radio shall be disabled in every other room to minimize channel congestion and improve spatial reuse.

2. Radio power levels shall be configured to minimize signal propagation outside of the room in which the WAP is installed.
3. Wireless channels shall be selected and managed to avoid conflicts with nearby WAPs, ensuring non-overlapping coverage where possible.

3.5.3 Documentation and Submittals

A. Documentation and Submittals
   1. Submit WAP locations with corresponding room numbers, mounting heights, cable IDs, and IP addresses.
   2. Submit screenshots or exports showing successful integration into the District's wireless controller.
   3. Include final port configurations on associated switches, EtherChannel setup, and VLAN assignments in the as-built documentation.
   4. For each installed WAP, provide the following:
      - GIS location per the Districts GIS requirements identified in 27 05 50
      - A heat map or RF coverage report showing power levels and coverage zones for each frequency band utilized (e.g., 2.4 GHz, 5 GHz, 6 GHz if applicable).
   5. Entered into the District's GIS system per Section 27 05 50 requirements.
B. Include final port configurations on associated switches, EtherChannel setup, and VLAN assignments in the as-built documentation.

3.6 ROUTERS – GENERAL

3.6.1 Installation

A. Routers shall be installed in standard 19-inch equipment racks using manufacturer-provided mounting hardware.
B. Maintain sufficient clearance for airflow and structured cable management.
C. Route power connections to UPS-backed circuits unless otherwise directed by the District ITS Project Manager.

3.6.2 Configuration

A. Router configurations shall follow the standards outlined in Section 3.3.
B. Coordinate interface assignments, VLAN tagging, routing protocols, and static routes with the District ITS Project Manager.
C. Configure redundancy features (e.g., HSRP, VRRP, or static failover) as shown in the design drawings or directed by District ITS.

3.6.3 Documentation and Submittals

A. Submit configuration files in plain-text format (.txt) for each router as part of project closeout.
B. Provide network diagrams showing interface IPs, physical connections, and routing relationships.
C. Label all router interfaces with descriptions consistent with the District's naming conventions.

3.7 ROUTERS – NETWORK

3.7.1 Installation

A. Network routers shall be installed in MDF or as indicated in the contract documents.
B. All WAN and LAN interfaces shall be clearly labeled at the device and in the rack elevation to match project documentation.
C. Install appropriate patch cables or fiber jumpers to connect router interfaces to core switches, firewalls, or WAN termination points.

3.7.2 Configuration

A. All configuration will be as directed by the District ITS Project Manager.

B. Configure routing protocols (e.g., OSPF, EIGRP, or static routing)
C. Assign interface IP addresses according to the project's subnet and addressing plan.
D. Configure NAT, route-maps, and filtering rules as required for WAN access or firewall integration
E. Apply QoS policies where directed for prioritized traffic such as voice or video.
F. Configure DHCP relay or helper-addresses on routed interfaces as needed.

3.7.3 Documentation and Submittals

A. Include all routing configuration and interface assignments in the as-built configuration files.
B. Submit routing topology diagrams identifying link types (e.g., uplink, failover), IP addressing, and protocol roles.
C. Provide interface descriptions matching District standards and clearly identifying connected systems.

3.7.4 All ports on patch panels must be patched to switch ports on a 1:1 basis unless otherwise approved in writing by the District ITS Project Manager. Patch cables shall be used for all connections and must be compliant with Section 27 15 13 Part 3.10. Patch cords shall follow the color scheme defined in Section 27 15 13 Part 3.10.

3.7.5 Where required by the drawings, provide new network switches to accompany new patch panels. Do not leave unused patch panel ports unconnected to live switch ports unless approved in writing by the District ITS Project Manager.

3.8 ROUTERS – VOICE

3.8.1 Installation

A. Voice routers shall be installed in MDF or as indicated in the contract documents.
B. Install all required voice modules, DSPs, and interface cards (e.g., FXS, FXO, PRI) prior to rack installation.
C. Ensure that all voice ports are labeled both physically and in the rack elevation and configuration file.
D. Connect voice router interfaces to switches and gateways using appropriately rated cables or fiber jumpers, as required.

3.8.2 Configuration

A. All configuration shall be performed in coordination with and as directed by the District ITS Project Manager.
B. Configure SRST, SCCP, MGCP, H.323, or SIP features as required for call control failover or gateway operation.
C. Assign voice VLANs and QoS settings in accordance with District voice network standards.
D. Configure dial peers, voice ports, codecs, and translations as required for PSTN and internal routing.
E. Disable all unused interfaces and services unless otherwise authorized.
F. Ensure all required licenses for voice features are properly installed and validated.

3.8.3 Documentation and Submittals

A. Submit full router configuration in plain-text format (.txt), including all voice-specific settings.
B. Provide labeled diagrams showing voice trunk paths, failover paths, and PRI/FXO/FXS interface assignments.
C. Include documentation for DSP capacity, port usage, and dial plan configuration in the as-built package.

3.9 ROUTERS – VOICE GATEWAYS

3.9.1 Installation

A. Voice gateways shall be installed in MDF or as indicated in the contract documents.
B. Gateways shall be equipped with FXS ports only and are intended solely for analog-to-IP conversion.
C. All FXS ports shall be fully populated and secured prior to rack installation.
D. FXS ports shall be connected via an amphenol cable to a dedicated amphenol 66 block.

E. 66 blocks shall be mounted on the telecommunications backboard alongside other phone punch blocks, in accordance with the layout shown in Section 27 13 13.
F. Label each FXS port and 66 block row clearly and consistently to match the as-built documentation.
G. Connect the gateway Ethernet interfaces to network switches using appropriate patch cables or fiber jumpers, as required.

3.9.2 Configuration

A. Configuration shall be performed in coordination with and as directed by the District ITS Project Manager.
B. Assign IP addresses and VLANs according to the District's voice network plan.
C. Configure SCCP, SIP or MGCP protocol as required to integrate with the District's IP telephony system.
D. Define dial peers and analog port assignments based on the District-provided call routing plan.
E. Disable all unused services, ports, and features unless specifically authorized by the District ITS Project Manager.

3.9.3 Documentation and Submittals

A. Submit full configuration files for each voice gateway in plain-text format (.txt).
B. Provide port mapping diagrams showing FXS assignments, phone numbers, and destination locations.
C. Document integration points to call managers and voice routers, including protocol and VLAN references.

3.10 FIREWALLS

3.10.1 Installation

A. Firewalls shall be installed in MDF or other locations as indicated in the contract documents or directed by the District ITS Project Manager.
B. Install firewalls in standard 19-inch racks using manufacturer-supplied brackets or shelf kits.
C. Maintain proper spacing for airflow and access to all ports and indicators.
D. Connect firewalls to core or edge switches using appropriately rated patch cables or fiber jumpers.
E. Ensure all connected ports are labeled and documented in rack elevation drawings and as-built diagrams.

3.10.2 Configuration

A. All firewall configuration shall be performed under the direction of the District ITS Project Manager.
B. Configure routing, NAT, VLANs, and access policies as required to enforce network segmentation and security zones.
C. Implement application-layer inspection, intrusion prevention, and logging features as directed.
D. Configure HA (High Availability) mode where redundant firewalls are specified.
E. Apply appropriate authentication and administrative access controls.
F. Ensure firmware is updated to the latest approved version before deployment.

3.10.3 Documentation and Submittals

A. Submit complete firewall configuration files in plain-text format as part of closeout documentation.
B. Provide network diagrams showing logical connections, security zones, NAT mappings, and access control layers.
C. Label all interfaces in the configuration with descriptive naming consistent with District standards.
D. Include a list of enabled features and any licensing installed or activated.

3.11 MEDIA CONVERTERS

3.11.1 General

A. Media converters shall be used only under special circumstances and require prior written approval from the District ITS Project Manager.
B. Use of media converters is restricted to situations where:

1. Standard copper Ethernet cabling exceeds the maximum channel length defined in ANSI/TIA-568.2-D (typically 100 meters for Cat6/6A) and where the installation of a remote IDF is not practical.
2. A conversion is required between single-mode and multimode fiber types.
3. Conversion is necessary between Ethernet and another protocol such as RS-232 or RS-485.

C. Media converters may only be installed where a unswitched 120V or 220V AC power source is available at the proposed mounting location.
D. All media converters must utilize modular SFP or SFP+ optics to provide flexibility for future technology or topology changes.

3.11.2 Installation

A. Media converters shall be installed in secure, environmentally controlled spaces.
B. Acceptable installation locations include:
1. Secured enclosures specifically designed for electronic equipment.
2. Mounted directly to telecommunications backboards.
3. Mounted securely within the rear section of IDF racks or cabinets.
C. Media converters must be permanently mounted and secured using appropriate hardware.
D. Devices shall not be left loose, resting on shelves, or placed unsecured inside cabinets or racks.
E. Media converters shall be affixed using screws or industrial mounting brackets where possible.
F. Double-sided tape is not permitted under any circumstances.
G. Industrial adhesive-backed Velcro may be used when mounting to metal or plastic surfaces, provided that:
1. The surface is thoroughly cleaned and prepared prior to installation.
2. The adhesive bond is strong enough to prevent the converter from detaching under normal use and environmental conditions.
H. Media converters shall be mounted such that their ports are oriented horizontally—not facing upward—to prevent the accumulation of dust, debris, or moisture in the connectors.
I. Power supplies for media converters shall be securely mounted and clearly labeled.
J. All connected cabling shall be dressed and secured to prevent damage, stress, or disconnection.
K. Each media converter location shall be documented on the project drawings and reviewed with the District ITS Project Manager prior to installation.

3.11.3 Configuration

A. All media converters shall be tested for full compatibility with the connected systems and interfaces.
B. Where management features are available (e.g., SNMP), they shall be configured per District ITS Project Manager instructions.

3.11.4 Documentation and Submittals

A. Submit a justification memo for each proposed media converter including the intended use case and explanation for why other solutions (e.g., additional IDF, direct fiber run) are not viable.
B. Provide final locations, connection diagrams, and power details as part of the as-built documentation.
C. Location data shall be submitted in a format compliant with the GIS documentation standards defined in Section 27 05 50

3.12 EXTENDED REACH ETHERNET SOLUTIONS

3.12.1 General

A. Extended Reach Ethernet Solutions shall only be used when standard copper Ethernet channel lengths exceed those defined by ANSI/TIA-568.2-D (i.e., 100 meters for Cat6/6A), and the installation of a remote IDF is impractical or cost-prohibitive.
B. Use of these solutions must be approved in writing by the District ITS Project Manager prior to installation.
C. Typical use cases may include deployments in fields, stadiums, parking lots, or other remote outdoor environments.

D. All devices must utilize modular SFP or SFP+ interfaces to allow flexibility and scalability with evolving distance and bandwidth requirements.

3.12.2 Installation

A. Devices shall be securely installed in environmentally rated enclosures as required by the site conditions and manufacturer specifications.
B. Mounting shall comply with manufacturer guidelines and shall not allow for exposure to water ingress, debris, or vandalism.
C. Devices shall be permanently secured and must not rest unsecured on shelves or supports.
D. Each device shall be connected using properly rated outdoor Ethernet or fiber cabling, terminated and labeled per Division 27 standards.
E. Equipment must be installed with sufficient slack and protection to allow future servicing and strain relief.
F. Power must be routed through appropriate surge protection devices and installed according to electrical code and project documentation.

3.12.3 Configuration

A. All devices shall be configured under the supervision of the District ITS Project Manager.
B. Each link must support and provide PoE++ (60W minimum) delivery at up to 1500 feet or as specified for the project.
C. Bandwidth, VLAN, and QoS settings must be reviewed with the District prior to activation.
D. Where supported, devices shall be added to the District's centralized network monitoring system.

3.12.4 Documentation and Submittals

A. Submit the device manufacturer, model, interface type (e.g., SFP+), and supported distance.
B. Include installed location, connected endpoint(s), power source, and cable type/length in as-built documentation.
C. Each extended reach device must be located per the Districts GIS requirements identified in 27 05 50.
D. Entered into the District's GIS system per Section 27 05 50 requirements.

3.13 WIRELESS BRIDGES

3.13.1 General

A. Wireless bridges shall only be used where permanent cabling (fiber or copper) is impractical due to environmental, structural, or distance constraints.
B. All bridge use must be approved by the District ITS Project Manager prior to installation.
C. Wireless bridges must be enterprise-grade, capable of operating in licensed or unlicensed frequencies as approved, and support encrypted communication.
D. Bridges must be capable of delivering throughput appropriate to their application (e.g., CCTV backhaul, wireless access, building interconnect).

3.13.2 Installation

A. Bridges shall be mounted on structures capable of supporting their weight, alignment, and environmental protection.
B. Mounting locations shall be coordinated with the District ITS Project Manager and may include poles, towers, rooftops, or wall brackets.
C. All antennas and bridge radios shall be mounted at a minimum of 20 feet above finished grade unless otherwise directed.
D. If a mast, pole, or tower is being installed specifically to support the antenna, it shall be designed at minimum to meet California Wind Zone 2 requirements.
E. It is the Contractor's responsibility to consult with a licensed structural engineer to verify the specific wind load and design requirements for the proposed mounting location and geographic area.

F. Equipment must be aligned using manufacturer-recommended procedures to achieve optimal signal strength and link quality.
G. Cable routing and sealing must prevent water intrusion, corrosion, and physical damage.
H. Each power supply and PoE injector shall be securely mounted and clearly labeled.

3.13.3 Configuration

A. Bridge radios shall be configured under the direction of the District ITS Project Manager.
B. Encryption and MAC filtering shall be enabled to prevent unauthorized access.
C. Bridge links must be set to static IPs and include clear VLAN assignment and routing logic.
D. Monitoring integration shall be configured if SNMP or web-based status reporting is available.

3.13.4 Documentation and Submittals

A. Provide radio model, antenna type, mounting method, cable type, and grounding method.
B. Submit alignment data (RSSI, SNR), IP settings, VLAN assignments, and routing configurations.
C. Each radio, antenna, and power supply shall be located per the District's GIS requirements identified in 27 05 50.
D. Entered into the District's GIS system per Section 27 05 50 requirements

3.14 CLEANUP AND TURNOVER

3.14.1 General Requirements

A. All work areas, IDFs, MDFs, telecommunications rooms, racks, and enclosures shall be left clean, free of debris, and ready for service at project closeout.
B. Equipment racks, cable trays, wall-mounted enclosures, and devices shall be wiped down to remove dust, dirt, fingerprints, and residue from labeling or installation.
C. Protective films, packaging materials, and shipping labels shall be fully removed from all equipment and components.

3.14.2 Post-Construction Cleaning

A. If any equipment was installed prior to the completion of major construction activities (e.g., demolition, wall finishing, sanding, abatement), the Contractor shall:
   1. Provide a written cleaning and protection plan to the District ITS Project Manager for approval.
   2. Thoroughly clean all installed equipment and cabling.
   3. Use manufacturer-approved cleaning methods to avoid damage to finishes or electronics.
   4. Verify proper airflow and operability following cleanup.

3.14.3 Final Inspection and Turnover

A. The Contractor shall coordinate with the District ITS Project Manager for a final walkthrough of all telecommunications spaces and installed systems.
B. Any missing labels, incomplete terminations, or loose cables shall be corrected prior to acceptance.
C. The District reserves the right to reject final turnover if rooms are not clean, racks are disorganized, or devices are found to be improperly mounted or secured.

3.14.4 Documentation Verification

A. All as-built drawings, configuration files, GIS data, and submittals required under this Section and Section 27 05 50 shall be submitted in full prior to final project acceptance.
B. The District ITS Project Manager shall review and approve all documentation and may require corrections or clarifications prior to sign-off.

SECTION 27 30 00 - VOICE COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section covers the design and installation requirements for the District's standardized Voice over IP (VoIP) communications system, including both IP and analog phone infrastructure.

1.1.2 The District utilizes a distributed VoIP system architecture based on Cisco Call Manager, with centralized call routing through the District's Education Center and Village Data Center facilities.

1.1.3 Each site shall include a minimum of one voice router with two POTS lines, dedicated for emergency (911) service redundancy.

1.1.4 The voice system supports both IP desk phones and analog wall-mounted phones depending on space type, and integrates with the District's copper and fiber backbone infrastructure.

1.1.5 The intent of the system design is to ensure that phone service remains operational during a power outage. All critical voice infrastructure must be supported by UPS backup where necessary.

1.2 RELATED SECTIONS

1.2.1 Refer to the following for coordination and supporting infrastructure:

A. 27 00 00 – Communications General Requirements
B. 27 05 28 – Pathways for Communications Systems
C. 27 05 50 – Communications Documentation and Submittals
D. 27 05 53 – Identification for Communications Systems
E. 27 15 13 – Communications Copper Horizontal Cabling
F. 27 15 23 – Communications Copper Backbone Cabling
G. 27 20 00 – Data Communications
H. 27 42 00 – Audio-Video Systems – Enhanced Classrooms and Collaboration Spaces

1.3 DESIGN AND DEVICE TYPES

1.3.1 All inbound and outbound calls shall be routed through the District's centralized voice infrastructure unless otherwise approved in writing by the District ITS Department Project Manager.

1.3.2 All classrooms and non-office environments shall be equipped with analog wall-mounted phones.

1.3.3 All administrative, office, or principal workspaces shall be equipped with IP-based desk phones, unless otherwise specified.

1.3.4 Analog cabling shall route from each device location back to the local IDF and be cross-connected to the MDF via copper backbone cabling for termination at the voice gateway.

1.3.5 The Contractor is responsible for providing additional voice gateways as required to ensure sufficient port availability for all analog phones.

1.4 DIAL PLAN AND NUMBERING

1.4.1 The District utilizes a five-digit dialing plan across all sites.

1.4.2 Phone numbers and extension assignments shall be provided by the District ITS Department Project Manager during system commissioning.

1.4.3 All phone configurations, including call routing, hunt groups, and voicemail integration, shall be coordinated with the District prior to system activation.

PART 2 - PARTS

2.1 GENERAL

2.1.1 All voice equipment and infrastructure shall be reviewed and approved by the District ITS Department Project Manager prior to installation.

2.1.2 All cabling, patching, and labeling associated with voice devices shall conform to the standards established in the following Division 27 sections:

A. Section 27 00 00 – Communications
B. Section 27 13 00 – Communications Backbone Cabling
C. Section 27 13 13 – Communications Copper Backbone Cabling
D. Section 27 15 00 – Communications Horizontal Cabling
E. Section 27 15 13 – Communications Copper Horizontal Cabling

2.1.3 Voice routers, voice gateways, and switches required for phone system operation shall be furnished, installed, and configured in accordance with Section 27 20 00 – Data Communications.

2.2 PRE-APPROVED MATERIALS

2.2.1 Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved cable types and manufacturers.

2.2.2 Products listed in 27 06 50 do not require additional approval.

2.2.3 Any proposed substitutions, or products or cable types not explicitly listed in Section 27 05 50, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 The following products are strictly prohibited:

A. Devices not compliant with the National Defense Authorization Act (NDAA)
B. Products lacking manufacturer support or without firmware update capability
C. Devices that conflict with the District's operational or security policies
D. Devices with factory passwords that cannot be changed or disabled

2.4 IP PHONES

2.4.1 IP phones shall be provided in two configurations:

A. IP phone with integrated HD video capability
B. IP phone without video capability (audio-only)

2.4.2 IP phones shall:

A. Be black or dark grey in color
B. Support Power over Ethernet (PoE) per IEEE 802.3af or 802.3at standards
C. Be fully compatible with Cisco Call Manager or equivalent SIP-based VoIP call control systems
D. Include a built-in full-duplex speakerphone with acoustic echo cancellation
E. Support wideband audio (G.722 codec) for handset, speakerphone, and headset operations
F. Support a minimum of five programmable line or feature keys
G. Include a high-resolution color or grayscale display with a minimum 800x480 pixel resolution
H. Support built-in Gigabit Ethernet switching with one network uplink and one PC passthrough port
I. Automatically detect and apply voice VLAN settings using CDP or LLDP-MED protocols
J. Provide an integrated switch port for a connected computer that operates as a standard data VLAN access port
K. Include a minimum of two USB ports for optional headset or peripheral connectivity (video model only)

L. Support headset connectivity via RJ-9 analog port and auxiliary electronic hookswitch (EHS) control
M. Support secure communications including TLS and SRTP encryption
N. Support wall-mounting without additional modification (optional mounting kits allowed)
O. Meet ADA compliance requirements for handset audio amplification and hearing aid compatibility
P. Support dynamic QoS marking and VLAN tagging compliant with IEEE 802.1Q and 802.1p
Q. Support SIP signaling protocol for call control
R. Support IPv4 and IPv6 dual-stack operation
S. Support local firmware upgrades via secure TFTP or HTTPS

2.5 ANALOG PHONES

2.5.1 Analog phones shall be provided in two configurations:

A. Wall-mounted analog phone for classrooms and public spaces
B. Desk-mounted analog phone for designated non-office locations as shown on the drawings

2.5.2 Wall-mounted analog phones shall:

A. Be hearing-aid compatible and meet applicable ADA requirements
B. Include a mechanical double-gong ringer for audible alerting
C. Be equipped with a ringer volume control switch
D. Be fully modular for field service and replacement
E. Include a minimum 9-foot handset cord
F. Use a standard RJ11 interface compatible with analog FXS signaling
G. Be supplied in an ash or light gray color unless otherwise noted
H. Include integrated wall mounting hardware for secure installation
I. Be rugged and suitable for institutional, educational, or commercial environments

2.5.3 Desk-mounted analog phones shall:

A. Be black in color
B. Be hearing-aid compatible
C. Include a modular design with standard RJ11 interface
D. Support caller ID functionality and include a flash button
E. Be line-powered and capable of full telephone operation without the use of batteries or external power adapters
F. Optional display backlighting or caller ID screen functionality may be powered by an external power brick, but the phone must function fully for call placement and receipt regardless of whether auxiliary power is present
G. Include a coiled handset cord
H. Be suitable for use in administrative or support spaces where IP phones are not specified

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 All installation, programming, testing, and commissioning activities under this section shall comply with all applicable Division 27 standards, including but not limited to cabling, pathways, labeling, documentation, grounding, and device configuration.

3.1.2 All installation and programming tasks must be performed with direct coordination with the District ITS Department Project Manager.

3.1.3 Any individual performing programming, configuration, or administrative access to the voice platform or Cisco Call Manager system must hold a current Cisco Certified Network Professional (CCNP) Collaboration certification or higher.

3.1.4 Contractor shall not energize, activate, or commission any portion of the voice communications system without prior review and approval by the District ITS Department Project Manager.

3.1.5 Any deviations from design drawings, product substitutions, or system configurations shall require written approval from the District ITS Department Project Manager before implementation.

3.2 POWER AND UPS REQUIREMENTS

3.2.1 All MDFs housing voice routers or core switches supporting the phone system shall be backed by a UPS system as specified in Section 27 11 16.

3.2.2 On school campuses where the main office is not directly served from the MDF, a dedicated UPS shall be installed in the IDF that feeds the office voice infrastructure.

3.2.3 Only the switches that directly support voice services for the office shall be connected to the IDF-based UPS.

3.2.4 UPS installation and configuration shall be coordinated with the District ITS Department Project Manager and comply with all Division 27 power and monitoring requirements.

3.3 DEVICE MOUNTING

3.3.1 Wall-Mounted Phones

A. Wall mounted analog phones shall be mounted at a height of 44 inches above finished floor (AFF) to the centerline of the device.
B. Mounting height may be adjusted as required to meet applicable ADA requirements.
C. Phones shall be installed in a location that is clearly visible and quickly accessible from the main door.
D. Preferred mounting location is within six feet of the primary door, on the same wall or adjacent wall, subject to structural and electrical conditions.
E. Faceplates, jacks and cabling shall comply with Section 27 15 13 – Communications Copper Horizontal Cabling for approved components and installation practices.
F. Final mounting location shall be field verified and approved by the District ITS Department Project Manager.

3.3.2 Office and Administrative Phones

A. Desk-mounted phones shall be installed on desks, workstations, or other horizontal surfaces as indicated in the construction drawings or as directed in the field.
B. Installation shall coordinate with furniture layouts, data outlet placements, and power availability to ensure clean cable management.
C. Phones shall be located to allow full access to all buttons, ports, and displays without obstruction.

3.4 VOICE VLAN AND NETWORK CONFIGURATION

3.4.1 General Requirements

A. Switch port configurations supporting IP phones shall follow the District’s standard network configuration requirements as outlined in Section 27 20 00 – Data Communications.
B. All configuration shall be reviewed and approved by the District ITS Department Project Manager prior to activation.

3.4.2 IP Phone VLAN Assignment

A. All IP phones shall automatically detect and apply the designated voice VLAN using CDP or LLDP-MED protocols as configured on the District's network switches.
B. Manual VLAN assignment on the phone device itself is not permitted unless specifically approved in writing by the District ITS Department Project Manager.

3.4.3 Switch Port Configuration

A. Each switch port assigned to an IP phone shall be configured as an access port with the voice VLAN parameter set, allowing both voice VLAN tagging and access VLAN operation.
B. Required switch configuration commands include:
   1. switchport access vlan [access vlan]
   2. switchport mode access
   3. switchport voice vlan [voice vlan]
C. PC Port Behavior
   1. The integrated switch port on each IP phone for computer passthrough shall operate as a standard access port, carrying untagged traffic assigned to the District's data VLAN.
   2. No voice VLAN tagging shall occur on passthrough traffic intended for computers or other non-phone devices.

3.4.4 Verification and Testing

A. Contractor shall test each installed IP phone to verify:
   1. Correct voice VLAN detection and tagging
   2. Proper operation of passthrough PC port on the data VLAN
   3. Successful registration of the phone with the VoIP call control system
   4. Basic call placement, call receipt, and feature operation

3.5 ANALOG PHONE CROSS-CONNECTS

3.5.1 General Requirements

A. Analog telephone cabling shall run from each device location to the nearest IDF.
B. All analog voice horizontal cabling shall comply with Section 27 15 13, including horizontal cabling installation practices defined in Section 3.5 – Horizontal Cabling – Analog Voice.

3.5.2 Tie Cable and Cross-Connection

A. Tie cables shall be installed to complete the full analog voice circuit pathway between device horizontal cabling, cross-connect blocks, and final connection points.
B. Tie cables shall be used to interconnect 66-blocks between the IDF and the MDF as required.
C. Tie cables shall also be used to connect from the 66-blocks to the designated voice gateway, voice router, or demarcation point (e.g., CO MPOE) as indicated in the project documents.
D. Tie cables shall comply with the material, color-coding, and performance requirements outlined in Section 27 15 13, Part 2.10 – Cross-Connect Wire (Tie-Cable).
E. Cross-connections on 66-blocks shall:
   1. Utilize bridging clips to establish active voice circuits where required.
   2. Cables may be untwisted up to a maximum of 1 inch at the 66-block.
   3. Cabling must be neatly routed using approved cable management devices (D-rings, trays) to maintain separation, bend radius, and accessibility.
   4. Tie cables and cross-connects shall be properly labeled at both ends per Section 27 05 53 – Identification for Communications Systems.

3.5.3 Voice Gateway Termination

A. Cross-connect cables from the MDF shall terminate onto a split 50-pair 66-block equipped with an amphenol (RJ21) connector interfacing directly to the voice gateway or router FXS ports.
B. Tie cables shall be terminated on the punch-down (non-amphenol) side of the split 66-block.
C. Bridging clips shall be installed to complete the connection between the tie cables and the corresponding voice gateway ports.
D. Cabling shall be neatly dressed, with slack managed to prevent mechanical stress and to maintain minimum bend radius requirements.
E. All terminations shall:
   1. Maintain pair integrity up to the point of termination.

2. Be labeled clearly and permanently to indicate both source and destination.

F. Amphenol connector pinouts shall match the numbering scheme and port assignments of the connected voice gateway, and shall be verified during installation.

3.5.4 Capacity Management

A. The Contractor shall verify that sufficient available port capacity exists across all required devices, including but not limited to:
   1. Voice gateways.
   2. Voice routers.
   3. Demarcation points.
   4. Cross-connect blocks.

B. All infrastructure must fully support all analog and IP devices included in the project scope.

C. If existing infrastructure does not provide adequate capacity:
   1. The Contractor shall furnish and install additional hardware and supporting components as necessary to meet project requirements.
   2. All additional hardware shall be submitted for review and must be approved in writing by the District ITS Department Project Manager prior to procurement or installation.

D. All installed equipment shall comply with all applicable standards, including:
   1. Mounting and seismic bracing requirements.
   2. Powering standards, including UPS backup requirements.
   3. Labeling per Section 27 05 53 – Identification for Communications Systems.
   4. Configuration requirements defined in Section 27 20 00 – Data Communications.

E. If additional software licenses are required to support the completed installation:
   1. Contractor shall furnish and install all necessary licenses, including but not limited to:
      - IP phone registration licenses (e.g., Cisco Call Manager licenses).
      - Voice gateway or voice router software feature licenses.
      - SRST licenses for remote site call survivability.
   2. All licenses shall:
      - Be valid, legally transferable to the District.
      - Match the warranty and subscription duration requirements outlined in Section 27 00 00.
      - Be documented and submitted with the final closeout package.

3.5.5 Testing and Verification

A. All analog telephone circuits shall be tested after installation to verify proper connectivity and functionality.
   1. Testing shall include, at a minimum:
      - Verification of active dial tone at each analog device location.
      - Successful placement of outbound calls to internal and external numbers.
      - Successful reception of inbound calls.
      - Verification that bridging clips are properly installed and circuits are live as intended.
      - Confirmation that labeling on 66-blocks, tie cables, and device outlets matches the project as-built documentation.
   2. Any deficiencies, miswires, or labeling errors discovered during testing shall be corrected by the Contractor at no additional cost to the District.
   3. Test results shall be submitted as part of the closeout documentation per Section 27 05 50 – Communications Documentation & Submittals.

3.6 VOICE SYSTEM PROGRAMMING

3.6.1 General Requirements

A. All programming shall be performed in direct coordination with the District ITS Department Project Manager.

B. All dialing plans, phone templates, VLAN assignments, device pools, and call restrictions shall be provided by the District ITS Department Project Manager.
C. Programming shall comply with District ITS Department standards and contract documents.
D. All programming work shall be documented in accordance with Section 27 05 50 – Communications Documentation & Submittals.

3.6.2 Personnel Qualifications

A. Technicians performing programming shall hold an active Cisco Certified Network Professional (CCNP) Collaboration certification or higher.
B. Certifications must be valid at the time of programming work.
C. Contractor shall submit proof of technician certifications for District ITS Department approval before beginning programming activities.

3.6.3 Cisco Call Manager Programming

A. Phones shall be configured for auto-registration or manual provisioning as directed by the District ITS Department Project Manager.
B. Device names shall conform to the District's approved naming standards.
C. Device descriptions shall include room name, location, and device function.
D. Extensions shall be assigned per the District-provided numbering plan.
E. Phones shall be assigned to the correct device pool, region, and location.
F. Class of Service (CoS) and Class of Restriction (CoR) shall match District templates.
G. Device Security Profiles shall be assigned based on District standards.
H. Firmware versions shall be verified and upgraded or downgraded to match approved District baselines.

3.6.4 Voice Gateway Programming

A. Voice gateways shall be registered with Cisco Call Manager.
B. FXS ports shall be mapped to extension numbers as directed by the District ITS Department Project Manager.
C. Translation patterns shall be configured where necessary to manage digit manipulation.
D. All gateway configurations shall comply with District security and device hardening standards.

3.6.5 Voice Router Programming

A. Voice routers shall be registered with Cisco Call Manager.
B. SRST (Survivable Remote Site Telephony) services shall be configured to support local call survivability.
C. Route patterns shall be configured to allow proper inbound and outbound call routing.
D. Translation patterns shall be configured to manage digit manipulation.
E. POTS fallback dialing rules shall be programmed for emergency call redundancy.
F. All router configurations shall comply with District security, device hardening, and QoS (Quality of Service) standards as directed.

3.6.6 Extension Assignment and Directory Integration

A. All extension numbers shall match the District's approved numbering plan.
B. Caller ID information shall be programmed to display site name and extension.
C. Phones shall be assigned to the correct partitions and calling search spaces (CSS).
D. Directory listings shall be created and/or updated to match extension assignments.

3.6.7 Backup and Turnover Documentation

A. A full backup of all programmed Cisco Call Manager configurations shall be performed after programming completion.
B. A full backup of all programmed voice gateway configurations shall be performed after programming completion.

C. Exported device registration lists, extension assignments, and directory information shall be submitted to the District.
D. Updated network topology diagrams showing all voice systems shall be submitted for approval.
E. All documentation and backup files shall conform to Section 27 05 50 – Communications Documentation & Submittals.

3.7 SYSTEM TESTING AND ACCEPTANCE

3.7.1 General Testing Requirements

A. All voice system testing shall be coordinated with the District ITS Department Project Manager.
B. All testing must confirm full functionality, call routing, and emergency calling capabilities.
C. All equipment must be fully installed, programmed, and configured prior to testing.
D. Systems must meet all District performance and quality standards to be accepted.

3.7.2 IP Phone Testing

A. Each IP phone shall be verified to:
   1. Register successfully with Call Manager.
   2. Display the correct extension number.
   3. Show the correct device name and description.
   4. Appear correctly in the District directory listing.
B. Each IP phone shall be tested to:
   1. Place outbound internal calls to other District extensions.
   2. Receive inbound internal calls from other District extensions.
   3. Place outbound external calls to public numbers.
   4. Receive inbound external calls from public numbers.
C. Each IP phone shall be tested for:
   1. Caller ID name and number presentation (both inbound and outbound).
   2. Functionality of speed dials, voicemail buttons, and programmable keys (if applicable).

3.7.3 Analog Phone Testing

A. Each analog phone shall be verified to:
   1. Receive a dial tone when picked up.
   2. Ring properly on incoming calls.
B. Each analog phone shall be tested to:
   1. Place outbound internal calls to other District extensions.
   2. Receive inbound internal calls from other District extensions.
   3. Place outbound external calls to public numbers.
   4. Receive inbound external calls from public numbers.
C. Each analog phone shall have:
   1. Working hook switch and flash button functionality.
   2. Any additional assigned features confirmed.

3.7.4 911 Emergency Call Testing

A. 911 test calls shall be placed from:
   1. At least one IP phone at the site.
   2. At least one analog phone at the site.
B. All 911 calls shall be verified to:
   1. Display the correct site name and emergency address to the PSAP.
   2. Route emergency callback correctly back to the originating site.
C. Parallel call testing shall be performed to verify analog circuit functionality:
   1. Two phones shall place simultaneous outbound test calls.
   2. Calls may be placed to 611 or 811 instead of 911 for this test.

3. Contractor must verify that both calls are using the analog CO lines connected to the voice gateway.
4. Successful completion of simultaneous calls shall confirm correct dual line functionality.

D. All 911 testing must:
1. Logged with the time and date of the call
2. Be scheduled and approved in advance.

3.7.5 Voice Gateway and Router Testing

A. All voice gateway FXS ports shall be tested to:
B. Originate outbound calls.
C. Receive inbound calls.
D. Voice gateway and voice router configurations shall be tested to:
E. Verify successful fallback to SRST mode during Call Manager outage simulation.
F. Confirm successful routing of emergency calls via POTS fallback circuits.
G. Validate consistent call routing both under normal operation and fallback conditions.

3.7.6 Documentation and Acceptance

A. Testing documentation shall include:
1. Completed pass/fail logs for each tested phone and gateway/router port.
2. Notations of any deficiencies discovered during initial testing.
3. Corrective action notes and retest results where deficiencies were found.
4. Final compiled report summarizing the testing status of all installed devices.

B. All testing documentation must:
1. Be organized and submitted in compliance with Section 27 05 50 – Communications Documentation & Submittals.
2. Be approved by the District ITS Department Project Manager as a condition of system acceptance.

3.8 PROJECT CLOSEOUT REQUIREMENTS

3.8.1 Final Configuration Submittals

A. Submit final device configurations for:
1. All IP phones.
2. All analog phones.
3. Voice routers.
4. Voice gateways.

B. All configuration files must:
1. Be in editable, non-proprietary text formats (e.g., .txt).
2. Match the installed and approved system configuration.

3.8.2 As-Built Documentation

A. Submit updated as-built drawings showing:
1. IP phone locations and device IDs.
2. Analog phone locations and cross-connect mappings.
3. Voice gateway and router port assignments.

B. All cross-connect and 66-block locations shall be:
1. Be located per the Districts GIS requirements identified in 27 05 50.
2. Entered into the District’s GIS system per Section 27 05 50 requirements.

C. For each backbone cross-connect location:
1. Provide the total number of pairs in each backbone cable.
2. List the number of pairs currently utilized.
3. List the number of remaining available pairs.
4. Identify any pairs found to be failed or unusable during testing.

D. All documentation must:

1. Comply with Section 27 05 50 – Communications Documentation & Submittals.
2. Be reviewed and approved by the District ITS Department Project Manager.

E. All documentation must:
1. Comply with Section 27 05 50 – Communications Documentation & Submittals.
2. Be reviewed and approved by the District ITS Department Project Manager.

3.8.3 Licensing and Subscription Handoff

A. Submit proof of ownership for all installed licenses and subscriptions, including:
1. Call Manager registration licenses.
2. Voice gateway feature licenses.
3. SRST licenses for voice routers.

B. All licensing must:
1. Be assigned to the District and not to the Contractor or subcontractors.
2. Match the duration and start date requirements defined in Section 27 00 00.

3.8.4 Device Labeling Verification

A. Verify and document that all installed devices are labeled per District standards, including:
B. IP phones.
C. Analog phones.
D. Voice gateways and routers.
E. Labeling shall match Section 27 05 53 – Identification for Communications Systems.

3.8.5 Password and Credential Turnover

A. Submit a complete list of all passwords, usernames, and access credentials used for:
1. Voice gateways.
2. Voice routers.
3. Phone system administrative portals.

B. Passwords must:
1. Be submitted securely per District ITS Department Project Manager instructions.
2. Use District-approved password standards at turnover.

3.8.6 Final Acceptance

A. All deliverables listed in Sections 3.8.1 through 3.8.5 must be received, reviewed, and approved.
B. No project shall be considered complete, and no final payment made, until all closeout requirements are satisfied.

END OF SECTION

SECTION 27 40 00 - AUDIO-VIDEO COMMUNICATIONS – GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section establishes general requirements, coordination standards, and baseline expectations for all audio-video communication systems furnished and installed under Division 27.

1.1.2 Audio-video systems vary in scope and complexity and are addressed in detail in the following related sections:

A. Standard AV systems for classrooms and small meeting rooms are covered in Section 27 41 00.
B. Enhanced AV systems for advanced instructional and collaboration environments are covered in Section 27 42 00.
C. Networked and distributed AV systems for complex venues and multi-room deployments are covered in Section 27 43 00.

1.1.3 This section applies to all installations regardless of system type, and sets baseline requirements for cabling, labeling, pathways, grounding, submittals, and coordination.

1.2 DESIGN AND COORDINATION

1.2.1 All AV system design and installation must be coordinated with the District ITS Department Project Manager.

1.2.2 The District reserves the right to approve, reject, or require modification of any system design or equipment selection.

1.2.3 Contractor shall confirm compatibility with the District's AV, network, and power infrastructure prior to installation.

1.3 RELATED SECTIONS

1.3.1 Refer to the following for general installation, cabling, and documentation requirements:

A. 27 00 00 – Communications General Requirements
B. 27 05 50 – Communications Documentation and Submittals
C. 27 05 53 – Identification for Communications Systems
D. 27 41 00 – Audio-Video Systems – Standard Classrooms and Meeting Rooms
E. 27 42 00 – Audio-Video Systems – Enhanced Classrooms and Collaboration Spaces
F. 27 43 00 – Audio-Video Systems – Networked, Distributed, and Multi-Zone Environments

PART 2 - PARTS

2.1 GENERAL

2.1.1 All components and installation practices governed by this section and related AV subsections shall conform to the product standards, labeling conventions, cabling guidelines, and documentation requirements established by the District.

2.1.2 All equipment shall be installed in accordance with manufacturer instructions and shall be subject to review and approval by the District ITS Department Project Manager.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 All installation and system integration activities must comply with the District's Division 27 standards and be coordinated with the District ITS Department Project Manager.

3.1.2 All work shall conform to applicable requirements of 27 00 00 and related technical sections including cabling, grounding, labeling, testing, and pathway management.

END OF SECTION

SECTION 27 40 01 - AUDIO-VIDEO SYSTEMS – STANDARD CLASSROOMS AND MEETING ROOMS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section covers basic audio-video systems designed for single-room use in classrooms, conference rooms, and similar spaces with minimal AV complexity. Systems addressed under this section typically include:

A. Simple switching between local input sources
B. One or two displays (flat panel or projector)
C. Basic audio playback, often from display-integrated speakers
D. Local control via wall-mounted keypad or small touch interface
E. No distributed audio, networked control, or advanced integration

1.2 DESIGN AND COORDINATION

1.2.1 All systems defined under this section shall be designed, coordinated, and approved in direct collaboration with the District ITS Department Project Manager.

1.2.2 The Contractor shall not proceed with procurement, installation, or programming until a system-level design has been reviewed and approved in writing by the District ITS Department.

1.2.3 Final equipment selection, layout, and configuration shall be documented and approved by the District ITS Project Manager prior to installation.

1.3 RELATED SECTIONS

1.3.1 Refer to the following for general installation, cabling, and documentation requirements:

A. 27 00 00 – Communications General Requirements
B. 27 05 50 – Communications Documentation and Submittals
C. 27 05 53 – Identification for Communications Systems
D. 27 40 00 – Audio-Video Communications – General Requirements
E. 27 42 00 – Audio-Video Systems – Enhanced Classrooms and Collaboration Spaces

PART 2 - PARTS

2.1 GENERAL

2.1.1 All equipment, components, and system design elements provided under this section shall be subject to review and approval by the District ITS Department Project Manager prior to procurement and installation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 All installation and system configuration activities under this section shall be performed in coordination with the District ITS Department Project Manager.

3.1.2 All work shall comply with applicable requirements found in other Division 27 sections, including but not limited to standards for cabling, pathways, labeling, and documentation.

END OF SECTION

SECTION 27 40 02 - AUDIO-VIDEO SYSTEMS – ENHANCED CLASSROOMS AND COLLABORATION SPACES

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section covers audio-video systems intended for advanced classrooms, flexible meeting spaces, and medium-sized instructional environments. These systems support enhanced functionality beyond standard classroom AV, and may include:

1. Multiple input and output sources with full matrix switching
2. Audio processing and amplification
3. Wall-mounted control panels or touch interfaces
4. Extended control and display functionality across several zones
5. Video scaling and signal conversion
6. Integration with network and communications infrastructure

1.2 DESIGN AND COORDINATION

1.2.1 All systems defined under this section shall be designed, coordinated, and approved in direct collaboration with the District ITS Department Project Manager.

1.2.2 The Contractor shall not proceed with procurement, installation, or programming until a system-level design has been reviewed and approved in writing by the District ITS Department.

1.2.3 Final equipment selection, layout, and configuration shall be documented and approved by the District ITS Project Manager prior to installation.

1.3 RELATED SECTIONS

1.3.1 Refer to the following for general installation, cabling, and documentation requirements:

A. 27 00 00 – Communications General Requirements
B. 27 05 50 – Communications Documentation and Submittals
C. 27 05 53 – Identification for Communications Systems
D. 27 40 00 – Audio-Video Communications – General Requirements
E. 27 43 00 – Audio-Video Systems – Networked, Distributed, and Multi-Zone Environments

PART 2 - PARTS

2.1 GENERAL

2.1.1 All equipment, components, and system design elements provided under this section shall be subject to review and approval by the District ITS Department Project Manager prior to procurement and installation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 All installation and system configuration activities under this section shall be performed in coordination with the District ITS Department Project Manager.

3.1.2 All work shall comply with applicable requirements found in other Division 27 sections, including but not limited to standards for cabling, pathways, labeling, and documentation.

END OF SECTION

SECTION 27 40 03 - AUDIO-VIDEO SYSTEMS – NETWORKED, DISTRIBUTED, AND MULTI-ZONE ENVIRONMENTS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section covers advanced audio-video systems that span multiple rooms, zones, or buildings and rely on networked technologies for audio, video, and control distribution. These systems may include:

A. Audio and video over IP (e.g., Dante, AVB, AES67, Crestron NVX)
B. Multi-zone matrix switching and distributed AV control
C. Room linking and AV bridging across campus or facilities
D. AV recording, streaming (e.g., RTSP), and capture integration
E. Live broadcast systems for events or meetings
F. Integration with digital signage platforms or content servers

1.2 DESIGN AND COORDINATION

1.2.1 All systems defined under this section shall be designed, coordinated, and approved in direct collaboration with the District ITS Department Project Manager.

1.2.2 The Contractor shall not proceed with procurement, installation, or programming until a system-level design has been reviewed and approved in writing by the District ITS Department Project Manager.

1.2.3 Final equipment selection, layout, control strategy, and network configuration shall be documented and approved by the District ITS Project Manager prior to installation.

1.3 RELATED SECTIONS

1.3.1 Refer to the following for general installation, cabling, and documentation requirements:

1.3.2 27 00 00 – Communications General Requirements

1.3.3 27 05 50 – Communications Documentation and Submittals

1.3.4 27 05 53 – Identification for Communications Systems

1.3.5 27 40 00 – Audio-Video Communications – General Requirements

1.3.6 27 42 00 – Audio-Video Systems – Enhanced Classrooms and Collaboration Spaces

PART 2 - PARTS

2.1 GENERAL

2.1.1 All equipment, components, and system design elements provided under this section shall be subject to review and approval by the District ITS Department Project Manager prior to procurement and installation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 All installation and system configuration activities under this section shall be performed in coordination with the District ITS Department Project Manager.

3.1.2 All work shall comply with applicable requirements found in other Division 27 sections, including but not limited to standards for cabling, pathways, labeling, and documentation.

END OF SECTION

SECTION 27 51 00 - DISTRIBUTED AUDIO-VIDEO COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This Section defines requirements for the design, furnishing, installation, configuration, and testing of distributed public address (PA), clock, and bell systems across District facilities.

1.1.2 The basis of design for District PA and clock/bell systems is a hybrid architecture, consisting of:

A. IP-based clock/speaker combinations installed in classrooms and offices.
B. Analog speakers installed in exterior areas, hallways, MPRs, and gyms.
C. Amplifiers located centrally in MDFs for both interior and exterior zones.

1.1.3 The system shall provide synchronized timekeeping, scheduled bell tones, emergency paging, and general announcements.

1.2 RELATED SECTIONS

1.2.1 The Contractor shall comply with all related Division 27 Sections, including but not limited to:

A. Section 27 00 00 – Communications
B. Section 27 11 00 – Communications Equipment Room Fittings
C. Section 27 13 00 – Communications Backbone Cabling
D. Section 27 15 00 – Communications Horizontal Cabling
E. Section 27 15 13 – Communications Copper Horizontal Cabling
F. Section 27 20 00 – Data Communications
G. Section 27 30 00 – Voice Communications

1.3 DEFINITIONS AND RESPONSIBILITIES

1.3.1 Definitions

A. IP Clock/Speaker:
   1. A network-attached device providing both audio output (paging, bells) and time display, powered via Power over Ethernet (PoE) and synchronized using NTP.
B. Analog Speaker:
   1. A traditional 70V or 8-ohm speaker receiving paging audio from centralized amplifiers through analog cabling.
C. Amplifier:
   1. A device located in the MDF providing signal amplification for analog speaker zones.
D. PA Controller:
   1. The server, appliance, or headend system managing audio distribution, scheduling, and network communication.
E. Zone:
   1. A grouping of speakers logically or physically assigned to a common paging or bell schedule.
F. Page Adapter:
   1. A device that interfaces between the District's VoIP phone system and the PA audio system, allowing live paging announcements from phones.
G. IP Relay:
   1. A network-connected relay device capable of receiving IP commands and triggering dry-contact closures, used for controlling external systems such as activating school bells through the page adapter.
H. IP Analog Gateway (Encoder/Decoder):
   1. A device that converts analog audio sources to IP streams (encoder) or receives IP streams and outputs analog audio signals (decoder) for integration with analog speakers, amplifiers, or paging systems.

1.3.2 Contractor Responsibilities

A. Provide and install all components necessary for a complete, functional distributed PA, clock, and bell system.
B. Coordinate installation locations, power, and cabling pathways with the District ITS Department Project Manager.
C. Configure all devices, including:
   1. IP clock/speakers for NTP synchronization, paging group membership, and volume control.
   2. Amplifiers for correct zone assignments and paging levels.
D. All work shall comply with District standards, Division 27 specifications, applicable codes, and manufacturer installation requirements.
E. All integrations with the District phone system shall be coordinated with the District ITS Department Project Manager.
F. Submit all required documentation, programming files, as-built drawings, and asset tracking per Section 27 05 50.

1.4 SUBMITTALS

1.4.1 General Requirements

A. Submittals shall comply with Section 27 05 50 – Communications Documentation & Submittals.
B. All submittals must be organized, complete, and reviewed by the District ITS Department Project Manager prior to procurement or installation.

1.4.2 Required Submittals

A. Product data sheets for all installed components, including:
   1. IP clock/speakers.
   2. Analog speakers.
   3. Amplifiers.
   4. PA controllers or servers.
   5. Page adapters.
   6. IP relay devices.
B. Block diagrams illustrating the system architecture, showing:
   1. Device types.
   2. Network connections.
   3. Analog speaker cabling runs.
C. Rack elevations for all equipment installed in racks or enclosures.
D. Proposed IP addressing and VLAN assignments for all networked devices.
E. Device configuration files or programming templates.
F. Sample labels for all devices, cabling, racks, and pathways per Section 27 05 53.
G. Manufacturer warranties and proof of system registration, as applicable.
H. Final firmware versions installed on all devices.

1.4.3 Closeout Submittals

A. Updated as-built drawings reflecting all installed device locations and configurations.
B. Documentation of all zone programming, bell schedules, and paging groups.
C. GIS location data for all major devices as required by Section 27 05 50, including:
   1. Analog speakers.
   2. IP clock/speakers.
   3. Amplifiers.
   4. Cross-connect locations.
   5. Page adapters.
   6. IP analog gateways (encoders and decoders).
   7. IP relays

D. Final user manuals and maintenance instructions for District staff.
E. Passwords and login credentials for all managed devices, submitted securely per District ITS Department Project Manager instructions.

1.5 QUALITY ASSURANCE

1.5.1 General Requirements

A. All work shall comply with the highest standards of workmanship and installation practices outlined in Division 27.
B. All devices, components, and systems shall be installed and configured per manufacturer specifications.

1.5.2 Installer Qualifications

A. All installation personnel shall have documented training and experience with distributed audio-video systems, paging, and bell systems.
B. Contractors must have at least three (3) years of documented successful experience installing similar systems in K-12, higher education, or commercial facilities.
C. Manufacturer certification for the proposed system components is required, if available.

1.5.3 Firmware and Software Standards

A. All devices must be installed with the latest stable firmware and software versions approved by the manufacturer.
B. Firmware updates must be completed prior to final acceptance unless otherwise approved by the District ITS Department Project Manager.

1.5.4 Factory Authorized Equipment

A. All products must be new, factory-authorized, and listed for use in commercial communications environments.
B. Used, refurbished, or open-box equipment is not permitted unless prior written approval is granted by the District ITS Department Project Manager.

1.5.5 Testing and Commissioning Coordination

A. Contractor shall coordinate all device testing, network testing, paging zone testing, and bell schedule testing with the District ITS Department Project Manager.
B. Functional verification must be completed prior to system acceptance.

1.6 WARRANTY

1.6.1 1.6.1 General Warranty Requirements

A. The Contractor shall furnish warranties as required by the individual specification sections and Division 01.

1.6.2 Warranty Duration

A. A minimum five (5) year manufacturer warranty is required on all equipment, covering both hardware and software/firmware support.

1.6.3 Warranty Start and End Dates

A. The warranty period shall begin on the earlier of the following dates, unless otherwise approved in writing by the District ITS Department Project Manager:
B. The date the District issues a Notice of Substantial Completion.
C. The date the District issues a Notice of Completion.
D. All product warranties for furnished equipment shall have a common start and end date, consistent with the effective warranty period defined above.

1.6.4 Warranty Coverage

1.6.5 Warranty shall include, at minimum:

A. Hardware failure coverage, including advanced replacement services where available.
B. On-site technical support when required for service or replacement.
C. Software and firmware updates to maintain security, compatibility, and system performance.
D. Parts-in-hand or replacement services within the next business day following diagnosis or service request, unless otherwise approved by the District ITS Department Project Manager.

1.6.6 License and Subscription Requirements

A. Software licenses and any subscriptions associated with system devices shall be included and shall align with the warranty duration.
B. License and subscription periods shall have the same start and end dates as the warranty.
C. The District ITS Department Project Manager reserves the right to waive or adjust subscription requirements in writing based on system needs or operational preferences.

1.6.7 Contractor Responsibility

A. The Contractor shall be fully responsible for ensuring all equipment warranties, licenses, and subscriptions are properly registered with the manufacturer and active at the time of system acceptance.

1.7 COORDINATION WITH DISTRICT ITS

1.7.1 General Coordination Requirements

A. The Contractor shall coordinate all work related to the installation, programming, and commissioning of the distributed audio-video communications system with the District ITS Department Project Manager.

1.7.2 Pre-Installation Coordination

A. The Contractor shall verify all device locations, zone assignments, speaker types, paging group configurations, and bell schedules with the District ITS Department Project Manager prior to installation.
B. Any conflicts or discrepancies between drawings and site conditions must be identified and resolved with the District ITS Department Project Manager before beginning work.

1.7.3 Programming Coordination

A. All programming of the system must be coordinated with and approved by the District ITS Department Project Manager, including:
   1. Zone definitions.
   2. Paging group assignments.
   3. Bell schedules.
   4. Device naming conventions.

1.7.4 Pre-Commissioning and Testing

A. Before system commissioning:
   1. All device configurations must be reviewed with the District ITS Department Project Manager.
   2. All test procedures must be approved in advance.
   3. Functional testing must be scheduled with a minimum of five (5) business days' notice to the District ITS Department Project Manager.

1.7.5 Final System Acceptance

A. Final acceptance of the system will only be granted after:
B. Successful completion of functional testing.
C. Approval of all device installations and programming.

D. Submission and approval of all required closeout documentation.

1.8 COMPLIANCE WITH CODES AND STANDARDS

1.8.1 General Compliance

A. All materials, installation practices, testing procedures, and documentation shall fully comply with the most recent editions of applicable codes, standards, and regulations.

1.8.2 Codes and Standards

A. The following codes and standards shall be followed, at a minimum:
   1. NEC (National Electrical Code, NFPA 70)
   2. 2025 CEC (California Electrical Code)
   3. ANSI/TIA Standards, including TIA-568, TIA-569, and TIA-606
   4. BICSI Best Practices (ITSIMM and TDMM)
   5. OSHA Safety Regulations
   6. Local Authority Having Jurisdiction (AHJ) requirements

1.8.3 District Standards

A. In cases where District standards exceed code minimums or conflict with industry standards, the District's published standards shall govern, provided that they meet or exceed all applicable code requirements.

PART 2 - PRODUCTS

2.1 2.1 GENERAL

2.1.1 Standards Compliance

A. All products, materials, cabling, and equipment furnished under this Section shall conform to the standards and requirements established in the following Division 27 sections:
   1. Section 27 00 00 – Communications
   2. Section 27 13 00 – Communications Backbone Cabling
   3. Section 27 13 13 – Communications Copper Backbone Cabling
   4. Section 27 15 00 – Communications Horizontal Cabling
   5. Section 27 15 13 – Communications Copper Horizontal Cabling
   6. Section 27 20 00 – Data Communications
   7. Section 27 30 00 – Voice Communications

2.1.2 Data Communications Equipment

A. Equipment required for system operation shall be furnished, installed, and configured in accordance with Section 27 20 00 – Data Communications.

2.2 PRE-APPROVED MATERIALS

2.2.1 Approved Manufacturers

A. Refer to Section 27 06 50 – Approved Communications Products for a list of pre-approved products and manufacturers.

2.2.2 Approval Process

A. Products listed in Section 27 06 50 do not require additional approval.
B. Any proposed substitutions, or products not explicitly listed, shall require written approval from the District ITS Department Project Manager prior to procurement or installation.

2.3 PROHIBITED MATERIALS

2.3.1 Prohibited Products

A. The following products and materials are strictly prohibited:
B. Devices not compliant with the National Defense Authorization Act (NDAA).
C. Products lacking manufacturer support or firmware update capability.
D. Devices that conflict with the District's operational or security policies.
E. Devices with factory passwords that cannot be changed or disabled.

2.4 IP CLOCK/SPEAKERS

2.4.1 Shall be PoE powered (IEEE 802.3af or IEEE 802.3at).

2.4.2 Shall synchronize time via NTP using District-approved NTP servers.

2.4.3 Must support integration with standard SIP-based paging systems.

2.4.4 Shall have an integrated:

A. High-contrast, high-definition digital display.
B. Paging speaker capable of delivering at least 90 dB SPL at 1 meter.
C. Visual alert functionality (e.g., flashing beacon or LED indicator) for emergency announcements.

2.4.5 Shall support centralized remote management for firmware updates, configuration changes, and monitoring.

2.4.6 Display brightness must be automatically or manually adjustable based on ambient lighting.

2.5 IP CLOCK/SPEAKER BACK BOXES AND MOUNTING HARDWARE

2.5.1 Wall-mounted IP clock/speakers shall be installed using:

A. Manufacturer-approved angled surface-mount back boxes or wall brackets designed specifically for the device.

2.5.2 Back box shall:

A. Be rated for the weight of the clock/speaker assembly.
B. Provide cable strain relief and protect terminations.
C. Allow concealed cable routing behind the mounted unit.
D. Be constructed of steel or heavy-duty ABS plastic, UL 94V-0 flame-rated.
E. Include gasketed or sealed entry points where required for indoor environmental durability.

2.5.3 Mounting bracket shall:

A. Support tilt/angled installation as required for optimal viewing and sound coverage.
B. Allow removal and reinstallation of the clock/speaker without damage to cabling or surface finishes.
C. Contractor must verify and submit bracket/back box selection during the submittal process to ensure compatibility with selected clock/speaker models.

2.6 ANALOG SPEAKERS – INDOOR

2.6.1 Shall be 70V distributed audio ceiling or wall-mount speakers with integrated multi-tap transformers.

2.6.2 Indoor speakers shall:

A. Offer minimum power tap selections of 0.5W, 1W, 2W, 4W, and 8W.
B. Include recessed volume control knobs to allow on-site volume adjustments with tamper resistance.
C. Be designed for distributed paging and bell applications within classrooms, offices, hallways, or similar spaces.
D. Produce a minimum of 95 dB SPL at 1W/1m.

E. Support ceiling tile mounting or wall surface mounting depending on location needs.
F. Be UL 1480 and UL 2043 listed for plenum ceiling installations.
G. Be manufactured with metal baffles and backcans where required for fire and acoustic rating compliance.

2.6.3 Contractor shall recommend tap settings and quantities based on space size, ambient noise levels, and desired paging clarity.

2.7 ANALOG SPEAKERS – OUTDOOR

2.7.1 Shall be 70V distributed horn or projector-style loudspeakers designed for outdoor paging and bell applications.

2.7.2 Outdoor speakers shall:

A. Offer minimum power tap selections of 7.5W, 15W, 30W, and 60W.
B. Be available in models capable of supporting up to 128 watts output at 70V.
C. Produce a minimum of 100 dB SPL at 1W/1m for high intelligibility in noisy environments.
D. Be IP65 or better rated for dust and water resistance.
E. Be UV resistant and corrosion resistant.
F. Support wall, pole, or rooftop mounting as appropriate for campus or field deployments.
G. Be UL 1480 listed for outdoor paging installations.

2.7.3 Contractor shall recommend speaker locations and tap settings to ensure full outdoor area coverage and audibility.

2.8 AMPLIFIERS

2.8.1 Shall include both:

A. IP network-based audio gateway functionality capable of receiving multicast or SIP audio streams.
B. Traditional analog audio inputs (minimum one line-level balanced input).

2.8.2 Must be wall or rack-mountable with standard 19-inch rack ears or shelf mounts.

2.8.3 Available in multiple power ratings based on project requirements, including:

A. 60W, 120W, 240W, and 600W models (nominal output at 70V).
B. Amplifier shall support distributed audio output for 25V, 70V, or 100V speaker systems.

2.8.4 Shall support:

A. Prioritized audio channel inputs for emergency paging.
B. Volume control and input gain adjustment per channel.

2.8.5 Contractor shall select amplifier model(s) appropriate for the designed speaker load, including 20% headroom for future expansion.

2.8.6 Integrated fault monitoring and reporting capability preferred (e.g., SNMP, web interface, or email alerts).

2.9 IP RELAY UNITS

2.9.1 Shall accept standard network control commands (HTTP, HTTPS, TCP/IP, or UDP protocols).

2.9.2 Minimum of two individually addressable Form C relay outputs (normally open/normally closed contacts).

2.9.3 Relays shall be rated for at least 24VDC / 2A or 120VAC / 0.5A.

2.9.4 Must be PoE powered (IEEE 802.3af) or support an optional 12VDC/24VDC external power supply.

2.9.5 Shall be compatible with the District's existing Bell Commander software for automated bell and paging control integration.

2.9.6 Shall support real-time monitoring of relay state via SNMP or web interface.

2.9.7 Must provide secure access methods, including password-protected login and encrypted communication where supported.

2.9.8 Shall be DIN-rail mountable or wall/surface mountable; contractor to provide appropriate mounting method for project.

2.9.9 Configuration and firmware updates must be remotely manageable via web browser.

2.10 IP ANALOG GATEWAYS (ENCODERS AND DECODERS)

2.10.1 Shall provide bidirectional audio conversion between:

A. Analog audio line-level (balanced or unbalanced) and
B. IP network audio streams (multicast, SIP, or RTP/RTSP).

2.10.2 Encoder/Decoder devices must:

A. Support at least 48 kHz sampling rate at 16-bit audio depth.
B. Support G.711 and G.722 audio codecs at a minimum.
C. Allow emergency override audio priorities.
D. Include volume adjustment (software-controlled) for input and output.
E. Provide hardware mounting brackets or be designed for rack shelf installation.

2.10.3 Shall allow remote monitoring of device status and stream health via SNMP, web browser, or REST API.

2.10.4 Support multicast failover or secondary stream redundancy where required.

2.10.5 Contractor responsible for sizing the quantity and capacity of encoders/decoders based on the system design and functional requirements.

2.11 ANALOG PAGE ADAPTERS

2.11.1 Shall interface directly between traditional analog telephony systems and analog paging amplifiers.

2.11.2 Must support telephone line seizure for immediate paging access.

2.11.3 Shall provide:

A. Zone paging capability (minimum of 3 or 6 zones, expandable).
B. Override capability for emergency paging with preemption of background audio.
C. Contact closure output for triggering visual indicators or auxiliary systems.

2.11.4 Input requirements:

A. Standard analog loop-start trunk or station port interface (600 Ohm nominal impedance).

2.11.5 Output requirements:

A. 600 Ohm balanced audio output to amplifier input.
B. Dry contact relay for page activation.

2.11.6 Shall include built-in tone generator for pre-page alert or bell tones where applicable.

2.11.7 Must support simple DTMF command programming for zone selection and function control.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Workmanship Standards

A. All installation shall be performed in a professional, workmanlike manner in compliance with:

1. Division 27 general requirements
2. Applicable codes, including NEC and CEC
3. Manufacturer installation guidelines
4. BICSI, TIA, and District ITS standards

3.1.2 Coordination

A. Coordinate all device mounting locations, cabling paths, paging zones, amplifier rack spaces, and IP network configuration with the District ITS Department Project Manager prior to installation.

3.1.3 Cabling Standards

A. All wiring associated with this system shall comply with:
   1. Section 27 00 00 – Communications
   2. Section 27 13 00 – Communications Backbone Cabling
   3. Section 27 15 00 – Communications Horizontal Cabling
   4. Section 27 15 01.46 – Communications Paging Horizontal Cabling

3.1.4 Equipment Labeling

A. All equipment, cabling, and ports associated with this system shall be labeled in accordance with Section 27 05 53 – Identification for Communications Systems.

3.1.5 Protection During Construction

A. Devices shall not be installed while major construction (e.g., framing, drywall, abatement) is ongoing unless approved by the District ITS Department Project Manager.
B. If early installation is approved, Contractor shall submit and implement a protection and cleaning plan as defined in Section 27 00 00.

3.2 DEVICE INSTALLATION

3.2.1 General Requirements

A. Devices shall be installed per approved shop drawings and the coordinated layouts with the District ITS Department Project Manager.
B. Device installation shall comply with all manufacturer guidelines, mounting hardware requirements, and seismic bracing needs where applicable.
C. Contractor shall ensure all devices are securely mounted and fully functional prior to commissioning and testing.

3.2.2 IP Clock/Speaker Units

A. Each classroom and instructional space shall receive an IP clock/speaker unit as the basis of design.
B. IP clock/speaker units shall:
   1. Be surface-mounted at the front center of the room following manufacturer recommendations for visibility and sound coverage.
   2. Be mounted using approved manufacturer-supplied brackets and fasteners.
   3. Receive primary power and network connectivity via a single Category 6 or better Ethernet cable terminated to a standard faceplate and jack behind the device.
   4. Utilize PoE (Power over Ethernet) for all normal operations, including speaker, clock display, and communications.
C. Analog override cabling:
   1. Each IP clock/speaker shall be provided with a wire for analog audio override capability. To be wired using compliant paging horizontal cabling (Section 27 15 01.46).
   2. Cabling shall be installed as a daisy chain between devices, connecting multiple clock/speakers together on a continuous loop.

3. Cables shall be tied into either the inside analog paging zone or the outside analog paging zone based on the design documents.
4. No more than 8 IP clock/speakers may be connected in a single analog daisy chain loop unless otherwise approved in writing by the District ITS Department Project Manager.
5. Daisy chain connections shall maintain correct polarity (+/-) and continuity throughout.
6. Shielded cable is not required unless specified otherwise by site conditions.

D. All IP clock/speaker units shall:
1. Synchronize time using NTP servers designated by the District ITS Department Project Manager.
2. Be addressable individually for zoning, volume adjustment, and device status reporting via the District's centralized paging management system.
3. Be configured and connected to the campus IP PA VLAN as specified by the District ITS Department Project Manager.
4. Receive IP addressing and device configurations via DHCP.
5. Have all username and password settings updated to credentials provided by the District ITS Department Project Manager.

3.2.3 Indoor Analog Speakers

A. Indoor analog speakers shall be installed in corridors, MPRs, gymnasiums, administrative spaces, and other areas as shown on the drawings.
B. Indoor analog speakers shall:
1. Be 70V distributed audio type.
2. Support selectable tap settings to allow adjustment for appropriate sound coverage (minimum tap options: 1W, 2W, 4W, and 8W).
3. Be rated for commercial indoor use with suitable enclosures for ceiling or wall mounting.
4. Include a recessed volume control knob accessible behind a tamper-resistant cover.
- Note: A recessed volume control knob is only required for indoor hallways and for classrooms, unless otherwise specified.
5. Be installed in accordance with manufacturer recommendations to optimize sound dispersion.
6. Be mounted using approved ceiling tiles, ceiling grids, or wall brackets, as appropriate for each location.
7. Be located to meet SPL (Sound Pressure Level) requirements appropriate for the space:
- Target 70–75 dB SPL average, measured 3–5 feet above finished floor.
- Volume settings shall be adjustable but shall not cause discomfort to occupants.
8. Be wired using compliant paging horizontal cabling (Section 27 15 01.46).
9. Be home-run directly back to the IDF, where cross-connection and consolidation shall occur before returning to the amplifier located at the MDF.
10. Be wired maintaining correct polarity throughout all connections and terminations.

C. Layout and amplifier loading:
1. Contractor shall calculate speaker tap settings based on room size, ceiling height, acoustics, and intended use of the space.
2. Speaker tap settings and amplifier sizing shall be coordinated to ensure that amplifier output capacity is not exceeded.
3. Contractor is responsible for calculating amplifier loading and ensuring compliance with the following:
- Existing amplifier installations shall not exceed 85% of rated output capacity.
- New amplifier installations shall not exceed 75% of rated output capacity.
4. Contractor shall adjust speaker taps to balance volume levels and coverage based on room size, acoustics, and functional use.
5. Final speaker tap settings and amplifier load calculations shall be submitted for review and approval by the District ITS Department Project Manager.

3.2.4 Outdoor Analog Speakers

A. Outdoor analog speakers shall be installed in courtyards, walkways, parking lots, sports fields, and other exterior areas as shown on the drawings.

B. Outdoor analog speakers shall:
   1. Be 70V distributed audio type.
   2. Support selectable tap settings to allow adjustment for appropriate outdoor sound coverage (minimum tap options: 5W, 10W, 15W, and 30W).
   3. Be rated for outdoor, weather-resistant applications, including:
      - Minimum IP-65 environmental protection rating.
      - UV-stabilized, corrosion-resistant housing.
   4. Be mounted a minimum of 15 feet above finished grade, unless otherwise specified or approved.
   5. Be installed in accordance with manufacturer guidelines to optimize sound dispersion and minimize maintenance exposure.
   6. Be aimed and installed to avoid excessive direct sound exposure into occupied spaces such as outdoor seating, play structures, and pedestrian paths.
   7. Be located to achieve the following SPL (Sound Pressure Level) requirements:
      - At primary walking paths, entrances, or building entries: maximum sustained 80 dB SPL at 6 feet.
      - At open fields, large gathering areas, or athletic fields: maximum sustained 85 dB SPL at 10 feet.
   8. Be wired using compliant paging horizontal cabling (Section 27 15 01.46).
   9. Be home-run directly back to the nearest telecommunications room (IDF), where cross-connection and consolidation shall occur before returning to the amplifier located at the MDF.
   10. Maintain correct speaker polarity throughout all wiring and terminations.

C. Amplifier loading and speaker tap settings:
   1. Contractor shall calculate speaker tap settings based on outdoor area size, mounting height, background noise levels, and intended paging coverage.
   2. Speaker tap settings and amplifier sizing shall be coordinated to ensure that amplifier output capacity is not exceeded.
   3. Contractor is responsible for calculating amplifier loading and ensuring compliance with the following:
      - Existing amplifier installations shall not exceed 85% of rated output capacity.
      - New amplifier installations shall not exceed 75% of rated output capacity.
   4. Contractor shall adjust speaker taps to balance volume levels and coverage based on space, acoustics, and functional use.
   5. Final speaker tap settings, aiming diagrams, and amplifier load calculations shall be submitted for review and approval by the District ITS Department Project Manager.

3.2.5 Amplifier Locations (Primary Paging Distribution)

A. A minimum of two (2) amplifiers shall be provided per campus/project:
   1. One amplifier dedicated to the indoor paging zone.
   2. One amplifier dedicated to the outdoor paging zone.

B. Additional amplifiers shall be provided as required to support the system design and maintain required capacity margins.

C. Amplifiers shall:
   1. Be located in the MDF (Main Distribution Frame) unless otherwise specified in the contract documents or approved by the District ITS Department Project Manager.
   2. Provide a minimum of 100 watts per output channel.
   3. Include a minimum of two (2) independently controllable audio zones.
   4. Support 70V distributed audio output.
   5. Be connected to the MDF's UPS system for continuous power in the event of a utility outage.
   6. Be connected to the District's PA VLAN per ITS Department Project Manager direction and support the following:
      - Audio-over-IP (AoIP) protocols for receiving paging audio streams.
      - SNMP or equivalent network management capabilities for monitoring status, load, and fault conditions.
      - Support remote configuration and monitoring by District ITS systems.
   7. Be integrated into the IP paging system as required for full control and zone paging.

8. Be integrated into the sites existing analog paging system as required for full control and zone paging.

D. Amplifier sizing and capacity requirements:
1. Contractor is responsible for calculating amplifier loading based on actual speaker tap settings, speaker quantities, and design requirements.
2. Amplifiers shall be sized to support the total speaker load per zone plus a minimum 25% spare capacity.
3. Contractor shall ensure:
4. Existing amplifier installations shall not exceed 85% of the amplifier's rated output capacity.
5. New amplifier installations shall not exceed 75% of the amplifier’s rated output capacity.
6. Final amplifier load calculations, including speaker wattage assignments and zoning layouts, shall be submitted for District ITS Department Project Manager review and approval prior to equipment procurement.

3.2.6 Extended Distance Analog Zones

A. Extended distance analog paging zones shall be provided only where:
1. Speaker cable runs (indoor or outdoor) exceed recommended 70V system limits for cable length or load.
2. Specific zone separation or isolation requirements necessitate distributed amplification.
3. Installation of an auxiliary amplifier must be approved in writing by the District ITS Department Project Manager prior to installation.

B. Auxiliary amplifiers shall:
1. Meet all requirements outlined in Section 3.2.5 Amplifiers.
2. Be located in the nearest IDF (Intermediate Distribution Frame) or other approved telecommunications room.
3. Be powered from a dedicated UPS system capable of maintaining full operation for a minimum of four (4) hours.
4. The UPS shall be sized to support the amplifier and a single network switch to maintain network connectivity.
5. Be fully integrated into the District’s IP paging system for:
- Remote monitoring
- Network-based audio delivery
- Support of zone-specific paging control

C. Contractor responsibilities:
1. Contractor shall calculate speaker loading and verify amplifier sizing consistent with standards defined in Section 3.2.5.
2. Final amplifier placement, UPS sizing, and network integration shall be submitted for review and approval by the District ITS Department Project Manager.

3.2.7 Analog Page Adapters

A. Analog page adapters shall:
1. Interface with the District's VoIP telephone system via an analog POTS port to initiate paging commands.
2. Generate analog line-level audio output suitable for amplifier input.
3. Support features such as priority override, all-call paging, and emergency tones.

B. Installation Requirements:
1. Shall be installed in the MDF, unless otherwise indicated in the project drawings and approved by the ITS Department Project Manager.
2. Mounted securely in a rack, cabinet, or backboard per manufacturer recommendations.
3. Powered from MDF UPS
4. Connected to the designated analog phone port configured for paging.

C. Configuration:
1. Contractor shall configure the page adapter settings, tones, and volume per District ITS Department Project Manager direction.

3.2.8 Analog Gateways (Encoders and Decoders)

A. Analog gateway encoders/decoders shall:
   1. Convert IP network audio streams to/from analog audio signals to integrate with analog PA zones or auxiliary systems.
   2. Support multicast and unicast IP streaming as required by District design standards.
B. System Requirements:
   1. Devices must allow configuration of encoding parameters (bitrate, codec, delay).
   2. Devices must be manageable over the network, supporting firmware updates and password protection.
   3. Be powered via PoE where possible, or otherwise powered per manufacturer specifications.
C. Installation Requirements:
   1. Equipment must be mounted securely in approved telecom spaces.
   2. Network connections shall be on the designated IP PA VLAN unless otherwise approved.
   3. Properly configure IP addressing via DHCP reservation or static assignment, as directed by the ITS Department Project Manager.
   4. Mount securely per manufacturer guidelines, avoiding exposure to weather unless housed in a rated enclosure.
   5. Device configuration and commissioning shall be coordinated with the ITS Department Project Manager.

3.2.9 IP Relays

A. IP relay units shall be installed to provide control functions, including bell signal triggering and auxiliary device control.
B. Units shall:
   1. Be connected to the District's PA VLAN per ITS Department Project Manager direction.
   2. Support integration with the District's existing Bell Commander software.
   3. Be powered via PoE where possible, or otherwise powered per manufacturer specifications.
   4. Support secure network management, with the ability to change default passwords and configure user access.
C. Contractor Responsibilities:
   1. Properly configure IP addressing via DHCP reservation or static assignment, as directed by the ITS Department Project Manager.
   2. Mount securely per manufacturer guidelines, avoiding exposure to weather unless housed in a rated enclosure.

3.3 PROGRAMMING REQUIREMENTS

3.3.1 General Requirements

A. All programming activities shall be coordinated with and approved by the District ITS Department Project Manager.
B. Contractor shall provide a complete, tested, and documented programming package including IP addressing, VLAN assignments, audio stream configurations, and relay triggers.
C. All programmed devices shall have security settings (usernames, passwords) configured according to District standards.
D. Bell schedules to be programed based on district requirements.

3.3.2 IP Clock/Speaker Programming

A. Each IP clock/speaker shall:
   1. Be assigned a DHCP IP address in the District's IP PA VLAN.
   2. Receive its time synchronization via NTP servers designated by the District ITS Department.
   3. Be assigned to correct paging groups (e.g., classroom, all-call, emergency override) as directed.
   4. Have device credentials changed from default settings per District security requirements.

3.3.3 Analog Page Adapter Programming

A. Each analog page adapter shall:

1. Be configured to accept inbound paging calls from the telephone system.
2. Provide correct output levels to the connected amplifiers.
3. Be tested for proper tone generation and emergency page override functionality.

3.3.4 Amplifier and Zone Programming

A. All IP-addressable amplifiers shall:
   1. Be configured with appropriate network settings (IP address, VLAN, gateway, etc.).
   2. Join correct multicast or unicast paging groups per District ITS Department directions.
   3. Have volume levels preset based on zone requirements (indoor vs outdoor).
   4. Emergency override priority shall be enabled and verified.

3.3.5 IP Relay Programming

A. IP relays shall:
   1. Be programmed to respond to network triggers from Bell Commander or other designated systems.
   2. Each relay port shall be clearly labeled and documented as to the device it controls.
   3. Relay actions (momentary closure, latch, open/close timings) shall be configured based on the bell or signaling device requirements.

3.3.6 Analog Gateway Programming

A. IP audio encoders and decoders shall:
   1. Be programmed to properly stream or receive multicast/unicast paging audio.
   2. Support fallback to emergency tones if paging server connection is lost.
   3. Audio input/output levels shall be calibrated per District ITS Department testing standards.

3.4 TESTING & VERIFICATION

3.4.1 General Testing Requirements

A. All installed systems shall be tested in the presence of or under the observation of the District ITS Department Project Manager.
B. All failures, deficiencies, or performance issues shall be corrected and re-tested at no additional cost to the District.
C. Test results shall be recorded and submitted in the project closeout documentation as specified in Section 27 05 50.

3.4.2 IP Clock/Speaker Testing

A. Verify each device powers on and successfully obtains an IP address.
B. Confirm successful time synchronization with the District's NTP servers.
C. Test device audio output for clarity and adequate volume within the designated coverage area.
D. Test membership in all assigned paging groups and verify proper reception of pages and emergency tones.

3.4.3 Analog Speaker Testing (Indoor and Outdoor)

A. Perform audio output tests to confirm coverage and volume meet specifications:
   1. Indoor Speakers: Target 70–75 dB SPL average at 3–5 feet above finished floor.
   2. Outdoor Speakers: Max sustained 80 dB SPL at 6 feet for walkways; 85 dB SPL at 10 feet for open fields.
B. Verify analog cabling and cross-connects are properly installed and labeled.
C. Confirm emergency page and all-call functionality through each speaker.

3.4.4 Amplifier Testing

A. Verify each amplifier powers on, connects to the network, and is accessible via IP management tools.
B. Confirm amplifier loading does not exceed design parameters (existing 85%, new 75% maximum loading).

C. Test both indoor and outdoor zones separately and simultaneously for paging functionality and audio quality.
D. Confirm emergency override functionality.

3.4.5 Analog Page Adapter Testing

A. Confirm the analog page adapter answers incoming calls from the phone system.
B. Verify that paging audio passes through the adapter and is broadcast across the correct zone(s).
C. Confirm tone generation and emergency override functions.

3.4.6 IP Relay Testing

A. Verify IP relay unit is accessible over the network.
B. Confirm relay outputs properly activate bells or other devices when triggered by the Bell Commander or designated system.
C. Simulate bell schedules and emergency triggers to verify relay response timing and accuracy.

3.4.7 Analog Gateway Testing (Encoders/Decoders)

A. Verify proper audio stream encoding from input devices (microphones, paging adapters) into the network.
B. Confirm decoding and playback at the amplifiers or speaker zones.
C. Test multicast/unicast audio streams for reliability and correct assignment to zones.

3.5 SYSTEM ACCEPTANCE AND CLOSEOUT

3.5.1 System Acceptance

A. Final system acceptance shall occur only after successful completion of all testing, punch list corrections, documentation submissions, and training requirements.
B. Acceptance shall be granted by the District ITS Department Project Manager in writing.

3.5.2 Punch List and Correction of Deficiencies

A. A preliminary punch list will be created during initial walkthroughs.
B. Contractor shall promptly correct all deficiencies noted by the District ITS Department Project Manager.
C. No final acceptance or payment shall be issued until all punch list items have been resolved to the satisfaction of the District.

3.5.3 Final Documentation Submittal

A. As-built drawings, configuration files, test results, labeling schedules, and GIS location data shall be submitted per Section 27 05 50 – Communications Documentation & Submittals.
B. GIS location data must include all installed equipment, including but not limited to:
   1. IP clock/speakers
   2. Indoor analog speakers
   3. Outdoor analog speakers
   4. Amplifiers
   5. Analog page adapters
   6. IP analog gateways (encoders and decoders)
   7. IP relay units
C. Final documentation must be reviewed and approved by the ITS Department Project Manager prior to system acceptance.

3.5.4 System Warranty Activation

A. Contractor shall ensure that all warranties, licenses, subscriptions, and software support agreements are fully activated before final acceptance.

B. Warranty documentation must include start and end dates in accordance with Section 27 00 00 and project requirements.

END OF SECTION

Division 28 – Electronic Safety and Security Systems

SECTION 28 00 00 – ELECTRONIC SAFETY AND SECURITY SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section provides general requirements and guidelines for communications systems, including but not limited to:

A. Access Control Systems
B. Intrusion Detection Systems
C. Video Surveillance Systems
D. Other Specialized Security Systems

1.1.2 These requirements apply to all Division 28 specifications, drawings, and related contract documents. More specific requirements found in individual Division 28 sections supersede the general requirements listed in this Section.

1.1.3 The Contractor shall provide a complete, functional, turnkey system for all Division 28 communications infrastructure. This includes furnishing and installing all required materials, cabling, devices, equipment, hardware, and accessories necessary for a fully operational and code-compliant solution, unless otherwise noted as Owner Furnished, Contractor Installed (OFCI) in the contract documents.

1.2 RELATED REQUIREMENTS:

1.2.1 Refer to individual Division 28 sections for specific system components, materials, and execution requirements. The list of Division 28 section specifications includes, but is not limited to, the following:

A. SECTION 28 00 00 – ELECTRONIC SAFETY AND SECURITY SYSTEMS
B. SECTION 28 06 50 – COMMUNICATIONS EQUIPMENT & MATERIALS SCHEDULE
C. SECTION 28 10 00 – ACCESS CONTROL
D. SECTION 28 20 00 – VIDEO SURVEILLANCE
E. SECTION 28 31 00 – INTRUSION DETECTION
F. SECTION 28 50 00 – SPECIALIZED SYSTEMS

1.2.2 Other Division Coordination:

A. Division 26 – Electrical: Power and grounding.
B. Division 27 – Communications.

1.3 DEFINITIONS & RESPONSIBILITIES

For the purposes of this specification, the following terms shall have the meanings defined below.

1.3.1 Contractor

A. The term Contractor refers to the Prime Contractor or any entity that holds a direct contractual agreement with the District for the execution of work under this specification. The Contractor is responsible for compliance with all contract documents, specifications, applicable codes, and coordination of work, whether self-performed or subcontracted.
B. Prime Contractor
   1. The Prime Contractor is the entity contractually responsible for the entire scope of work, including managing all subcontractors. The Prime Contractor may be a General Contractor, Electrical Contractor, or other entity as designated in the contract. Responsibilities include:
C. Ensuring all work meets contract documents, applicable codes, and specifications.
D. Coordinating all subcontractors to ensure compliance with pathway sizing, fill ratios, and infrastructure requirements.

E. Reporting any discrepancies in pathway availability, conduit sizing, or other conflicts to the District ITS Project Manager and Facilities Project Manager for resolution before proceeding.
F. Delivering final project completion and ensuring work is accepted per contract requirements.

1.3.2 District

A. Refers to Pomona Unified School District (PUSD), the governing entity overseeing all construction and technology infrastructure projects.

1.3.3 General Contractor (GC)

A. The General Contractor (GC) is a licensed contractor responsible for overall construction management, which may include site preparation, structural work, and coordination of multiple trades. The GC may also serve as the Prime Contractor if contractually designated.

1.3.4 ITS

A. Refers to the District's Information Technology Services (ITS) Department, responsible for managing telecommunications, networking, and low-voltage infrastructure.

1.3.5 ITS Project Manager

A. The ITS Project Manager is the District's representative responsible for overseeing all telecommunications, networking, and low-voltage infrastructure work and is appointed by the Director of Information and Technology Services or their designee. Responsibilities include:
1. Reviewing and approving all submittals pertaining to Division 28 work.
2. Reviewing and approving any variances Division 28 specifications and industry standards.
3. Verifying compliance with Division 28 specifications and industry standards.
4. Coordinating with the Facilities Project Manager to ensure low-voltage infrastructure aligns with overall project execution.

1.3.6 Owner

A. Synonymous with the Pomona Unified School District (PUSD), as the entity funding and authorizing the project.

1.3.7 Project Manager

A. The Project Manager is the District's representative responsible for oversight of all construction, scheduling, and contract compliance. This individual ensures project execution aligns with the District's goals, coordinates inspections, and serves as the point of contact for construction matters.
1. The Project Manager is responsible for coordinating communication between the Contractor and the ITS Project Manager to ensure Division 28 work is properly integrated into the overall construction schedule and project scope.
2. Facilitates resolution of conflicts between construction and ITS infrastructure requirements.
3. Ensures Division 28 work is completed in alignment with the project's construction milestones.

1.3.8 PUSD

A. Synonymous with the Pomona Unified School District (PUSD), as the entity funding and authorizing the project.

1.3.9 Subcontractor

A. A Subcontractor is any entity or trade working under the Prime Contractor to perform a specialized scope of work. Examples include:
1. Electrical Subcontractor – Responsible for power and conduit installation.
2. Low-Voltage Subcontractor – Responsible for structured cabling and telecommunications pathways.
3. Other Specialty Subcontractors – Includes security, audiovisual, and other trades.

B. All Subcontractors report to the Prime Contractor, who is responsible for their compliance with contract requirements.

1.4 COORDINATION WITH DISTRICT ITS DEPARTMENT

1.4.1 Project Coordination and Communication

A. The contractor shall coordinate with the District's ITS Department Project Manager and designated personnel prior to the start of any work.

1.4.2 The District ITS Department reserves the right to reassign or change the ITS Project Manager at any time.

1. Any change in Project Manager designation shall be communicated to the Contractor in writing by the District ITS Department.

2. Upon receiving notification of a change, the Contractor shall direct all future correspondence, coordination, and approvals to the newly assigned ITS Project Manager.

3. If a transition period is required, the outgoing ITS Project Manager shall facilitate a handover meeting to ensure continuity of project oversight.

1.4.3 Pre-Installation and Ongoing Coordination

B. The Contractor must schedule and attend a pre-installation coordination meeting with the District ITS Department to review project scope, site conditions, and any special requirements prior to the start of any work.

C. Ongoing communication with the District ITS Project Manager is required throughout the duration of the project to ensure compliance with District standards and integration with existing systems.

D. The **Contractor must provide advance notice of any planned service interruptions, testing, or major installations to allow for proper coordination and approval by the District ITS Department.**

1.5 COMPLIANCE WITH STANDARDS AND REGULATIONS

All work must be performed in accordance with the latest District ITS standards, industry best practices, and applicable codes.

1.5.1 Codes and Regulations

A. All materials, installation, and workmanship shall comply with the most recent editions of the following codes and regulations, including addenda and technical service bulletins (TSB), in effect at the time of bid submission:

1. National Electrical Manufacturers Association (NEMA).
2. 2025 California Electrical Code (CEC).
3. National Electrical Safety Code (NESC).
4. FCC Rules and Regulations.
5. Local, county, state, and federal regulations and codes.

1.5.2 Industry Standards Compliance

A. All materials, installation, and workmanship shall conform to the latest editions of applicable industry standards, best practices, and regulatory requirements, including but not limited to:

6. ANSI/TIA-568 – Structured Cabling Standards.
7. ANSI/TIA-569 – Telecommunications Pathways and Spaces.
8. ANSI/TIA-606 – Administration of Telecommunications Infrastructure.
9. ANSI/TIA-607 – Grounding and Bonding for Telecommunications.
10. ANSI/TIA-758 – Customer-Owned Outside Plant Telecommunications Infrastructure.
11. BICSI - Telecommunications Distribution Methods Manual (TDMM).
12. BICSI - Outside Plant Design Reference Manual (OSPDRM).
13. BICSI - Information Technology Systems Installation Methods Manual (ITSIMM).

14. All materials and products shall be Underwriters Laboratories (UL) listed or tested by a nationally recognized testing laboratory (NRTL) acceptable to the District, and shall meet or exceed applicable industry safety and performance standards.

1.5.3 District ITS Standards Compliance

A. The contractor must ensure that all installations meet the latest District ITS Standards and Design Guidelines.

1.5.4 Handling Non-Compliant Systems, Installations, and Pathways

A. If existing systems, installations, or pathways do not comply with current standards, the contractor shall:
15. Install new systems and pathways separately to prevent integration with non-compliant legacy infrastructure.
16. Retrofit existing installations and pathways where required to bring them into compliance with current standards.
17. Replace or properly abandon any obsolete or non-compliant conduit, raceways, or cable pathways that cannot be upgraded.
B. Expanding upon or reusing a non-compliant legacy system, installation, or pathway is strictly prohibited and must be corrected before new work proceeds.
C. The contractor shall:
18. Identify, document, and report all discovered non-compliant conditions, including pathways, conduits, cabling, and equipment.
19. Submit a corrective action plan for approval by the District ITS Project Manager before proceeding with work.

1.6 CONTRACT DOCUMENTS & INTERPRETATION

1.6.1 In the event of a conflict between the Division 28 specifications, industry standards and the drawings, the **Division 28 specifications shall take precedence**, unless otherwise approved in writing by the **District ITS Project Manager**.

1.6.2 All **requests for deviations** from Division 28 specifications must be submitted **in writing** to the District ITS Project Manager for **review and written approval** before implementation.

1.6.3 If discrepancies arise between Division 28 and other divisions (e.g., Division 26 – Electrical, Division 28 – Security), the ITS Project Manager shall provide the final determination for all work governed by Division 28.

1.7 COORDINATION & COMPLIANCE

1.7.1 General Responsibility

A. Prime Contractor Responsibilities:
1. Shall ensure all conduits and pathways meet required fill ratios before any cable installation begins.
2. Shall coordinate between subcontractors, including Electrical and Low-Voltage Subcontractors, to verify that all conduits are sized appropriately for the intended cable load.
3. If the drawings or specifications indicate a conduit size that does not meet the fill ratio requirements, the contractor shall:
- Notify the District ITS Project Manager immediately.
- Propose a revised conduit size or alternative solution to maintain compliance.
- Obtain written approval before proceeding with installation.
B. Low-Voltage Subcontractor Responsibilities:
1. Shall review all planned cable routes and verify that pathway sizing meets project requirements prior to installation.
2. Before pulling cables, shall verify that the existing fill ratio complies with Division 27 - Fill Ratio Requirements.
C. Discrepancy Management:

1. If a discrepancy is identified before or during installation, the responsible party must immediately notify the Prime Contractor and District ITS Project Manager.
2. Failure to comply with fill ratio requirements or address issues prior to installation will necessitate corrective action at no additional cost to the District.

1.7.2 Deficiency Identification/Resolution RFI:

A. The contractor shall submit an RFI for any issues or deficiencies identified, including, but not limited to:
   1. Fill ratio non-compliance, as outlined in Section 27 00 00 Part 1.9 Pathway Fill Ratio Requirements.
   2. Inability to meet installation requirements or design intent.
   3. Non-viable pathways, such as obstructed conduits, damaged sleeves, or overfilled raceways.
   4. Conflicts with other building systems, including mechanical, plumbing, or electrical installations.
B. RFI Submission Requirements:
   1. Description of the discrepancy or issue, including location details and impact on the project.
   2. Proposed alternative solutions with supporting documentation, such as photos, drawings, and specifications.
   3. Impact analysis on project timelines, system performance, and compliance with standards.
   4. Recommended temporary measures, if applicable, to maintain safety and system functionality until a permanent resolution is approved.
C. RFI Approval Process
   1. Submit the RFI to the District ITS Project Manager within 3 business days of identifying the issue.
   2. Contractor will obtain written approval from the District ITS Project Manager before proceeding with any modifications.
   3. If the approved RFI necessitates changes to the as-built documentation, the contractor shall update all affected documents as part of the final submittals per Section 27 05 50 - Communications Submittals.

1.8 PATHWAY REQUIREMENTS

1.8.1 General:

A. Pathways for all Division 28 systems shall be designed and installed in accordance with Division 27 – Communications, including all referenced standards, materials, and installation practices. This includes adherence to all Division 27 requirements for conduit fill ratios, maximum allowable bends, and any other pathway-related limitations.

1.9 SAFETY REQUIREMENTS

1.9.1 General Safety Requirements

A. The Contractor shall comply with all applicable safety codes, including:
   1. OSHA regulations (e.g., 29 CFR 1926 for construction safety).
   2. National Electrical Code (NEC), especially regarding electrical safety.
   3. Local Authority Having Jurisdiction (AHJ) requirements.
B. Personal Protective Equipment (PPE):
   1. All workers must wear appropriate PPE
C. Job Site Safety:
   1. Maintain clear access to emergency exits and fire equipment at all times.
   2. Store materials safely, avoiding obstructions in walkways and access points.
   3. Secure all tools and equipment when not in use, especially in occupied areas.
D. Additional Safety Requirements:
   1. Individual sections within Division 28 may include additional safety requirements specific to their section.
   2. Contractors are responsible for complying with all safety requirements, including those found in specific sections.

1.9.2 Contractor Responsibilities

A. The Contractor is responsible for:
   1. Providing all necessary safety equipment and ensuring it is in good working order.
   2. Conducting regular safety briefings with work crews, especially when job conditions change.
   3. Reporting any safety incidents or near misses to the District ITS Project Manager within 24 hours.
B. Pre-Work Safety Assessment:
   1. Highly recommend taking photos of work areas before starting work to document existing conditions.
   2. Report any pre-existing hazards or damage to the District ITS Project Manager before work begins.

1.9.3 Safety for Underground Structures

A. Barrier & Safety Measures:
   1. When working in underground structures, the Contractor shall ensure the safety of personnel and prevent unauthorized access by:
      - Caution taping off the area with high-visibility tape.
      - Installing physical barriers, such as cones, safety fencing, or portable barricades, around the open pull point.
      - Posting warning signs indicating "Open Trench", "Work in Progress", or "Do Not Enter".
B. Monitoring Requirements:
   1. Open pull points may not be left unattended at any time.
   2. The Contractor shall assign a dedicated spotter or safety monitor to remain at the pull point whenever the cover is removed.
   3. The safety monitor must:
      - Maintain visual contact with the open pull point.
      - Direct pedestrians and other workers away from the hazard area.
C. Unattended Pull Points:
   1. If the pull point must be left unattended, the Contractor shall securely replace the cover and ensure it is locked or bolted if applicable.
   2. Temporary covers, such as weighted steel plates, may be used only if they are:
      - Rated for the load requirements of the area (e.g., vehicular traffic, pedestrian use).
      - Properly labeled with warning signage and taped off until permanent covers are reinstalled.
D. Inspection Before Leaving Site:
   1. At the end of each workday, the Contractor shall conduct a final safety check to ensure:
      - All pull points are properly covered and secured.
      - No barriers or safety equipment remain in walkways or roadways, unless approved by the ITS Department Project Manger
      - The work area is free of hazards, including tripping hazards and exposed cables.

1.9.4 Safety Measures for Overhead Work in Occupied Spaces

A. When performing overhead work in spaces that may be occupied during business hours, the Contractor shall:
   1. Establish a safe work zone around the overhead work area.
   2. Use barriers, such as caution tape, safety cones, or portable barricades, to prevent access to the hazard area.
   3. Post clear signage, including "Overhead Work in Progress", "Keep Clear", and "Authorized Personnel Only" as needed.
B. Protection Measures:
   1. Ensure the work zone is large enough to protect people from:
      - Falling objects, such as tools, hardware, or debris.
      - Overhead hazards, including lifts, scaffolding, and open ceiling tiles.
C. When working in hallways, classrooms, or shared spaces:
   1. Restrict access to the area directly below and adjacent to the work area.
   2. Provide alternative routes if hallways or entrances are blocked.
   3. Ensure emergency exits and fire egress paths are not obstructed.

1.10 SITE SECURITY REQUIREMENTS

1.10.1 General Security Responsibilities

A. The Contractor is responsible for maintaining the security of the job site, including:
   1. Securing all access points, doors, windows, and gates at the end of each workday.
   2. Ensuring that all keys, badges, and access credentials are accounted for and returned as required.
   3. Reporting any security incidents or access control issues to the District ITS Project Manager and School Security immediately.

B. Preventing Unauthorized Access:
   1. Close and lock doors when moving between rooms, preventing unauthorized access
   2. If working in sensitive areas, such as server rooms or secure spaces, ensure:
      - The area is never left unsecured.
      - Only authorized personnel are allowed entry.

C. Photo Documentation:
   1. Highly recommend taking photos of work areas before starting work, particularly in:
      - Classrooms, offices, and sensitive locations.
      - Areas with pre-existing damage or security concerns.
   2. Existing damage must be reported to the District ITS Project Manager before work begins to avoid liability.

D. Incident Reporting:
   1. If the Contractor cannot secure an area, they must:
      - Notify the District ITS Project Manager and School Security immediately.
      - Document the issue in the daily security log.
      - Take temporary measures to reduce risks.

1.10.2 School Security Information

A. School Security Phone Number:
   1. After Hours: 909-629-7797
   2. During Business Hours: 909-397-4800

B. Emergency Contact Protocols:
   1. If a security emergency occurs, contact School Security immediately, then notify the District ITS Project Manager.
   2. Keep a record of all communications with School Security, including call times, personnel contacted, and instructions provided.

1.10.3 Check-In Procedures:

A. Scheduling & Approval:
   1. All site work must be scheduled a minimum of 48 hours in advance with the District ITS Project Manager.
   2. Failure to schedule with District ITS Project Manager may result in contractor being denied entry and turned away.

B. Business hours work
   1. Before starting work each day, the Contractor shall:
      - Check in at the school office.
      - Sign in and obtain a visitor badge.
      - Provide work details, including:
        ◊ Locations being accessed.
        ◊ Expected duration of work.
   2. After-hours or weekend work
      - The Contractor must contact School Security at the start work before entering the campus and provide:
        ◊ Name of Company
        ◊ Expected work hours.
        ◊ Work location, including site and areas

- Failure to notify School Security may result in a police response.

C. If unable to check in, immediately notify the District ITS Project Manager.

1.10.4 Check-Out Procedures:

A. Business hours work
1. Check-out with office before leaving campus.
2. Verify that all areas and equipment accessed during work are properly locked and secured.
3. Tools, materials, and equipment are secured and stored safely.

B. After hours/weekends work
1. Contact School Security before leaving campus.
2. Verify that all areas and equipment accessed during work are properly locked and secured.
3. Verify that the campus perimeter is secured, including all exterior doors and gates.
4. Restore all intrusion alarm systems to their normal operating state before leaving the site.
5. Perform a final walkthrough to ensure all exterior doors and gates are securely locked.
6. Notify School Security immediately if there are area that are unable to be secure, do not leave site until direct to do so by School Security.

1.10.5 Key & Access Control Management

A. Key Management:
1. The Contractor shall maintain strict control of all District-provided keys.
2. Return keys daily, unless overnight access is pre-approved.
3. Report lost or damaged keys to the District ITS Project Manager and School Security immediately.
4. Contractor responsible for all cost associated remediation of lost or solen keys

B. Access Control Systems:
1. Restore all access control systems to their normal operating state before leaving the site.
2. Restore all intrusion alarm systems to their normal operating state before leaving the site.
3. Ensure alarm systems are re-armed and security devices are functioning properly.

1.11 QUALITY CONTROL

1.11.1 Contractor Qualifications

A. Licensing Requirements
1. The Contractor shall have a current and valid State of California:
- C-7 Low Voltage Systems License OR
- C-10 Electrical Contractor License.

B. General Contractor Requirements
1. Shall have been in business of furnishing and installing communication systems of this type for at least two years
2. Is capable of being bonded to assure the District of performance and satisfactory service during the guarantee period.
3. Shall be a factory authorized installer for the brands of equipment offered and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment located within 100 miles from District.

C. General Training & Certification Requirements
1. The Contractor shall be **trained, certified, and authorized** to install, terminate, and test **all systems covered under Division 28 included within their scope of work**.

D. Manufacturer-Specific Certification Requirements

Contractor must be a manufacture authorized installer and possess a current manufacture installer certification for all installed products.

E. Proof of Certification & Compliance
1. The Contractor must provide proof of all required certifications upon request.
2. Only certified personnel shall perform installation, termination, programming, and testing of applicable systems.

3. If subcontractors are used, they must also meet the same certification requirements.

1.11.2 Abandoned Cabling

A. General Requirements
1. All abandoned cabling shall be removed unless explicitly noted otherwise in the contract documents or directed by the District ITS Project Manager.
2. Abandoned cabling is defined as any cable that:
   - Is no longer in active use or designated for future use per NEC 800.2 and 800.25.
   - Is not terminated on both ends
   - Has been replaced or decommissioned without being fully removed.
3. Removal shall include all abandoned horizontal, backbone, and device cabling.
4. Cables that are known to be abandoned but cannot be removed must be documented in as-built drawings.
5. The removal of abandoned cabling shall comply with:
   - NEC Article 800.2 & 800.25 – Defines abandoned communication cables and mandates removal.
   - CEC Title 24, Part 3 – California-specific electrical code requirements for cabling removal.
   - TIA-569-D – Telecommunications Pathways and Spaces standard addressing abandoned cable management.
   - NFPA 70 & NFPA 75 – Fire protection requirements related to excess cable accumulation.

B. Accessibility & Removal
1. Accessible Pathways:
   - All abandoned cabling in accessible pathways must be removed entirely unless otherwise approved by the District ITS Project Manager.
2. Inaccessible Pathways:
   If a portion of a cable is inaccessible due to crushed conduit, high risk to other systems, or structural barriers:
   - The cable shall be severed 12 inches beyond the point where it exits the inaccessible pathway
   - The remaining inaccessible section of cable may remain in place, but all accessible portions must be fully removed.
   - The cable shall have both ends of the remaining cable shall be labeled with a **2-inch-wide permanent red label** featuring **black text** stating **"ABANDONED."** Labels shall be machine-printed and securely affixed.
   - Contractor shall submit written justification to the District ITS Project Manager for approval before leaving any cable in place.

C. Pathway Considerations
1. Pathways containing abandoned cable shall not be used for new cable installations until all abandoned cables are fully removed.
2. If abandoned cable cannot be fully removed due to inaccessibility, the pathway shall be marked as "FULL" or "OUT OF SERVICE" at all accessible entry points and shall not be used for new cable.
3. If a pathway is partially blocked, it must be evaluated for future use and documented as restricted.
4. If abandoned cable is removed from conduit, the contractor shall install a new pull string per Section 27 05 28.

D. Documentation & Compliance
1. All abandoned cable locations must be noted in as-built documentation.
2. The contractor is responsible for verifying that all removals comply with NEC, CEC, and any applicable state and local codes.
3. Any exceptions to complete removal must be approved in writing by the District ITS Project Manager.

1.12 PROTECTION OF EXISTING EQUIPMENT DURING CONSTRUCTION

1.12.1 Where existing telecommunications or data equipment is located within or adjacent to a construction area, the Contractor shall coordinate with the District ITS Project Manager to ensure uninterrupted service and full protection of active systems throughout the construction phase.

1.12.2 Active equipment shall not be exposed to dust, debris, vibration, or moisture from construction activities. This includes, but is not limited to:

A. Demolition
B. Wall framing or drywall sanding
C. Concrete cutting or core drilling
D. Abatement or hazardous material removal

1.12.3 If early installation or continued operation in an active construction zone is necessary, the Contractor shall:

A. Submit a written justification to the District ITS Project Manager.
B. Provide a detailed protection and cleaning plan for approval, including:
   1. Physical containment or barrier systems
   2. Air filtration and negative pressure measures
   3. Cooling and ventilation provisions to prevent heat buildup around active equipment
   4. Cleaning protocols and materials

1.12.4 The Contractor shall be fully responsible for:

A. Protecting all systems from environmental or physical damage.
B. Restoring any impacted services or equipment.
C. Performing all cleaning and reactivation steps to the satisfaction of the District ITS Project Manager.

1.12.5 Any equipment that fails or is damaged as a result of construction-related conditions or inadequate protection shall be replaced by the Contractor at no cost to the District, including all associated materials, labor, and configuration.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS & COMPONENTS

2.1.1 New and from a regularly manufactured line, currently in production at the time of installation, unless otherwise specified in writing by the District ITS Project Manager.

2.1.2 Of the quality specified in the contract documents.

2.1.3 Compliant with all applicable codes, regulations, and standards.

2.1.4 All Division 28 systems shall be installed by certified contractors and shall meet all applicable manufacturer warranty requirements.

2.1.5 System-specific product details, including approved manufacturers and performance requirements, are specified in individual Division 28 and Division 28.

2.2 SUBSTITUTIONS & DEVIATIONS

2.2.1 General Requirements

A. All materials and components shall be selected from the Pre-Approved Materials Schedule in Section 28 06 50 – Communications Documentation & Submittals.
B. Any substitutions or deviations from the Pre-Approved Materials Schedule require prior written approval from the District ITS Project Manager.
C. Substitutions will only be considered if:
   1. The specified item is discontinued or unavailable.
   2. The substitution offers equal or better performance, quality, and warranty at no additional cost to the District.
   3. The substitution is required due to project-specific conditions and is approved in writing by the ITS Project Manager.

D. All products must be new, UL/NRTL-listed, compatible, non-proprietary, and compliant unless otherwise specified.

2.2.2 Software, Licenses & Server Requirements

A. Contractor must furnish all licenses.
B. Licenses must be registered to PUSD.

2.2.3 Compatibility & Contractor Responsibility

A. All substituted products must be fully compatible with the District's existing infrastructure.
B. If a substituted product is found to be incompatible, the contractor shall be responsible for replacing all non-compatible equipment at no additional cost to the District.
C. Approval of a substitution does not waive the contractor's responsibility for proper installation, performance, and compliance with contract requirements.

2.2.4 OWNER-FURNISHED, CONTRACTOR-INSTALLED (OFCI)

A. Contractor shall:
   1. Receive, inspect, inventory, store securely.
   2. Install OFCI items with provided accessories.
   3. Protect OFCI equipment; responsible for damage/loss.
B. Doa Parts Requirements
   1. DOA items must be reported to ITS Project Manager within 48 hours of receipt.
   2. Report must include serial, photos, description, date/time.
   3. Failure results in Contractor liability.

2.2.5 Substitution Request Process

A. All substitution requests shall be submitted in writing to the District ITS Project Manager at least 30 days prior to procurement or installation.
B. Each request shall include:
   1. A completed Substitution Request Form (28 06 50 PART 3)
   2. Manufacturer data sheets and specifications for both the specified item and the proposed substitute.
   3. Independent test reports (if applicable) verifying compliance with performance standards.
   4. A written statement detailing the reason for the substitution request.

2.2.6 Evaluation & Approval

A. The District reserves the right to request a physical sample of any proposed substitution at no cost to the District for evaluation.
B. The District ITS Project Manager will evaluate substitutions based on:
C. Compliance with District standards and Division 28 performance requirements.
D. Compatibility with existing District systems.
E. Long-term reliability, maintainability, and manufacturer support.
F. Review Timeframe: The District will provide a decision within 10 business days of receiving a complete substitution request. If additional information is required, the timeframe may be extended.

2.3 SYSTEM INFRASTRUCTURE & INTEROPERABILITY

2.3.1 All systems shall be designed and installed to ensure full interoperability between Division 28 subsystems.

2.3.2 All cabling and connectivity components shall be fully compatible with the active and passive Division 28 infrastructure, as well as all Division 27 and Division 28 systems, as specified in their respective sections.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 General Workmanship Standards

B. All work shall be performed in a neat, professional, and workmanlike manner accordance with:
   1. BICSI Telecommunications Distribution Methods Manual (TDMM).
   2. ANSI/TIA and NEC installation standards.

A. Improperly installed or damaged equipment, cabling, or components shall be removed and replaced at no additional cost to the District.

B. The contractor shall thoroughly clean all equipment and materials. All exposed parts of the equipment, cabinets, and other equipment shall be left in a clean condition, unblemished and free of all dirt, dust, smudges, spots, fingerprints, etc., The contractor shall remove all debris and rubbish occasioned by the work from the site. The contractor shall thoroughly clean all buildings of any dirt, debris, rubbish, marks, etc., caused by the performance of this work.

3.1.2 Coordination & Integration

A. Contractor shall **coordinate all Division 28 system installations** with electrical, security, and other trades to avoid conflicts.

B. Verify all pathways, power, and grounding provisions before starting work.

C. All equipment shall be fully integrated with active and passive network infrastructure per project requirements.

3.2 LABELING, TESTING & CERTIFICATION

3.2.1 Labeling & Identification

A. All labeling shall comply with ANSI/TIA-606 and Section 27 05 53 – Identification for Communications Systems.

B. Machine-printed labels only; handwritten labels are not permitted.

C. All equipment shall be labeled in accordance with Section 27 05 53 – Identification for Communications Systems, as well as the labeling requirements specified in the applicable Division 27 and Division 28 sections.

3.2.2 Testing & Certification

A. All Division 28 systems requiring testing and certification shall comply with the requirements specified in their respective sections.

B. All test results shall be submitted to the District ITS Project Manager before system acceptance.

3.3 CLEANUP & RESTORATION REQUIREMENTS

3.3.1 General Cleanup Standards

A. The Contractor shall maintain clean and orderly work areas throughout the project duration, ensuring that tools, materials, and equipment are stored safely and trash is regularly removed.

B. During the course of work, the Contractor shall:
   1. Cover and protect floors, furniture, and sensitive equipment to minimize dust and prevent damage.
   2. Use drop cloths, floor protection, and dust containment methods where needed.
   3. Prevent debris accumulation in hallways, stairwells, and emergency exits, maintaining safe and clear access.

C. Post-Work Daily Cleanup
   1. Daily Cleanup Requirement:
      - At the end of each workday, the Contractor shall perform a full cleanup of all work areas, ensuring:
      - Ceiling tiles are reinstalled, with damaged tiles replaced immediately.
      - Pull box covers, LB fittings, and access panels are secured in place.

- Tools, materials, and equipment are properly stored or removed from the site.
- Trash, debris, and waste materials are removed from the job site.
- Walkways, corridors, and occupied spaces are left in a clean and safe condition.

2. Nightly Walkthrough:
   - The Contractor shall conduct a self-inspection at the end of each shift to verify compliance with cleanup requirements.
   - Any deficiencies identified must be addressed immediately, ensuring the site is ready for normal use by building occupants the next day.

3.3.2 Post-Work Final Cleanup & Restoration

A. Ceiling Tiles:
   1. Reinstall all ceiling tiles that were removed during work.
   2. Replace broken, damaged, or stained tiles with matching ceiling tiles.
B. Pull Boxes & LB Fittings:
   1. Securely reinstall all pull boxes and LB covers.
   2. Ensure labeling remains visible and legible, as required by Section 27 05 53.
C. Wall & Ceiling Repairs:
   1. Patch and repair any damage to walls and ceilings, including holes, scratches, and marks.
   2. Repaint surfaces to match existing finishes, using color-matched paint and consistent textures.
   3. Remove all markings, including pencil marks, tape residue, and layout lines.
D. Room Condition:
   1. Leave work areas free of dust, debris, and trash.
   2. Vacuum floors, wipe down surfaces, and dispose of all waste materials offsite.
   3. Do not use the District's trash receptacles or dumpsters without prior approval.
E. Final Walkthrough:
   1. Conduct a walkthrough with the District ITS Project Manager to verify all cleanup tasks are completed.
   2. Address any deficiencies identified during the walkthrough immediately.

3.3.3 Additional Requirements for Occupied Spaces

A. When working in occupied areas, the Contractor shall:
   1. Minimize disruption to building occupants, including noise, dust, and access limitations.
   2. Coordinate with facility staff to schedule work during non-peak times when possible.
   3. Notify the ITS Project Manager if work cannot be completed without impacting building operations, to arrange alternative solutions.

3.3.4 Damage Responsibility & Pre-Work Documentation

A. Contractor's Responsibility for Damages:
   1. The Contractor is responsible for repairing or replacing any damage caused by their work, including but not limited to:
      - Walls, ceilings, and floor finishes.
      - Ceiling tiles, lighting fixtures, and HVAC components.
      - Existing equipment, furniture, and building infrastructure.
   2. Repairs must restore surfaces to their original condition or as approved by the District ITS Project Manager.
B. Pre-Work Documentation:
   1. It is highly recommended that the Contractor document all work areas prior to the start of work.
   2. Pre-work documentation should include:
      - High-resolution photos of existing conditions.
      - Written descriptions of pre-existing damage, if applicable.
      - Date-stamped records to support existing condition claims.
C. Reporting Pre-Existing Damage:
   1. Any existing damage must be reported to the District ITS Project Manager prior to the start of work.

2. Document all pre-existing conditions with photos and written descriptions, including:
   - Ceiling tiles with stains or cracks.
   - Walls with holes, scratches, or peeling paint.
   - Existing equipment with visible damage or defects.
3. Failure to document pre-existing damage may result in the Contractor being held responsible for repairs.

3.4 FINAL ACCEPTANCE & DOCUMENTATION

3.4.1 **General Requirements**

A. Final acceptance of the project will not be granted until all work has been completed, tested, and reviewed by the District ITS Project Manager.

3.4.2 Closeout Documentation

A. The Contractor shall submit all required closeout documentation per Section 27 05 50 – Communications Documentation & Submittals.
B. All as-built drawings, test results, warranty documentation, and submittals must be provided as outlined in 27 05 50.
C. **Final acceptance will not be granted until all required documentation has been received and approved.**

3.4.3 **System Testing & Certification**

A. All installed systems must pass final testing and certification before acceptance.
   1. Structured cabling systems shall be tested per industry standards, with results submitted in accordance with 27 05 50.
   2. Any system that fails testing must be repaired or replaced at the Contractor's expense before project closeout.

3.4.4 **Final Walkthrough & Punch List Resolution**

A. A final walkthrough will be conducted with the District ITS Project Manager to verify compliance with all specifications.
B. The Contractor shall correct all punch list items before project closeout.
C. Once all issues have been resolved, the ITS Project Manager will issue formal written acceptance of the project.

END OF SECTION

SECTION 28 06 50 – COMMUNICATIONS EQUIPMENT & MATERIALS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section provides a comprehensive schedule of approved equipment, and materials.

1.2 SUBSTITUTIONS

1.2.1 No substitutions will be accepted unless approved in writing by the ITS Project Manager.

1.2.2 Substitution approval process

A. Only listed manufacturers and models are permitted.
B. Any product substitutions must be submitted in writing to the ITS Project Manager for approval.
C. Substitutions must meet or exceed the listed product specifications and be certified for compatibility.
D. Approval must be obtained before procurement and installation.

PART 2 - PRODUCTS

2.1 ACCESS CONTROL

ITEM	MANUFACTURE	MODEL NUMBER	DESCRIPTION
Access Control Controller	Mercury	MP1502	Multi-door intelligent controller; supports 2 native doors, expandable to 64
Access Control Controller	Mercury	MP1501	Single-door PoE+ intelligent controller; supports 1 opening, 2 readers; expandable to 17
Access Control Power Supply	Altronix	eFlow104NB	120VAC input, 10 A24VDC output supply/charger.
Access Control Controller	Altronix	ACM8	8-output fused access power controller; supports Fail-Safe/Fail-Secure; fire alarm disconnect per output
Power Distribution Module	Altronix	PDS16	16-output dual-input fused power distribution module; selectable input steering; 5–24VDC or 16–28VAC
Voltage Regulator	Altronix	VR6	24VDC input regulator; selectable 5VDC or 12VDC output; 6A max
Access Control Enclosure	Altronix	Trove2M2	Access control enclosure compatible with Mercury hardware
Mounting Backplane	Altronix	RSB1	Backplane for mounting controllers and power components inside Trove enclosures
Reader Controller	Mercury	MR52	Dual reader interface module
Reader Controller	Mercury	MR50	Single reader interface module
Reader	Essex	IRXPO-2S-BLE	Single gang multiCLASS SE reader with BLE
Reader	Essex	IRXPO-3S-BLE	Double gang multiCLASS SE reader with BLE; pedestal/gate use
Reader	Essex	IRXPO-1S-BLE	Narrow profile multiCLASS SE BLE reader
Door Position Switch	Bosch	1076D-N	DPDT steel door contact, 1/2 inch gap
Request-to-Exit Sensor	GE/Interlogix	DS160i	High-performance PIR REX sensor
Electric Rim Strike	HES	9600	Fail-secure surface mount rim strike; requires SmartPac III
Mortise Electric Strike	HES	8500	Fail-secure mortise electric strike; requires SmartPac III
Cylindrical Electric Strike	HES	8000C	No-cut cylindrical strike; requires SmartPac III
Strike Power Conditioner	HES	SmartPac III	Inline strike power conditioner

Electrified Mullion	Command Access	V-KRM-EL	Electrified removable mullion with wiring passthrough

2.2 VIDEO SURVEILLANCE

ITEM	MANUFACTURE	MODEL NUMBER	DESCRIPTION
Camera	iPRO	WV-S65300-ZY	S-series PTZ camera with AI Engine 2MP (1080p) 3.1x Outdoor PTZ Network Camera
Camera	iPRO	WV-S25500-V3LN	5MP Vandal Resistant Outdoor Dome Network Camera
Backbox	Panasonic	WV-QJB500-W	Backbox bracket for outdoor box camera
Bracket	iPRO	WV-QWL500-W	Integrated wall mount bracket
Bracket	iPRO	WV-QJB504-W	Outdoor Base Mount Bracket for Outdoor Dome Camera
Video Intercom	Hanwa	TID-600R	2MP Video Intecom

2.3 INTRUSION DETECTION

ITEM	MANUFACTURE	MODEL NUMBER	DESCRIPTION
ALARM ENCLOSURE	DMP	352P-G	EXTRA-LARGE ALARM ENCLOSURE FOR PANEL AND ACCESSORIES
POWER SUPPLY	DMP	505-12	12VDC REGULATED POWER SUPPLY WITH BATTERY CHARGING
POWER DISTRIBUTION BOARD	ALTRONIX	PD16W	16-OUTPUT FUSED LOW-VOLTAGE POWER DISTRIBUTION MODULE
ALARM PANEL	DMP	XR150	NETWORK/DIALER INTRUSION CONTROL PANEL (NO ENCLOSURE)
ALARM PANEL	DMP	XR550	HIGH-CAPACITY NETWORK/DIALER INTRUSION CONTROL PANEL (NO ENCLOSURE)
ZONE EXPANDER	DMP	714-16PCB	16-ZONE EXPANSION MODULE
ZONE EXPANDER	DMP	714-18T	4-ZONE LOOP EXPANDER WITH INTEGRATED TERMINAL STRIP
KEYPAD	DMP	7060-I	ALARM KEYPAD, IVORY FINISH
MOTION DETECTOR	BOSCH	DS9370	360-DEGREE CEILING-MOUNT PIR MOTION DETECTOR
MOTION DETECTOR	BOSCH	ISC-PDL1-WAC30G	LONG-RANGE 100 FT ANTI-MASK PIR MOTION DETECTOR
MOTION DETECTOR	BOSCH	ISC-CDL1-W15G	STANDARD 50 FT PIR MOTION DETECTOR
DOOR CONTACT	GE	1078W / 1076W	STEEL-DOOR MAGNETIC CONTACT PAIR
DOOR CONTACT	BOSCH	ISN-C66	OVERHEAD DOOR TRACK-MOUNT MAGNETIC CONTACT
DOOR CONTACT	BOSCH	ISN-CMET-200AR	ARMORED MAGNETIC DOOR CONTACT
DOOR CONTACT	BOSCH	ISN-C60-W	SLIM TERMINAL MAGNETIC CONTACT

2.4 SPECIALIZED SYSTEMS

ITEM	MANUFACTURE	MODEL NUMBER	DESCRIPTION
Vape Sensor	Triton	TRTN-UA	Smart Sensor for Health, Safety, and Drug Detection

PART 3 - SUBSITIONS REQUEST FORM

General information

Project name: _____

Project location: _____

Contractor name: _____

Contact person: _____

Phone number: _____

Email: _____

Date submitted: _____

Substitution details

Specification section (e.g., 28 11 00): _____

Pre-approved product (manufacturer & model): _____

Proposed substitute (manufacturer & model): _____

Reason for substitution request: (check one)

☐ specified product is discontinued or unavailable

☐ proposed product offers equal or better performance at no additional cost

☐ project-specific conditions require a substitution

☐ other (explain): _____

Performance & compliance

(attach supporting documentation as required)

Requirement	Pre-approved product	Proposed substitute	Meets or exceeds? (yes/no)
Manufacturer warranty			
Compliance with TIA/NEC standards			
Physical dimensions (rack units, size, weight)			
Electrical requirements (voltage, amperage)			
Environmental ratings (temp, humidity)			
Network/power compatibility			
Availability (lead time)			

Required Attachments

(submissions without required attachments will be rejected)
☐ manufacturer data sheets/specifications for both products
☐ independent test reports (if applicable)
☐ installation instructions & compatibility documentation
☐ sample (if requested by the district)

Contractor certification

I certify that the proposed substitution meets or exceeds the requirements of the specified product and will be installed in full compliance with contract requirements. I acknowledge that if the substitute product is later found to be incompatible, the contractor will be responsible for replacing all non-compatible equipment at no additional cost to the district.

Contractor signature: _____ date: _____

District review & approval *(for district use only)*

Review date: _____

Substitution request status:
☐ approved – substituted product may be used
☐ approved with conditions – (see comments)
☐ rejected – contractor must use the specified product
Comments/conditions:

District its project manager signature: _____ date: _____

END OF SECTION

SECTION 28 10 00 – ACCESS CONTROL

PART 1 - GENERAL

1.1 INTRODUCTION

1.1.1 The District has adopted Maxxess eFusion as its enterprise-wide access control platform for new installations.

1.1.2 All provided products must fully integrate with this system and operate as a single, seamless, centrally managed solution districtwide.

1.1.3 The system must support automated user account creation and management.

1.2 GENERAL REQUIREMENTS

1.2.1 Contractor must comply with ALL Division 27 and Division 28 sections in full.

1.2.2 If Division 27 00 00 is not provided, the contractor must request it from the ITS Project Manager.

1.2.3 Any discrepancies between: this specification, drawings, actual site conditions, or methods proposed must be reported to the District for resolution.

1.2.4 Installation of parts in sub optimal conditions (even when approved parts are used) shall be deemed non-compliant.

1.2.5 All electronic security system equipment must be furnished and installed by an authorized manufacturer distributor/installer with proof of authorization.

1.2.6 Entire access control system must be installed by one primary contractor. Subcontractors act solely as the agent of the primary contractor.

1.2.7 Upon District notification of failure, the contractor must repair or replace failed components that no longer meet manufacturer specifications.

1.2.8 Installation must meet manufacturer requirements to maintain warranty.

1.2.9 Installation must be supervised/inspected by an installer with current Maxxess eFusion certification (issued within the last 5 years).

1.3 SUBSTITUTIONS

1.3.1 Substitution of parts/software is allowed only if the contractor proves equivalence.

1.3.2 If accepted, the contractor must pay all costs for District staff to receive factory certification training (travel, lodging, meals, gear, etc.).

1.3.3 Training must allow District staff to perform installs, repairs, service, and software upgrades without voiding warranties.

1.4 QUALITY ASSURANCE STANDARDS

1.4.1 Regulatory Requirements

A. Equipment must comply with:
1. NEC / NFPA
2. TIA 568 C
3. TIA 569
4. TIA 607
5. ICC/ANSI A117.1 (Accessibility)
6. ADA requirements

1.4.2 Contractor Qualifications

1.4.3 Contractor must:

A. Be trained, authorized, certified for all products installed.
B. Hold a current valid Installer Certification (issued within past 2 years OR valid through project duration).
C. Have minimum 5 years experience designing, supervising, and installing access control systems.
D. Maintain a local office within 60 miles staffed by factory trained techs.
E. Keep an inventory of critical spare parts locally.
F. Provide a dedicated project manager for entire duration (subject to District approval).
G. Maintain compliance with Drug Free School Zone laws.

1.5 PRE-INSTALLATION CONFERENCE

1.5.1 Before any work begins:

A. Contractor must meet with the ITS Project Manager to review installation methods, materials, and coordinate shared spaces.
B. Work at school sites must be scheduled in advance.
C. If the contractor arrives without prior authorization, they will be removed from the site.
D. District will communicate any hazards (asbestos, lead, etc.).
E. Contractor must immediately notify District of any safety concerns.

1.6 WARRANTY

1.6.1 Provide a 3-year factory warranty on the entire system beginning at Notice of Completion.

1.6.2 All system updates during the warranty period must be provided at no cost to the District.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

2.1.1 All products shall be new, commercial grade, and compliant with:

A. Applicable codes and standards (NEC, NFPA, TIA, ADA, ICC/ANSI A117.1).
B. All Division 27/28 sections.
C. District ITS Standards.

2.1.2 All equipment shall be fully compatible with and support integration into the District's enterprise access control platform.

2.1.3 Components shall be modular, serviceable, and designed for long term maintainability.

2.1.4 Specific manufacturers and model numbers are listed separately in Section 28 06 50 – Communications Equipment & Materials Schedule.

2.2 ACCESS CONTROL ENCLOSURES

2.2.1 Enclosure shall be purpose built for access control systems and sized to support all required controllers, interfaces, and power equipment.

2.2.2 Enclosure shall:

A. Support up to sixteen (16) access controlled openings.
B. Provide integrated backplates or mounting grids for controllers, power supplies, distribution modules, and accessories.
C. Include provisions for:
   1. Dedicated power conduit entry
   2. Low voltage and data conduit entry
D. Provide a lockable door
E. Provide an internal switch to disconnect 120VAC power to Power Supply

F. Provide an internal switch to disconnect 24VDC power to Power Supply
G. Provide adequate clearances for serviceability.

2.3 POWER SUPPLIES & BATTERY BACKUP

2.3.1 Power supplies shall:

A. Provide regulated DC output suitable for electronic access control loads.
B. Include independent over current protection for each output circuit.
C. Provide continuous 24VDC output @ 10A
D. Form C Supervision Contacts
   1. AC Fail
   2. Battery Fail
E. Include integrated battery charging for 24 volt DC backup.
F. Provide automatic switch over to stand-by battery when AC fails
G. Ensure that transfer to stand-by battery power is instantaneous with no interruption
H. Support minimum 4 hours of standby operation under full load (unless otherwise indicated by project scope).

2.3.2 Batteries shall be sealed lead acid or equivalent, sized per load calculations.

2.4 POWER DISTRIBUTION MODULES

2.4.1 Distribution modules shall:

A. Provide individually protected outputs for access control controllers and reader interfaces.
B. Provide individually protected low voltage outputs for field controllers and interfaces.
C. Support status indication (LEDs or equivalent) for each output.
D. Support 8 protected outputs.

2.4.2 Voltage regulation modules shall convert controller supply voltages to levels required for readers, interfaces, and accessories.

2.5 ACCESS POWER CONTROLLER

2.5.1 General Requirements

A. Access Power Controllers shall provide multi output, independently controlled power distribution for electrified door hardware and access control components. Units shall:
   1. Accept 12–24V AC or DC input power without requiring jumper or selector settings.
   2. Convert the input into multiple independently controlled, fuse protected outputs for powering locks, strikes, maglocks, door holders, and accessory devices.
   3. Provide individually triggered outputs capable of being activated via either:
      - Normally Open (NO) dry contact inputs, and/or
      - Open collector sink control signals
   4. Support both Fail Safe and Fail Secure operating modes for each controlled output.
   5. Offer dry Form C relay contacts for switching applications when fuses are removed
   6. Provide auxiliary unswitched power outputs for powering additional access devices as required.

2.5.2 Input Power Configuration Requirements

A. Access Power Controllers shall support both of the following:
   1. Common power input configuration:
      - One input providing both board operating power and lock/device power.
   2. Dual isolated power input configuration:
      - One input dedicated to controller/board power and a second independent input dedicated to lock or accessory power.

2.5.3 Output Requirements

A. Each Access Power Controller shall provide:
   1. Eight (8) independently controlled outputs.
   2. Fuse protected outputs rated up to 3.5A per output
   3. Eight (8) unswitched auxiliary outputs matching the input voltage.
   4. Form C relay output ratings of up to 5A @ 24V AC/DC (for fused output models when configured as dry contacts).

2.5.4 Fire Alarm Interface Requirements

A. The Access Power Controller shall include:
   1. A Fire Alarm Control Panel (FACP) interface capable of:
   2. Emergency egress release
   3. Alarm monitoring
   4. Activation of auxiliary shutdown devices
B. Input compatibility with:
   1. NO or NC dry contacts, or Polarity reversal FACP outputs
C. Individually selectable fire alarm disconnect for each controlled output (latching or non latching).

2.5.5 Indicators & Diagnostics

A. Units shall provide:
   1. Red LEDs indicating active (energized) outputs.
   2. Green LED indicating FACP disconnect activation.
   3. Removable terminal blocks for service friendly installation and maintenance.

2.5.6 Environmental & Compliance Requirements

A. Operating temperature range: 0°C to 49°C (32°F to 120°F).
B. Storage temperature range: –20°C to 70°C.
C. Relative humidity: Up to 85% non condensing.
D. Compliance with UL 294 for Access Control System Units.

2.6 ACCESS CONTROL CONTROLLERS

2.7 General Requirements

2.7.1 Access Control Controllers shall provide all decision making, event logging, credential validation, and database storage for the District's enterprise access control system. Controllers shall:

A. Support local processing during network outages.
B. Provide secure IPv4/IPv6 communication using TLS 1.2/1.3 or AES 256 encryption.
C. Support OSDP (including secure channel), Wiegand, and other standard reader signaling protocols.
D. Provide supervised inputs and Form C relay outputs for door hardware control.
E. Include onboard cybersecurity features such as secure boot, ARM TrustZone processing, crypto chip protection, and data at rest encryption.

2.7.2 Approved Controller Platforms

A. The District supports two Access Control Controller platforms for new installations:

2.7.3 Controllers

A. Single-Door Controller
   1. Support 1 reader for a single controlled opening.
   2. Provide onboard input/output capability including:
      - Two general purpose supervised/unsupervised inputs
      - Two Form C relay outputs for lock and auxiliary control
   3. Support Power over Ethernet Plus (PoE+) operation, providing sufficient power for the controller, readers, and door hardware when used in edge mounted scenarios.

4. Allow expansion via downstream RS 485 modules for additional inputs, outputs, or additional controlled openings.

B. Multi-Door Access Control Controllers

1. Support two (2) native controlled openings with the ability to support multiple reader technologies per opening.
2. Support expansion to large door counts, including:
   - Scaling up to multiple downstream RS 485 or network based expansion modules
   - Maximum expansion capability of up to 64 total openings, depending on module selection
3. Provide significant onboard storage for large site deployments, including:
   - High cardholder capacity (200k+ range)
   - Large transaction/event buffers for offline operation
4. Support enhanced edge processing, enabling the running of advanced logic, local rules, and integrated applications.

2.8 READER INTERFACES

2.8.1 A. Reader interfaces shall:

A. Support one or two access controlled opening as required.

2.8.2 Provide input/output integration for:

A. Request to Exit (REX)
B. Door Position Switch (DPS)
C. Lock control
D. Auxiliary functions
E. Support supervised inputs and controlled outputs.

2.8.3 Reader interfaces installed outside of primary access control enclosures shall be housed in lockable, service rated enclosures.

2.9 ACCESS CONTROL READERS

2.9.1 Readers shall:

A. Support multi technology credential formats mandated by District standards.
B. Support card, fob, mobile BLE, or equivalent credential technologies.
C. Be suitable for indoor or outdoor use depending on location.
D. Be vandal resistant.
E. Operate on low voltage (nominal 12VDC).
F. Support tamper detection where required.

2.9.2 Reader form factors may include:

A. Single gang
B. Double gang
C. Narrow profile
D. Pedestal or specialty mounting where applicable

2.10 DOOR CONTACTS, REQUEST TO EXIT (REX) DEVICES, AND SWITCHES

2.10.1 Door Position Switches (DPS):

A. Magnetic or mechanical contact type
B. Support steel door frames and varying gap tolerances
C. Provide dual pole or single pole operation as required by system design

2.10.2 Request to Exit Devices (REX):

A. Sensor based or hardware integrated

B. Shall only suppress door alarm/contact reporting; shall not unlock door directly unless specifically engineered for application

2.10.3 Door Unlock Switches:

A. Single pole maintained or momentary switches as required
B. Engraved cover plates indicating door or group served

2.11 ELECTRONIC LOCKS AND DOOR HARDWARE

2.11.1 Standard Approved Locking Hardware

A. General:
1. All standard electrified locking hardware shall be:
- Fail-Secure, unless otherwise required by code or directed by District ITS.
- Powered via 24VDC
- Be UL listed for access control and fire/life-safety usage
- Meet egress and local AHJ requirements
B. Electrified Strikes
1. Must be paired with a District approved strike power conditioner (e.g., SmartPac type) when required by the hardware.
2. Must be compatible with the existing mechanical lock and door frame preparation.

2.11.2 Prohibited Locking Hardware

A. The following categories of hardware are prohibited and may only be installed with explicit written approval from the ITS Department Project Manager:
1. Electrified Latch Retraction Panic Hardware
2. Magnetic Locks (Maglocks)
- May only be used in exceptional cases where door/frame conditions disallow electrified strikes.
- Requires written ITS approval plus documentation for CBC/NFPA code compliance.
3. Integrated Lock/Reader Units
- Examples: Schlage AD Series, Schlage NDE/LE, SALTO wireless, Aperio, BEST/Stanley WiQ, etc.
- May be considered only under written ITS approval for non-standard, isolated conditions.
4. Wireless Locks of Any Kind
- Examples: BLE, Wi Fi, ZigBee, Z Wave, proprietary mesh, or hybrid wireless devices.
- May be considered only under written ITS approval for non-standard, isolated conditions.
5. Electrified Mortise or Cylindrical Locks (Hardwired Integrated Units)
- Prohibited unless required for special applications and approved in writing.
6. Door Cords
- Only allowed only for limited-access mechanical rooms, and only with written ITS approval.
7. Other Electrified Door Hardware
- Any device not explicitly listed above requires prior written authorization to be used.
B. Approval Process:
1. Any prohibited hardware listed in this section may only be used if the District ITS Department Project Manager grants explicit written approval.
2. The written approval must:
- Be received before ordering or installing hardware
- Be included in the as built closeout documentation
- Clearly state the reason and the specific device approved
3. If written approval is not provided, the District will require the contractor to remove and replace the hardware at no cost.

2.11.3 UL AND CODE REQUIREMENTS (APPLIES TO ALL APPROVED EXCEPTIONS)

A. All hardware approved for exception must:

1. Be UL listed for access control and egress applications
2. Comply with NFPA 101, CBC, ADA, and local AHJ requirements
3. Not impair emergency exiting under any condition
4. Be fully compatible with the Access Control System

2.12 SPECIALTY DOOR TYPES

2.12.1 Motorized Gates

A. Shall include:
1. Controlled input(s) for open/close
2. Supervised contact monitoring
3. Integration via reader interface modules

2.12.2 Roll Up Doors

A. Shall include:
1. Controlled relay activation for open/close
2. Appropriate safety interlocks
3. Integration via reader interface module

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 Install all equipment per manufacturer requirements and District standards.

3.1.2 All hardware shall be installed to fully integrate with Maxxess eFusion, a UL 294 compliant enterprise access control & security management platform.

3.1.3 Work shall be neat, code compliant, and fully serviceable.

3.1.4 All controllers, interfaces, and power components shall be mounted per District's standard enclosure layout.

3.2 PREPARATION

3.2.1 Coordination

A. Coordinate all work with:
1. Division 26 Electrical
2. Division 27 Communications
3. Division 08 Door Hardware
B. Installation windows must be scheduled through District ITS Project Manager.
C. Access to school sites requires prior administrative approval.

3.2.2 Pre Installation Conference

A. Review project scope, hardware list, eFusion integration points, and required Mercury controller configuration.
B. Review graphical mapping, device naming, and logical grouping to be used in Maxxess eFusion.

3.2.3 Field Verification

A. Verify all existing site conditions before installation, including:
1. Door frames, hardware prep, power availability, network paths, conduit conditions.
2. IDF/MDF locations and available rack/board mounting space.
B. Confirm that openings designated for access control support required electrified hardware.
C. Confirm that required connectivity to the Maxxess eFusion server environment is available, including network segmentation and SQL Server access.
D. Identify all discrepancies and notify District ITS prior to installation.

E. Do not proceed until all conditions are acceptable.

3.3 WIRING PRACTICES

3.3.1 General Wiring Requirements

A. All wiring for access control devices shall be installed neatly, professionally, and in accordance with manufacturer recommendations and District standards.
B. All cable jackets shall remain intact up to the point of termination; excessive jacket removal is prohibited.
C. All wiring shall be fully supported and routed to avoid mechanical stress, abrasion, or pinch points.

3.3.2 Unused Wire Pairs

A. Unused conductor pairs shall NOT be cut off.
B. Unused wires shall be:
   1. Neatly wrapped backward along the main cable,
   2. Formed into a tidy, controlled service loop, and
C. Secured with a small hook and loop tie
D. Unused conductors must remain long enough to allow future re termination or re purposing.
E. Stripping, tinning, or exposing copper on unused conductors is strictly prohibited.
F. Unused pairs may not be left protruding into enclosures or junction devices.

3.3.3 Termination Requirements

A. All terminations shall be made using proper crimp terminals, screw terminals, or manufacturer approved punchdown blocks.
B. Wire nuts are prohibited on all access control system wiring.
C. Signal wiring shall not be landed under the same terminal as power wiring.

3.3.4 Shielding and Grounding (If Applicable)

A. When shielded cable is specified, shields shall be:
   1. Terminated only at one end,
   2. Bonded to the controller or enclosure ground as appropriate.
   3. Shielding shall not be left loose, uncut, or exposed within the enclosure.

3.3.5 Cable Dressing Requirements

A. Cable bundles shall be:
   1. Tightly grouped,
   2. Routed through wire guides or anchors,
   3. Tied with hook and loop ties (zip ties are prohibited).
B. Cable dressing shall allow full visibility and access to:
   1. Access control controllers
   2. Reader interfaces
   3. Power distribution modules
   4. Battery compartment
C. All wiring shall be oriented to avoid obstructing airflow, module removal, or enclosure servicing.

3.3.6 Service Loop Requirements

A. Provide a minimum 6-inch service loop at each termination point unless prohibited by the hardware.
B. Service loops shall be neatly formed and secured inside the enclosure or behind the wall device.
C. Service loops must not interfere with door operation, hinge movement, or enclosure closing.

3.4 NETWORK & SYSTEM CONNECTIONS

3.4.1 Enterprise Platform Integration

A. All controllers shall be enrolled into Maxxess eFusion using the District assigned hardware profile.

B. All devices must report real time events to the eFusion event engine and appear within the unified dashboard.

3.4.2 Networking Requirements

A. All controllers must be connected to the District network via dedicated, labeled, orange Ethernet cabling following all Division 27 requirements.

3.5 ACCESS CONTROL ENCLOSURES

3.5.1 General Requirements

A. All access control system components shall be installed in a District-approved Trove-series enclosure.
B. Installation shall comply with all enclosure and equipment mounting requirements defined in Section 27 11 00 – Communications Equipment Room Fittings, in addition to the requirements specified herein.
C. Installation shall meet the following minimum requirements for standardization, serviceability, and safety.

3.5.2 Required Components in Every Enclosure

A. Primary Power Supply (One per enclosure)
   1. Each enclosure shall include one (1) low voltage power supply, UL listed for access control, sized to support all controllers, interfaces, processors, power modules, reader loads, and auxiliary devices housed within the enclosure.
B. Power Distribution Board (One per enclosure)
   1. Provide a dedicated power distribution board to supply regulated low voltage power to:
   2. Mercury controllers
   3. Reader interfaces
   4. Access power controllers
   5. Auxiliary components
   6. Board shall include fused protected outputs and LED indicators.
C. Access Power Controllers
   1. Provide one (1) Access Power Controller for every eight (8) readers supported by the enclosure.
   2. Each APC shall:
      - Protect lock power circuits
      - Be used exclusively for powering electrified hardware
      - Reader interfaces and Mercury controllers shall not directly power lock devices.
D. RSB1 (or District Approved Equivalent) Power Shut Off Module
   1. Each enclosure shall contain one (1) RSB1 power shut off module, providing:
      - Master power disconnect for the power supply
      - Technician lockout capability
      - Safe servicing of components
   2. All splices to and from the RSB1 shall use crimp or lever style connectors; wire nuts are prohibited.
   3. Backup Batteries
      - Include sealed lead acid batteries properly sized based on load calculations for:
        ◊ Access control controllers
        ◊ Reader interfaces
        ◊ Access power controllers
        ◊ Distribution boards
        ◊ Electrified hardware
      - Batteries shall provide required District standby runtimes and be mounted in the designated battery bay.

3.5.3 Mounting Requirements (Refer to Section 27 11 00 for Complete Requirements)

A. All mounting, clearances, elevations, and physical installation practices shall comply with Section 27 11 00, including but not limited to:

1. Mounting height, spacing, and service access clearances for wall mounted equipment.
2. Minimum 3 ft clear working space in front of cabinets and panels.
3. Panel door must be able to open a full 90 degrees without obstructions.
4. Proper separation of AC, DC, and data pathways.
5. Conduit entry alignment and coordination with adjacent equipment.
6. Structural backing and load bearing requirements for wall hung panels.

B. If any conflict arises between 28 10 00 and 27 11 00, Section 27 11 00 shall govern enclosure mounting and spatial requirements.

3.5.4 Panel Layout

A. Panel shall be laid out as shown in Figure 28 10 00 -1

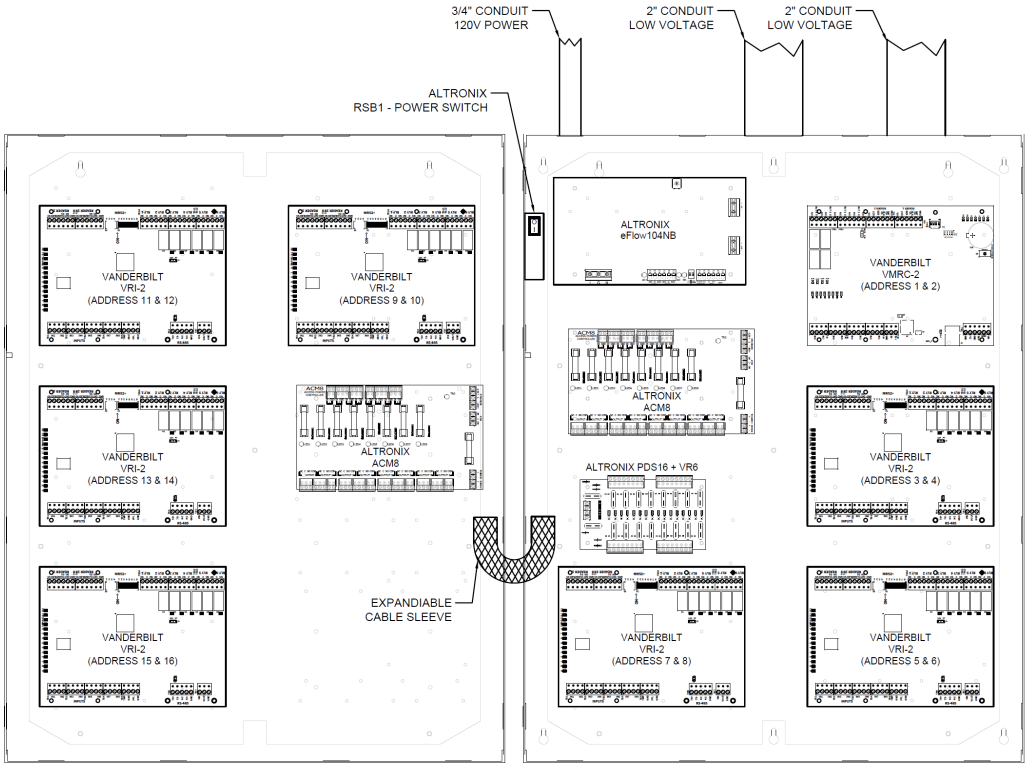


FIGURE 28 10 00 - 1

3.5.5 Internal Cable Routing Requirements

A. Maintain clear separation between:
1. Low voltage data
2. 12/24 VDC power
3. 120VAC primary power

B. Dress cabling using wire managers/anchors for a clean, serviceable layout.
1. All wiring shall be neatly routed to prevent obstruction of:
   - Battery storage areas
   - Reader interfaces
   - Access control controllers
   - Power modules
2. Cables shall be managed using velcro, the use of zip-ties is prohibited.

3. No exposed or unsupported terminal strips are permitted.
4. All DC splicing shall use euro style terminal strips, lever connectors, or crip connectors, wire-nuts and exposed terminal blocks are prohibited.

3.5.6 Labeling Requirements

A. Inside each enclosure, clearly label:
   1. Controller IP address
   2. Power supply circuit ID
   3. Reader interface channel/ID numbers
   4. Access power controller output assignments
   5. Battery installation date
   6. Wiring diagram
B. Labels shall comply with Section 27 05 53 – Identification.

3.6 MERCURY CONTROLLER INSTALLATION

3.6.1 Configure controllers with:

A. District assigned IP addresses
B. Proper panel type, firmware version, and downstream module mapping
C. Secure communication settings as defined by eFusion

3.6.2 All programming shall be performed in eFusion, including:

A. Reader modes
B. Schedules
C. Threat levels
D. Access levels
E. Alarm/event routing

3.7 POWER SUPPLY AND DISTRIBUTION INSTALLATION

3.7.1 Install all power equipment (eFlow, VR6, ACM8, PDS16) inside the enclosure unless otherwise approved as shown in Figure 28 10 00 -1.

3.7.2 Wiring Requirements:

A. All 120V AC wiring shall be performed by licensed electricians.
B. Low voltage wiring shall use lever connectors only — wire nuts are prohibited.
C. Lock load power must originate from ACM8 or equivalent power distribution modules.
D. Battery backup must meet District standby duration requirements.

3.8 READER INTERFACE INSTALLATION

3.8.1 Install interfaces within Trove Enclosure unless otherwise specified per District standard layouts as shown in Figure 28 10 00 -1

3.9 READER INSTALLATION

3.9.1 General Requirements

A. All card readers shall be mounted flush to the wall, mullion, or approved mounting surface with no exposed cabling.
B. Readers shall be installed on the latch/handle side of the door, unless otherwise directed by District ITS.

3.9.2 ADA Mounting Height Requirements

A. Readers shall comply with ADA reach standards:
B. 48 inches AFF maximum (forward reach)
C. 54 inches AFF maximum (side reach where applicable)

D. District standard height is 48 inches AFF to reader centerline.
E. Clear floor area in front of the reader must meet ADA approach requirements.

3.9.3 Location & Clearance Requirements

A. Readers shall be mounted within 12 inches horizontally of the door handle unless construction prevents it.
B. Readers shall not obstruct or interfere with:
   1. Door operation
   2. Latch or lock visibility
   3. ADA push plates
   4. Video intercom stations
   5. Door hardware
C. If an ADA push plate and/or a video intercom are installed at the opening, the reader shall be mounted:
   1. Adjacent to the ADA push plate and/or video intercom, maintaining a coordinated cluster of access devices
   2. Positioned to ensure all devices remain independently reachable per ADA reach standards
   3. In a location that does not block, partially obstruct, or make difficult the actuation of the ADA device or use of the intercom
D. Readers must be mounted so that ADA push plate users can perform the following without repositioning or excessive movement:
   1. Credential presentation
   2. ADA door activation
   3. Intercom activation
E. When ADA push plates are installed on a post/stanchion, the reader shall be located on the same structure only if spacing requirements are met and cabling pathways allow.
F. When video intercoms include cameras, reader placement must not interfere with:
   1. Camera field of view
   2. Speaker/microphone operation
   3. Button access

3.9.4 Environmental & Mounting Surface Requirements

A. Outdoor readers must be vandal resistant and rated for the installation environment and positioned to minimize water exposure.
B. Where installed on mullions, ensure:
   1. Reader is not impacted by door movement
   2. Conduit or wireway has adequate capacity
C. Reader shall be securely mounted using manufacturer approved hardware.

3.10 INTERCOM / VIDEO INTERCOM INTEGRATION

3.10.1 General Requirements

A. Intercom / video intercoms installed at any controlled entry shall fully integrate into the District's access control system using Maxxess eFusion and Mercury hardware.
B. The intercoms output relay shall be treated as an input to the access control system for request/notification purposes and shall not directly energize, power, or switch electrified locking hardware.

3.10.2 Relay Wiring Requirements

A. The intercom's dry contact output relay shall be landed on:
   1. Access Control Controller contact
   2. Reader Interface contact
B. The relay wiring shall:
   1. Use shielded or unshielded cable appropriate to the intercom specifications
   2. Be terminated at the controller/interface input using proper polarity and secure terminations
   3. Be dressed neatly and labeled per 27 05 53 – Identification

C. Under no circumstances shall the video doorbell/intercom relay:
   1. Directly activate a strike, mag lock, or gate operator
   2. Be wired to the Access Power Controller output side
   3. Be used as a substitute for required REX, DPS, or access reader functions

3.10.3 Functional Behavior / Programming Requirements

A. The intercom relay input shall be configured in Maxxess eFusion as a supervised or unsupervised input (as applicable) and logically linked to door control functions using eFusion's Link Logic engine.
B. When activated, the intercom relay may:
   1. Trigger a "Request to Enter"
   2. Alert an operator at a workstation
   3. Pop-up video or event notifications (if using eFusion ViewPoint or integrated VMS)
   4. Enable a momentary unlock only through eFusion logic, never through the intercom relay itself
C. All unlock commands generated by intercom events must:
   1. Be routed through Mercury hardware
   2. Follow door schedules
   3. Obey all door locking mode, forced/held open, and alarm rules configured in eFusion
D. Unlock duration, valid intercom hours, and permitted operators shall all be controlled within eFusion.

3.10.4 After Hours Disablement (Scheduling Requirement)

A. The intercom relay input shall be assigned to an eFusion schedule that disables intercom activation signals outside of authorized time periods.
B. After hours behavior shall be one of the following (District option):
   1. Intercom relay ignored
   2. Intercom event logged but no unlock permitted
   3. Intercom event routed to remote monitoring / notifications only
C. Under no circumstances shall a video intercom unlock a door outside of scheduled hours via relay, software, or bypass mechanism.

3.10.5 Testing Requirements

A. Test the relay input at the controller/reader interface for proper activation and event reporting in eFusion.
B. Verify momentary unlock input logic functions correctly under normal schedule and restricted after hours schedule.
C. Confirm that no direct door unlock occurs when the intercom output contacts are activated.
D. Validate that the intercom relay does not interfere with REX, DPS, reader valid access, or alarm handling.

3.11 DOOR HARDWARE INSTALLATION

3.11.1 Install electrified door hardware per manufacturer and District standards.

A. All strikes shall use SmartPAC (or approved equivalent) for surge suppression and reliable release.
B. REX and DPS shall be wired to interface inputs and configured in eFusion for:
   1. Valid access suppression
   2. Alarm routing
   3. Door forced/door held logic
   4. REX shall be programmed to only disable contact reporting. Under no circumstances shall REX unlock the door.

3.12 ADA DOOR ACTIVATION PUSH BUTTON INTEGRATION (NEW SECTION)

3.12.1 General Requirements

A. All ADA automatic door operators and associated push buttons installed at access-controlled openings shall be fully integrated into the District's access control system using Mercury controllers and Maxxess eFusion.

B. ADA push buttons shall never directly control or bypass the electrified lock.
C. Wiring ADA push button controllers in parallel with access control door lock power is strictly prohibited.

3.12.2 Outside ADA Push Button Control Logic

A. When an exterior (public-facing) ADA push button is installed at an access-controlled door, its activation relay shall be wired to an input contact on a:
   1. Access Control Controller
   2. Reader Interface
B. The exterior ADA button shall be permitted to activate the door operator only when the door is in an unlocked state or otherwise authorized by the Access Control System.
C. When the door is locked, activation of the exterior ADA push button shall:
   1. Generate an event in Maxxess eFusion
   2. NOT operate the door
   3. NOT unlock the hardware
   4. NOT allow any mechanical or electrical bypass
D. The access control system shall always arbitrate door unlock logic, even when an ADA device is present.

3.12.3 ADA Push Button Controller Wiring Requirements

A. The ADA door operator (and its push buttons) shall be controlled via a relay output from the Mercury controller or reader interface.
B. Wiring shall be arranged so that:
   1. Access control unlocks the door latch,
   2. Only then the ADA door operator receives an activation signal,
   3. The ADA controller never receives power directly from the ADA push plate alone.
C. ADA door operator wiring must comply with:
   1. Door operator manufacturer specifications
   2. Electrified hardware specifications
   3. ADA Standards for Accessible Design
D. All wire terminations must use approved connector types (lever connectors for low-voltage power; screw terminals for operator control).

3.12.4 System Behavior & Maxxess eFusion Programming

A. Exterior ADA push button input shall be configured as a valid operator request only when the door is in an access-granted state.
B. Interior (egress-side) ADA push buttons shall remain active at all times to comply with life-safety requirements.
C. eFusion must be configured to:
   1. Require BOTH “Door Unlocked” + “ADA Button Pressed” before activating operator
   2. Record all ADA-related events in system log
   3. Prevent door activation when locked
   4. Provide optional alarm notifications for repeated ADA activation attempts during locked periods
D. Door schedules shall control when ADA functionality is allowed externally (during business hours) and disabled externally (after-hours), without impairing interior ADA egress operation.

3.12.5 Prohibited Configurations

A. The ADA push plate shall NOT:
   1. Directly energize or unlock the door
   2. Be wired in parallel with the Access Power Controller output
   3. Override access levels, schedules, forced/held open logic, or door position monitoring
   4. Serve as a substitute for an REX device
B. No wiring arrangement shall allow a push plate to bypass Mercury controller logic or unlock the door independently.

3.12.6 Testing Requirements

A. Contractor shall verify:
   1. Door only opens by ADA activation when access control unlocks the door.
   2. Exterior ADA push plate is fully disabled when the door is locked in eFusion.
   3. Pressing the ADA button while locked logs an event and does not actuate the operator.
   4. Interior ADA button always activates the operator regardless of schedule.
   5. ADA door operator and lock operate in correct sequence:
      - Access control unlocks
      - ADA operator opens door
      - Door position monitoring functions correctly

3.12.7 Documentation & Labeling

3.12.8 ADA button wiring shall be clearly labeled:

A. [DOOR] ADA PUSH INPUT – EXT SIDE
B. [DOOR] ADA PUSH INPUT – INT SIDE
C. [DOOR] ADA DOOR OPERATOR OUTPUT

3.12.9 Panel diagrams shall include ADA device wiring and relay connections.

3.13 VEHICLE GATE INTEGRATION

3.13.1 General Requirements

A. All motorized or automated vehicle gates shall be fully integrated into the District's access control system using inputs/outputs and Maxxess eFusion for logic, scheduling, and event reporting.
B. Under no circumstances may a vehicle gate be operated directly by a reader or physical loop without the Access Control System arbitrating the unlocking/opening logic.

3.13.2 Gate Operation via Valid Credential

A. Each controlled vehicle gate shall be wired so that a valid card read at the associated access reader triggers a gate opening command.
B. The gate open signal shall be delivered via:
   1. A Mercury controller relay output, or
   2. A Reader Interface relay output
C. The reader event shall be processed through Maxxess eFusion's access rules, access levels, schedules, and operator permissions before a gate open command is sent.

3.13.3 Gate Position & Alarm Integration

A. If the vehicle gate hardware includes:
   1. Gate position output (open/closed),
   2. Alarm contacts (e.g., obstruction, intrusion, manual override),
   3. Tamper signals,

   these signals shall be wired into the Access Control System as input contacts on:
   4. Access control controller inputs, or
   5. Reader interface inputs
B. All gate status contacts shall be configured in Maxxess eFusion for:
   1. Live monitoring
   2. Alarm reporting
   3. Event logging
   4. Custom operator workflows or automation rules
   5. If gate outputs are supervised or specify end of line resistors, the contractor shall follow manufacturer requirements for proper supervision.

3.13.4 Gate Exit Loops (Vehicle Detection Loops)

A. All exit loop activation circuits shall be wired through the Access Control System, not directly to the gate:
   1. The loop detector's relay output shall land on a controller or interface input
   2. A controller or interface relay output shall command the gate to open
   3. The gate operator shall never be triggered directly by a loop relay
B. The Access Control System shall control exit loop function via schedule:
   1. During open campus hours: Exit loops may automatically activate gate opening for vehicles
   2. After hours: Exit loop input shall be disabled or reprogrammed to require operator approval or a credential
C. Gate exit loops must be connected such that:
   1. The access control system mediates all gate opening logic
   2. Safety standards for entrapment, obstruction detection, and UL 325 compliance are maintained
D. Exit loop conditions (continuous vehicle present, oscillation, fault) shall be logged as events if supported by the loop hardware.

3.13.5 Prohibited Wiring Methods

A. Direct wiring of:
   1. Card readers → Gate operator
   2. Exit loops → Gate operator
   3. Video intercom → Gate operator
   4. Open Button → Gate operator
B. No device may supply low voltage power or a dry contact directly to the gate operator unless the Access Control System mediates the logic.
C. Parallel wiring of any access control relay and any gate operator relay is not permitted.

3.13.6 Programming Requirements

A. In Maxxess eFusion, each vehicle gate must have:
   1. A dedicated access level
   2. A gate control schedule
   3. A gate open momentary time
   4. Event logging enabled
B. Logical behavior shall be implemented through eFusion Link Logic to:
   1. Trigger gate open on valid credential
   2. Enable/disable exit loops on schedule
   3. Alarm on gate forced open or held open
   4. React to gate obstruction alarms
C. Operators may use eFusion workstation or mobile client to:
   1. Open gate (if permitted)
   2. View gate position
   3. Clear alarms
   4. Monitor loop activity
D. Gate unlock/open logic must not violate life safety or UL 325 safety sensor rules.

3.13.7 Testing and Commissioning Requirements

A. Contractor shall verify and document:
   1. Valid card → gate opens
   2. Invalid card → no gate movement and event is logged
   3. Exit loop opening logic follows programmed schedules
   4. After hours loop disablement functions as programmed
   5. Gate position (open/closed) displays correctly in eFusion
   6. Gate alarm contacts generate correct alarm events
   7. Gate operator does not accept direct signals from any device except the Access Control System

8. Operator workstation commands function correctly and safely
9. All safety devices (photo eyes, edge sensors, obstruction inputs) remain fully functional and uncompromised

3.14 UNLOCK BUTTONS AND UNLOCK SWITCHES

3.14.1 General Requirements

A. Unlock buttons and unlock switches shall be integrated into the Access Control System as input contacts.
B. Unlock devices shall never directly control or energize a door strike, maglock, gate operator, or any other locking device.
C. All unlock actions must be executed exclusively by the Access Control System (Maxxess eFusion) through the proper access control relay.

3.14.2 Prohibited Wiring Methods

A. It is strictly prohibited to connect any unlock device:
   1. Directly to lock power
   2. In parallel with the Access Power Controller (APC) output
   3. In a way that bypasses controller logic or schedules
B. The unlock button/switch may not serve as a Request to Exit (REX), ADA trigger, or gate loop replacement.

3.14.3 Allowed Device Types & Quantity Restrictions

A. Each button or switch must have its own home run cable to the controller or interface.
B. Unlock Switch (Maintained Contact)
   1. Only one (1) unlock switch (toggle, key switch, or maintained state device) is allowed per controlled door.
   2. Provides a continuous unlock request to the system when engaged.
C. Unlock Buttons (Momentary Contacts)
   1. Multiple unlock buttons may be installed per door.

3.14.4 Wiring Requirements

A. Every unlock button or switch must be home run back to the appropriate Mercury panel.
   1. Daisy chaining or looping devices together is prohibited.
B. Buttons/switches may be paralleled in / next to the Access Control enclosure but may not be physically paralleled in the field.
C. Wiring shall be:
   1. Minimum 22/2 for dry contacts
D. Labeled per Section 27 05 53 - Inputs/Outputs: [Door] [FUNCTION] – [LOCATION]
E. Unused conductor pairs must be wrapped neatly and left intact

3.14.5 Programming Requirements

A. All unlock inputs shall be configured in Maxxess eFusion as momentary unlock request.
B. The Access Control System shall decide whether unlock requests are permitted based on:
   1. Schedules
   2. Door mode (locked, unlocked, card-only, secured)
   3. Threat level
   4. Access level permissions
C. Lockdown Behavior
   1. Unlock button and unlock switch inputs shall be configured to have NO unlock effect when the system enters lockdown.
   2. During a lockdown event, all unlock inputs must be automatically overridden.
   3. Any activation of a button or switch must generate a logged event but must not release or energize the lock.
   4. This includes:
   5. Momentary unlock buttons

6. Maintained unlock switches
7. Multi-point unlock stations at admin or reception areas

D. Unlock contacts must actively support forced-secure mode:
1. The controller must ignore the input during lockdown.
2. eFusion's threat level/lockdown rules must supersede all unlock logic.
3. Unlock requests must not queue or trigger delayed unlock events.

E. Post lockdown restoration:
1. Unlock inputs shall return to normal behavior once the lockdown is cleared by authorized District personnel.
2. System must reset properly even if a maintained switch is left in the ON position.

3.14.6 Testing Requirements

A. Contractor must verify:
1. Unlock button → door unlocks only when allowed by system.
2. Switch unlocks when engaged, and re-secures the door when returned to OFF.
3. All unlock inputs generate correct events in eFusion.
4. During lockdown, all unlock devices are fully disabled, and no electrical or logic bypass exists.
5. Multiple momentary buttons operate correctly when grouped in software.
6. No wiring configuration allows a direct or parallel unlock path to the lock hardware.

3.15 DEVICE NAMING & PROGRAMMING

3.15.1 All naming conventions shall follow the District's schema:

A. Controllers: [SITE] [IDF]
B. Readers: [SITE] [ROOM] [DOOR]
C. Inputs/Outputs: [SITE] [FUNCTION] – [LOCATION]

3.15.2 eFusion Programming Shall Include:

A. Real time event display with graphical mapping
B. Email-on-event configuration for alarms

3.16 TESTING AND COMMISSIONING

3.16.1 Contractor must test:

A. Every reader
B. Every electric strike
C. Every REX/DPS
D. Every input/output
E. Controller communications
F. eFusion event routing
G. Alarm graphics
H. Schedule enforcement
I. Anti passback (if enabled)

3.16.2 District ITS will witness acceptance testing.

3.16.3 Any failed components must be corrected prior to acceptance.

3.17 CLOSEOUT DOCUMENTATION

3.17.1 Deliver:

A. As built panel wiring diagrams
B. CAD & GIS Map showing all doors, controllers, and pathways following requirements from 27 05 53
C. Controller network map

D. eFusion configuration export
E. Reader/interface lists
F. Door schedules
G. Access level assignments
H. Hardware manuals
I. Warranty documentation

3.17.2 Purge contractor credentials from eFusion and return all access cards.

SECTION 28 20 00 – VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1.1 Introduction

A. The District has adopted Panasonic Video Insight as its enterprise-wide Video Management System (VMS) platform for all new and replacement video surveillance installations.
B. All provided cameras, recorders, servers, software, and related products must fully integrate with Panasonic Video Insight and operate as a single, seamless, centrally managed video surveillance system districtwide.
C. The system shall support centralized administration, including user management, permissions, camera configuration, recording policies, and retention schedules.
D. The surveillance system shall support automated or centrally controlled user account provisioning where the District's authentication environment allows.

1.1.2 GENERAL REQUIREMENTS

1.1.3 The Contractor must comply with ALL Division 27 and Division 28 sections in full.

1.1.4 If Division 27 is not provided, the Contractor must request it from the ITS Project Manager.

1.1.5 Any discrepancies between this specification, the drawings, actual field conditions, or proposed installation methods must be reported to the District ITS Project Manager for resolution before proceeding with installation.

1.1.6 Installation of cameras or equipment in sub-optimal conditions (even if equipment is approved) shall be considered non-compliant.

1.1.7 All video surveillance equipment shall be furnished and installed by an authorized manufacturer distributor/installer with proof of certification for the exact products being provided.

1.1.8 The entire video surveillance system shall be installed by one primary contractor. Subcontractors may be used, but all work performed by subcontractors shall remain fully the responsibility of the primary contractor.

1.1.9 Upon District notification of a camera, or VMS component failure, the Contractor must repair or replace any failed components that no longer meet manufacturer specifications.

1.1.10 Installation must meet all manufacturer installation requirements, including environmental clearances, power requirements, and mounting specifications, to maintain warranty.

1.1.11 VMS-related installation and configuration must be performed or supervised by personnel with documented training or certification for Panasonic Video Insight (issued within the past 5 years or valid through project duration).

1.2 SUBSTITUTIONS

1.2.1 Substitution of cameras, VMS components, NVR hardware, or software is allowed only if the Contractor demonstrates full and equivalent compatibility with Panasonic Video Insight.

1.2.2 If a substitution is accepted, the Contractor must pay all costs for (2) District staff to receive factory certification training (including travel, lodging, meals, and required equipment) to maintain the same support capability offered with the originally specified products.

1.2.3 The required training must enable District ITS personnel to perform all manufacturer-approved repairs, configuration, firmware upgrades, software updates, and service tasks without voiding warranties.

1.3 QUALITY ASSURANCE STANDARDS

1.3.1 Regulatory Requirements

A. All video surveillance equipment shall comply with applicable codes and standards, including but not limited to:
   1. NEC / NFPA
   2. TIA-568 (cable & connectivity per Division 27)
   3. TIA-569 (pathways per Division 27)
   4. TIA-607 (grounding per Division 27)
   5. FCC regulations
   6. ADA requirements for intercom video stations (where applicable)

1.3.2 Contractor Qualifications

A. Contractor must:
   1. Be trained, authorized, and certified for all surveillance products installed, including Panasonic Video Insight–related components.
   2. Hold a current valid installer certification for the installed VMS or provide manufacturer training credentials.
   3. Have a minimum of 5 years experience designing, installing, and configuring enterprise-class IP video surveillance systems.
   4. Maintain a local office within 60 miles staffed by factory-trained technicians.
   5. Maintain local inventory of critical spare parts.
   6. Provide a dedicated project manager for the entire duration of the project (subject to District approval).
   7. Maintain compliance with all Drug-Free School Zone laws and requirements.

1.4 PRE-INSTALLATION CONFERENCE

1.4.1 Before any work begins:

A. Contractor must meet with the ITS Project Manager to review camera placement, mounting methods, lens selection, network requirements, VMS configuration, and project phasing.
B. Work at school sites must be scheduled in advance with District ITS and school administration.
C. Contractors arriving on-site without prior authorization will be removed from the site.
D. The District will communicate known hazards (asbestos, lead, etc.) prior to work.
E. The Contractor must immediately notify the District of any newly observed safety concerns before beginning installation.

1.4.2 WARRANTY

A. Contractor shall provide a minimum 3-year manufacturer warranty on all cameras, VMS licenses, mounts, and accessories, beginning at Notice of Completion.
B. All VMS software updates, firmware updates, and security patches required during the warranty period shall be provided to the District at no additional cost.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

2.1.1 Unless otherwise specified all products shall be new, commercial-grade, and compliant with:

A. Applicable codes and standards (NEC, NFPA, TIA, FCC, ADA as applicable).
B. All Division 27/28 sections.
C. District ITS Standards.

2.1.2 All equipment shall be fully compatible with and support integration into the District's enterprise Panasonic Video Insight Video Management System (VMS) platform.

2.1.3 Video surveillance components shall be modular, field-serviceable, and designed for long-term maintainability. Components that are proprietary or require factory service for routine maintenance or firmware upgrade are prohibited.

2.1.4 Specific “District Approved Models” shall be as indicated in Section 28 06 50 – Communications Equipment & Materials Schedule.

2.1.5 Software, Firmware & Cybersecurity

A. All surveillance devices shall run District-approved firmware versions.
B. Default usernames/passwords are prohibited and shall be changed prior to final acceptance.
C. All devices shall support secure configuration access (HTTPS or manufacturer-approved secure channel).
D. Remote access or cloud-based management is prohibited unless explicitly approved.

2.2 VIDEO MANAGEMENT SYSTEM (VMS)

2.2.1 The District has adopted Panasonic Video Insight as the sole enterprise VMS platform. All installed equipment must integrate natively without the use of third-party middleware.

2.2.2 The Contractor shall provide:

A. One (1) Panasonic Video Insight camera license per installed camera.

2.2.3 All VMS licenses shall be perpetual unless otherwise specified by District ITS.

2.3 NETWORK VIDEO RECORDERS (NVR) / RECORDING SERVERS

2.3.1 Mandatory Requirements

A. When an NVR or server is required, the District ITS Project Manager will provide required hardware specifications and design criteria.
B. All hardware must be certified compatible with Panasonic Video Insight.
C. Hardware shall be server-class; consumer-grade devices are prohibited.
D. Minimum Server Capabilities
   1. RAID storage per District retention policy (minimum 14 days).
   2. Enterprise-class processors and memory sized per camera count.
   3. Windows Server OS licensing (e.g., Windows Server 2022 Standard) appropriate for CPU/core count.
E. Storage Requirements
   1. Storage capacity shall be sized based on District-approved calculations for resolution, FPS, codec, and retention.
   2. Hot-swap SATA/SAS drives required where NVRs are located in MDF/IDF spaces.
   3. Write cache, read cache, or SSD tiering may be required depending on scale.

2.4 CAMERA EQUIPMENT

2.4.1 General Requirements

A. All cameras must:
   1. Be IP-based and fully compatible with Panasonic Video Insight.
   2. Support H.264 and/or H.265 compression.
   3. Support ONVIF Profile S or G (District preference may supersede).
   4. Include day/night mode with mechanical IR cut filter.
   5. Include Wide Dynamic Range (WDR).
   6. Support PoE (IEEE 802.3af minimum, or 802.3at if required).
   7. Include vandal resistance (IK10 minimum for exposed locations).
   8. Include weather resistance (IP66 or greater for outdoor locations).
   9. Have PTZ functionality for remote adjustments.
   10. All cameras shall be powered via PoE unless otherwise approved by ITS.

2.4.2 Lens & Sensor Minimum Requirements

A. 2 MP: F1.6 or better, 1/2.7" CMOS.
B. 5 MP: F2.0 or better, 1/2.5" CMOS.

C. Intercom cameras: 180° horizontal FOV minimum.

2.4.3 Optical Performance Requirements

A. All cameras must meet the following District standard PPF (Pixels Per Foot) requirements:
   1. 80 PPF minimum at near end of the target zone.
   2. 40 PPF minimum at far end of the target zone.
B. Contractor shall validate lens selection and focal length to meet PPF targets prior to installation.

2.4.4 Camera Mounting Hardware

A. General Requirements
   1. Mounts must be manufacturer approved for the camera model.
   2. All mounting hardware shall be vandal resistant where located below 20 feet AFF.
   3. Camera mounts shall support concealed cable routing.
B. Allowed Mount Types
   1. Wall mounts.
   2. Ceiling / pendant mounts.
   3. Pole mounts.
   4. Corner brackets.
   5. J box adapters.

2.5 INTERCOM VIDEO STATIONS (VIDEO DOORBELL CAMERAS)

2.5.1 Video intercom cameras shall:

A. Fully integrate into Panasonic Video Insight.
B. Provide SIP or network-based audio\video compatible with Districts Cisco Call Manager
C. Provide a dry-contact output for access control integration.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 Install all video surveillance equipment per manufacturer requirements and District standards.

3.1.2 All cameras and related components shall be installed to fully integrate with Panasonic Video Insight, the District's enterprise VMS platform.

3.1.3 Work shall be neat, code-compliant, and fully serviceable. Cameras, mounts, junction boxes, and cabling must be installed so they can be maintained without removing unrelated systems.

3.1.4 All devices and connections shall be mounted and terminated in accordance with Division 27 specifications related to mounting, cabling, labeling, patching, pathways, and equipment room practices.

3.2 PREPARATION

3.2.1 Coordinate work with Division 26 Electrical, Division 27 Communications, and Division 28 Access Control.

A. All camera locations must be verified and approved by the ITS Project Manager prior to installation.
B. Review project scope, camera list, VMS integration details, addressing scheme, and naming conventions.
C. Verify required network connectivity, VLAN assignments, switch port provisioning, and PoE capacity.
D. Verify mounting surfaces, pathway conditions, lighting conditions, breezeways, and obstructions.
E. Do not proceed until all field conditions are verified as acceptable.

3.3 WIRING PRACTICES

3.3.1 General

A. Install cabling neatly and professionally.
B. Cable routing, support, bend radius, and jacket preparation shall follow Division 27 requirements.

C. Provide service loops at camera and IDF ends as required by Division 27.
D. Terminate cables only at approved connectors or patch panels.
E. Field-installed RJ45 ends on horizontal cabling are not allowed unless approved by ITS.
F. Ground junction boxes and metal conduits per Division 27 requirements.

3.4 CAMERA INSTALL & CONFIGURATION REQURIMENTS REQUIREMENTS

3.4.1 General

A. Enroll all cameras into Panasonic Video Insight using District-assigned configuration parameters.
B. Cameras must appear in correct site folders, groups, and naming structure.
C. Cameras shall synchronize time with District-approved NTP sources.
D. Camera streams and encoding settings must match District-approved profiles.
E. Connect cameras using District-approved cabling and switch ports.
F. Cameras must be placed on District-assigned VLANs.
G. Verify PoE load capacity on all switches prior to activation.

3.4.2 Mounting

A. Cameras shall be mounted level, plumb, and only in District-approved locations.
B. Mounts must fully conceal cabling; exposed surface raceway is not permitted unless approved.
C. Cameras shall be installed at District-approved heights (typically 12–15 feet unless otherwise required).
D. Cameras shall be high enough to reduce tampering but maintain required PPF performance.
E. Breezeway and under-canopy cameras below 15 feet shall use a round box adapter plate with a minimum of eight screws.
   1. Verify fastener length does not penetrate the deck above.
F. Outdoor cameras shall be installed to prevent water ingress and shall include drip loops where allowed.
G. Cameras shall not be placed where soffits, gutters, or fixtures obstruct the field of view.
H. Contractor shall verify each camera meets District-required PPF values (80 PPF near / 40 PPF far).
I. District ITS must approve each camera's final FOV before acceptance.

3.4.3 Camera Aiming And Configuration

A. Adjust focus, zoom, WDR, white balance, and exposure for clear imaging.
B. Avoid backlighting, direct sunlight, glare, or other obstructions.
C. Verify night-mode performance after sunset, including IR coverage.

3.4.4 Recording Configuration

A. Configure resolution, frame rate, codec, retention, and any motion detection zones.
B. Apply District-standard VMS settings for consistency across sites.

3.4.5 Addressing And Naming

A. ITS will assign all IP addresses for cameras.
B. Camera naming shall follow the District schema: [SITE] – [LOCATION] – [CAMERA #].
C. VMS names, wall labels, and as-built documents shall match exactly.

3.5 VIDEO INTERCOM INSTALL & CONFIGURATION REQURIMENTS REQUIREMENTS

3.5.1 Installation

A. Install intercom cameras 46–48 inches AFF to comply with ADA.
B. Ensure clear view, microphone/speaker access, and unobstructed approach.
C. Route the intercom's dry contact output directly to Access Control panel input per 28 10 00
D. Intercom devices shall not directly energize or unlock any door.

3.5.2 Intercom Camera Integration Requirements

A. Intercom cameras shall never directly unlock a door.

B. Unlock logic must only occur through Access Control system per Section 28 10 00.
C. Intercom video must record in Panasonic Video Insight.
   1. Contractor shall confirm intercom button events are logged properly.
D. Video Intercom must be configured to integrate with Districts Cisco Call manager software so that by rining the video intercom the video is routed to the designated desk phones.

3.6 TESTING AND COMMISSIONING

3.6.1 General

A. Test every camera for image quality, VMS streaming, and correct configuration.
B. Verify recording retention and time synchronization.
C. Confirm field of view and PPF compliance.
D. Verify motion recording (if used) and proper intercom camera behavior.
E. District ITS will witness acceptance testing.
F. Correct all deficiencies prior to acceptance.

3.7 DOCUMENTATION AND CLOSEOUT

3.7.1 Submittals

A. CAD & GIS Map showing all cameras and pathways following requirements from 27 05 53
B. Provide final FOV and PPF verification for each camera.
C. Provide final camera inventory with IP, MAC, model, and switch port.
D. Submit VMS configuration export and firmware versions.
E. Provide intercom wiring diagrams.

3.7.2 Spare Parts (per 20 cameras installed):

A. One spare dome bubble
B. One spare mounting bracket
C. One gasket kit
D. One cable gland
E. One set of vandal-resistant screws and tool

END OF SECTION

SECTION 28 31 00 – INTRUSION DETECTION

PART 1 - GENERAL

1.1 INTRODUCTION

1.1.1 The District has adopted the DMP Entre Access & Security Management System as its intrusion alarm platform.

A. The system must operate as one centrally managed solution for arming/disarming, alarm reporting, and trouble notifications.
B. All intrusion alarm panels, sensors, devices, and software must fully integrate with this District-wide system.

1.2 GENERAL REQUIREMENTS

1.2.1 Contractor must comply with all Division 27 and Division 28 sections in full.

A. Any discrepancies between this specification, the drawings, or site conditions must be reported to the District ITS Systems Administration Department before work begins.
B. Installation of approved products in unsuitable or non-recommended conditions will be considered non-compliant.
C. All intrusion alarm equipment must be furnished and installed by an authorized manufacturer distributor/installer.
D. The entire intrusion alarm system must be installed by a single primary contractor; subcontractors act only as agents of the primary contractor.
E. When notified by the District of a failure, the contractor must repair or replace components that do not meet manufacturer specifications.
F. Contractor must follow all manufacturer installation requirements necessary to maintain warranty.

1.3 SUBSTITUTIONS

1.3.1 Substitutions may only be proposed when the contractor can demonstrate full equivalence to District-approved products.

A. If a substitution is accepted, the contractor must pay all costs to provide factory-level certification training for at least two District representatives.
B. This training must allow District personnel to perform manufacturer-approved service, repairs, software upgrades, and configuration without voiding warranties.

1.4 QUALITY ASSURANCE STANDARDS

1.4.1 All equipment must comply with applicable laws, codes, and regulations, including ADA and ICC/ANSI A117.1 accessibility requirements.

A. Contractor must be trained, authorized, and certified to install all specified intrusion alarm components.
B. Contractor must have at least five years of intrusion alarm system design, installation, and supervision experience.
C. Contractor must maintain a fully staffed local office within 60 miles of the project site, staffed by factory-trained technicians.
D. Contractor must maintain an inventory of critical spare parts to support warranty service.
E. Contractor must provide a dedicated project manager for the entire project duration, subject to District approval.
F. Contractor must comply with all Drug-Free School Zone requirements.

1.5 PRE-INSTALLATION CONFERENCE

1.5.1 Before installation begins, the contractor shall meet with the District ITS Systems Administration Department.

A. The meeting shall include review of materials, wiring plans, panel locations, installation procedures, and coordination of related work.
B. Contractor may not begin work until all requirements are understood and approved.

1.6 WARRANTY

1.6.1 All installed intrusion alarm components shall have a minimum one-year warranty beginning at Notice of Completion.

1.6.2 All required firmware and software updates during the warranty period must be provided at no cost to the District.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

2.1.1 Unless otherwise specified, all products shall be new, commercial-grade, and suitable for use in a supervised intrusion alarm system.

A. Products shall comply with all applicable codes, standards, and District Division 27 and Division 28 requirements.
B. All components shall be fully compatible with the District's adopted intrusion alarm platform.
C. Component part numbers will be defined in Section 28 06 50 – Communications Equipment & Materials Schedule.

2.1.2 Alarm Enclosures And Power Supplies

A. Alarm system enclosures shall be purpose-built cabinets sized to house alarm panels, expanders, distribution boards, and batteries.
B. Enclosures shall support secure mounting, proper ventilation, and sufficient clearance for wiring and servicing.
C. Power supplies shall deliver regulated 12VDC with battery charging capability and monitored AC/battery supervision.
D. Power supplies shall support connection of alarm panel battery terminals and external supervised inputs.
E. Power capacity shall be sufficient to power all connected sensors, keypads, and accessories.

2.1.3 Alarm Panels

A. Alarm panels shall be network-capable intrusion control units compatible with the District's enterprise intrusion management platform.
B. Panels shall support supervised inputs, programmable outputs, and full network-based communication with the District's monitoring system.
C. Panels shall include:
   1. Network communication module suitable for District LAN
   2. Support for multiple areas/partitions
   3. Supervised power and battery monitoring
D. Support for system event reporting, arming/disarming, and remote configuration

2.1.4 Zone Expanders

A. Zone expanders shall increase the number of supervised input zones available to the main alarm panel.
   1. Expanders shall be compatible with the District's alarm panel platform.
   2. Expanders shall support supervised inputs and required wiring distances per manufacturer specifications.
   3. Zone expanders shall support end-of-line resistor supervision.
   4. Zone expanders shall mount inside the alarm enclosure and integrate with panel bus requirements.

2.1.5 Keypads

A. Keypads shall be compatible with the District's adopted intrusion alarm system.
B. Keypads shall support arming/disarming, zone status display, and local system interaction.
C. Keypads shall provide backlit displays suitable for low-light environments.
D. Keypads shall support supervised bus wiring per panel requirements.

2.1.6 Alarm Sensors – General

2.1.7 Alarm sensors may include motion detectors, door contacts, glass break detectors, leak detectors, or other approved devices.

A. Sensors shall support supervised wiring and use District-approved resistor values for end-of-line supervision.
B. Sensors shall be compatible with the District's alarm panel platform and power distribution scheme.
C. Sensors requiring power shall be powered from regulated, fused low-voltage outputs.

2.1.8 Motion Detectors

A. Motion detectors shall be commercial-grade PIR or dual-technology sensors.
B. Detectors shall support supervised alarm contacts and tamper circuits.
C. Detectors shall support coverage patterns suitable for classrooms, offices, and large interior spaces.
D. Detectors shall support ceiling or wall mounting depending on space layout.
E. Detectors must be compatible with the panel voltage and wiring architecture.

2.1.9 Door Contacts

A. Door contacts shall be commercial-grade magnetic sensors suitable for wood, metal, or overhead doors.
B. Contacts shall include supervised wiring terminals for end-of-line resistor installation.
C. Heavy-duty armored contacts shall be used for overhead doors or exposed environments.
D. Contacts must support concealed, surface, or armored installation as appropriate for door type.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 All intrusion alarm equipment, devices, and hardware shall be installed in accordance with manufacturer instructions and District standards.

A. Installations must allow for full serviceability, clear access, and proper separation from unrelated systems.
B. Contractor shall furnish and install all components required to achieve a fully operational system, whether or not each component is explicitly called out.
C. All programming, configuration, and setup must be completed by the contractor prior to District testing.

3.2 LOW-VOLTAGE CABLING REQUIREMENTS

3.2.1 All alarm cabling shall be installed per Division 27 requirements and District standards.

A. All exposed cable shall be routed in conduit. Conduit is optional above 10 feet in limited-access rooms.
B. All cabling shall include adequate service loops.
   1. Minimum 5 feet service loop at the alarm panel.
   2. Minimum 10 feet service loop at each field device.
C. All splices shall use approved gel-filled connectors; wire nuts are not permitted.
D. Factory connectors shall not be removed from devices; matching pigtails shall be used where required.

3.3 ALARM ENCLOSURE INSTALLATION

3.3.1 Alarm enclosures shall be installed to meet District clearance and accessibility requirements.

A. Enclosures must open fully to at least 90 degrees and maintain a minimum of 3 feet clearance in front and 1 foot on one side.
B. Enclosures shall be mounted:

1. Top of enclosure below 10 feet above finished floor.
2. Bottom of enclosure at least 1 foot above the floor.
3. At least 4 inches below any ceiling.
4. Backboards must be painted and span at least two studs when mounted to drywall.

C. Enclosures shall be installed adjacent to nearest IDF unless otherwise directed by District ITS.
D. Input power shall be a hardwired dedicated 120V circuit with properly installed EMT or rigid conduit.

3.4 POWER DISTRIBUTION BOARD INSTALLATION

3.4.1 Power distribution boards shall be installed on an adapter plate inside the enclosure.

A. Direct mounting to enclosure metal is prohibited.
B. Boards shall be powered from the regulated 12VDC output of the alarm power supply.
C. Wiring from the distribution board to devices must correspond to device zone numbering.

3.5 ALARM PANEL INSTALLATION

3.5.1 Alarm panels shall be mounted inside the alarm enclosure in the locations designated by District layouts.

A. Each panel shall include an Ethernet jack (biscuit) inside the enclosure routed to the nearest IDF.
B. Panels shall be assigned District-provided IP addresses.
C. Battery terminals shall be wired to the distribution board using District-approved wiring methods
   1. A diode shall installed to prevent charging of the batteries.
   2. Batteries to be charged via enclosure power supply
D. Battery supervision wiring must be terminated per District resistor requirements.

3.6 ZONE EXPANDER INSTALLATION

3.6.1 Zone expanders shall be mounted inside the enclosure in designated side locations.

A. Expanders shall be mounted using VHB-backed Velcro unless otherwise specified.
   1. Expander wiring shall be:
      - One continuous run back to the alarm enclosure.
      - Minimum 22/4 cable for runs up to 500 feet.
      - Minimum 18/4 cable for runs between 500 and 1000 feet.
      - Runs over 1000 feet are not permitted.
   2. Each expander shall be landed on its own dedicated bus unless otherwise approved.

3.7 KEYPAD INSTALLATION

3.7.1 Keypads shall comply with ADA reach standards:

A. 48 inches AFF maximum (forward reach)
B. 54 inches AFF maximum (side reach where applicable)
C. District standard height is 48 inches AFF to keypad centerline.
D. Clear floor area in front of the reader must meet ADA approach requirements.

3.7.2 Keypads must be mounted near the entrance of the designated room unless otherwise directed.

3.7.3 Cabling shall be installed in-wall where possible; surface raceways shall be used only when in-wall access is not feasible.

3.8 SENSOR INSTALLATION – GENERAL

3.8.1 Alarm sensors include motion detectors, door contacts, glass break sensors, leak detectors, and similar devices.

A. Each alarm sensor must be wired with a continuous cable run without in-line splices except at consolidation points.
B. Each alarm sensor shall be assigned its own dedicated zone unless the District approves consolidation.

C. Every alarm zone shall include a 1K Ohm end-of-line resistor installed at the device.
D. Devices requiring power shall be landed on the fused output matching their zone number.

3.9 MOTION DETECTOR INSTALLATION

3.9.1 Motion detectors shall be installed in all rooms that have exterior doors or windows.

A. Detectors shall be 360-degree ceiling-mount unless otherwise specified.
B. Detectors shall be mounted in the center of the room unless obstructions require alternate placement.
C. Wiring shall be routed to the matching distribution board and zone expander terminals.

3.10 DOOR CONTACT INSTALLATION

3.10.1 Door contacts may be used instead of motion detectors only in rooms without windows such as custodial, mechanical, storage, or electrical rooms.

A. Contacts shall be armored when installed in public or exposed locations.
B. Overhead door contacts shall be mounted to the track assembly using manufacturer brackets.
C. Where wire cannot be concealed, surface raceway shall be installed until the cable reaches concealed space.
D. Each contact shall include the required 1K Ohm end-of-line resistor at the device.

3.11 PROGRAMMING

3.11.1 Contractor shall perform all programming required for panels, expanders, zones, and keypads.

3.11.2 Contractor shall follow District naming conventions:

A. <SITE> <LOCATION> for areas
B. <SITE> <ROOM> for zones
C. <SITE> Keypad <ROOM> for keypads

3.11.3 Alarm panel programming shall include all District-required system, device, and remote options.

A. Remote Disarm = Enabled
B. Reset Swinger Bypass = Enabled
C. Swinger Bypass Trips = 0
D. Power Fail Delay = 0
E. GMT = 8
F. Bell Cutoff = 5 minutes

3.11.4 Each newly added zone shall be configured according to required alarm/tamper/trouble behaviors.

3.11.5 Zone Configuration

A. Each monitored zone shall follow these output action rules:
1. For motion detectors, door contacts, and similar alarm inputs:
- Disarm Open = None
- Disarm Short = Trouble
- Armed Open = Alarm
- Alarm Short = Alarm
2. For supervisory inputs such as power supplies and battery monitors:
- Disarm Open = Trouble
- Disarm Short = Trouble
- Armed Open = Trouble
- Alarm Short = Trouble

3.12 LABELING

3.12.1 All wiring shall be labeled per Division 27 labeling standards.

A. Labels must be laminated, machine-printed, and placed 6 inches from cable ends.
B. Enclosures must include:
   1. IP address label for the alarm panel.
   2. Power circuit identification.
   3. Manufacturer wiring diagram stickers.

3.13 TESTING AND ACCEPTANCE

3.13.1 Contractor shall test and certify each installed component prior to District inspection.

3.13.2 Testing shall confirm proper wiring, correct operation, zone response, and communication to the District monitoring system.

3.13.3 The District ITS Systems Administration Department will perform a joint walk-through inspection.

3.13.4 A punch list will be created if deficiencies are found; contractor must correct all items before final inspection.

3.13.5 Final acceptance requires:

A. Successful final test and inspection.
B. All documentation delivered.
C. All contractor access credentials removed.
D. System demonstration completed at District request.

3.14 POST-INSTALLATION CLEANUP

3.14.1 Contractor shall restore all affected areas to pre-work condition.

A. All debris, removed cables, hardware packaging, and installation materials must be removed.
B. All unused parts, including dust covers and spare hardware, must be returned to the District.
C. All borrowed keys must be returned; lost keys will require lock replacement at contractor expense.
D. All doors must be secured before contractor leaves the site.

3.15 DELIVERABLES

3.15.1 Contractor shall provide the following:

A. Software and license information for all installed components.
B. All keys for enclosures and hardware.
C. All unused parts and removed components not reinstalled.
D. Failed parts not covered by warranty shall be returned to the District unless otherwise directed.
E. As built panel wiring diagrams
F. CAD & GIS Map showing the following based on the requirements from 27 05 53:
   1. All sensors
   2. Zones
      - Location
      - Zone Number
      - Zone Name
   3. Controllers
      - Site and room location of each panel.
      - Assigned IP address.
   4. Pathways
G. One set of manuals and installation guides for each equipment type installed.

SECTION 28 50 00 – SPECIALIZED SYSTEMS

PART 1 - GENERAL

1.1 INTRODUCTION

1.1.1 The District utilizes many specialized systems. This section defines requirements for system types not covered in other specifications, and serves as a catch all for specialized systems not explicitly listed elsewhere

1.2 GENERAL REQUIREMENTS

1.2.1 Any discrepancies between this specification, the drawings, and field conditions must be brought to the attention of the District's Systems Administration Department.

1.2.2 Installation of approved parts in sub optimal applications will be considered non compliant.

1.2.3 All electronic systems equipment shall be furnished and installed by an authorized manufacturer's distributor/installer, and proof of authorization must be included in the proposal.

1.2.4 The entire system shall be installed by one primary contractor; subcontractors serve only as agents, and their work remains the responsibility of the prime contractor.

1.2.5 Upon District notification of equipment failure, the Contractor shall repair or replace components not meeting manufacturer specifications.

1.2.6 Contractor must fully comply with all Division 27 and Division 28 sections.

1.3 SUBSTITUTIONS

1.3.1 Substitutions may be accepted only if the vendor proves full equivalence.

1.3.2 If the District approves a substitution:

A. The Contractor must pay all costs required to provide factory certification training for at least two District representatives, including travel, lodging, meals, and equipment.
B. Training must allow District personnel to perform all factory approved repairs, services, upgrades, without voiding warranties.

1.4 QUALITY ASSURANCE

1.4.1 Regulatory Requirements

A. Security equipment shall comply with applicable laws, codes, ordinances, and regulatory agencies, including:
   1. NEC / NFPA
   2. TIA 568 C
   3. TIA 569
   4. TIA 607
   5. ICC/ANSI A117.1 (Accessibility)
   6. Americans with Disabilities Act (ADA)

1.4.2 Contractor Qualifications

A. Contractor must:
   1. Be trained, authorized, and certified to install the specified products.
   2. Have minimum 5 years experience in system design, engineering supervision, and access control related installations.
   3. Maintain a fully staffed local office within 60 miles with factory trained technicians and critical spare parts inventory.

4. Provide a dedicated project manager, subject to District approval, consistent for the duration of the project.
5. Participate in a drug free workplace and adhere to all Drug Free School Zone laws.

1.5 PRE INSTALLATION CONFERENCE

1.5.1 Before any work begins:

A. Contractor must meet with the Systems Administration Department to review materials, procedures, site conditions, and shared space coordination.
B. All school site work must be scheduled in advance and approved by school administration.
C. Unauthorized arrival on site will result in the contractor being asked to leave.
D. District will advise contractors of known hazards (asbestos, lead, etc.).
E. Contractor must immediately report any safety concerns before work begins.

1.6 WARRANTY

1.6.1 All components must include a minimum 3 year warranty against defects from Notice of Completion.

1.6.2 During the warranty period, system updates must be provided to the District at no cost.

PART 2 - PRODUCTS

2.1 GENERAL

2.1.1 All products furnished under this section shall be new, of commercial or industrial grade, and suitable for continuous 24/7/365 operation.

2.1.2 All equipment shall be fully compatible with District technology standards, Division 27 infrastructure requirements, and other applicable Division 28 systems.

2.1.3 All system components shall comply with all applicable codes, standards, and regulations, including but not limited to:

A. NEC and NFPA requirements
B. ANSI/TIA structured cabling, grounding, and pathway standards
C. ICC/ANSI A117.1 Accessibility Requirements
D. California IoT Security Law (Civil Code §1798.91.04)
E. All devices must support District cybersecurity requirements, including secure protocols, password management, firmware upgrade capability, and the ability to disable unused services or ports.

2.2 SYSTEM PERFORMANCE REQUIREMENTS

2.2.1 Components shall be IP based unless specifically exempted by the District.

2.2.2 Devices requiring low voltage power shall support Power over Ethernet (PoE) when practical and comply with IEEE PoE standards.

2.2.3 Devices shall support automatic network speed negotiation and utilize standard RJ45 network interfaces unless otherwise approved.

2.2.4 Devices shall support District approved time synchronization services (e.g., NTP).

2.2.5 Each system shall include the capability for event reporting, status monitoring, and integration with District authorized supervisory systems, where applicable.

2.2.6 All systems must support remotely configurable parameters, diagnostics, and firmware upgrades without requiring physical device access.

2.3 ENVIRONMENTAL OR BEHAVIORAL DETECTION DEVICES

2.3.1 General

A. (1) Video Insight camera license shall be provided with every installed device.
B. Provide multi-function environmental and behavioral detection devices designed for continuous 24/7 operation in commercial and educational facilities.
C. Devices shall not record video, store audio, or collect personally identifiable information, and shall be suitable for installation in privacy-sensitive areas such as restrooms or single-use spaces.
D. Devices shall comply with all applicable federal, state, and local codes and standards.

2.3.2 Detection Capabilities

A. Air Quality & Environmental Monitoring
   1. Devices shall measure and report the following environmental indicators:
   2. Air Quality Index (AQI)
   3. Volatile organic compounds
   4. Carbon monoxide
   5. Carbon dioxide
   6. Nitrogen dioxide
   7. Temperature and humidity
   8. Particulate matter (multiple sizes)
B. Vape / Smoke / Substance Detection
   1. Devices shall detect airborne indicators of:
      - Vaping
      - Cigarette or other smoke
      - THC or marijuana related aerosols
      - Masking agents used to conceal smoke or vape emissions
C. Behavioral & Safety Related Event Detection
   1. Devices shall detect:
      - Elevated noise levels suggesting aggression
      - Screams or distress vocalizations
      - A minimum of ten predefined safety related spoken keywords
      - Gunshot acoustic signatures
      - Breaking glass events
      - Loitering behavior via time in area analytics
      - Occupancy and crowding conditions including people counting
D. Tamper and Status Detection
   1. Devices shall detect:
      - Physical tampering (impact, movement, covering)
      - Device removal or disconnect
      - Motion in sensor vicinity

2.3.3 Communication & System Integration

A. A. Devices shall support standard IP communication protocols including IPv4/IPv6, TCP/IP, HTTPS, RTSP, and DHCP.
B. Devices shall include:
   1. At least one network input port
C. Dry contact input(s) and output(s) for system integration
   1. Devices shall integrate with:
      - Third party safety, communication, or monitoring platforms
      - District Video Insight VMS
   2. Local management dashboards
D. Notification capabilities shall include:
   1. Email (SMTP or API)
   2. SMS via gateway
   3. API-based triggers for safety or automation systems

2.3.4 Alerting & User Interface

A. Devices shall include a built-in visual indicator capable of displaying multiple colors and patterns based on event type.
   1. Devices shall include an integrated audible alert system capable of playing different tones or user-provided audio files.
B. Devices shall be compatible with real-time dashboards showing occupancy patterns, environmental trends, event history, and health index values

2.3.5 Electrical Requirements

A. Devices shall support Power over Ethernet (PoE) meeting IEEE 802.3at Class 3 standards.

2.3.6 Physical & Environmental Requirements

A. Operating temperature range: 32°F to 112°F (0°C to 44°C).
B. Operating humidity: 0%–90% relative humidity (non-condensing).
C. Enclosure shall be impact-resistant to a minimum of an IK8 rating or equivalent.
D. Devices shall support surface, ceiling, wall, or pole mounting configurations.

2.3.7 Software & Management Requirements

A. Devices shall support both local (on premises) and cloud based management platforms for:
   1. Event configuration
   2. Firmware updates
   3. Data visualization
   4. Device grouping
   5. Analytics review
B. Devices shall support:
   1. Role based user management
   2. Secure firmware update mechanisms
   3. Password policy enforcement
   4. Event logging and audit trails

2.3.8 Warranty

A. Devices shall include a long-term manufacturer warranty of no less than 10 years, including hardware replacement and firmware/software updates.
B. Warranty shall include technical support for configuration, diagnostics, and device performance.

PART 3 - EXECUTION

3.1 GENERAL

3.1.1 The Contractor shall furnish, install, configure, program, test, and place into full service all specialized environmental and behavioral detection devices required for the project.

3.1.2 All work shall comply with District standards, Division 27 requirements for pathways, communications cabling, identification, and equipment room practices, and all Division 28 general requirements.

3.1.3 The Contractor shall provide all ancillary materials, terminations, connectors, cabling, mounting hardware, and accessories needed for a fully operational system, whether specifically listed or reasonably implied.

3.2 PRE INSTALLATION REQUIREMENTS

3.2.1 Coordination Meeting

A. A pre installation coordination meeting shall be held with the District's Information Technology Services (ITS) Department prior to starting work.

B. The Contractor shall review device locations, mounting requirements, power and network provisions, event trigger requirements, and any site specific constraints.

3.2.2 Site Verification

A. The Contractor shall field verify all device locations shown on drawings.
B. Conflicts with ceiling fixtures, mechanical equipment, airflow patterns, or privacy considerations shall be reported to the District ITS Department prior to installation.
C. No installation shall proceed without confirmation of acceptable mounting locations.

3.2.3 Scheduling Requirements

A. All work occurring on school campuses must be scheduled and approved a minimum of 48 hours in advance.
B. Unauthorized or unscheduled presence on campus may result in removal from the site.

3.3 ENVIRONMENTAL OR BEHAVIORAL DETECTION DEVICES

3.3.1 Installation Requirements

A. Mounting
   1. Devices shall be mounted in accordance with manufacturer guidelines for airflow, detection accuracy, and environmental exposure.
   2. Devices shall be surface mounted unless otherwise approved by the District.
   3. Devices shall be installed at heights recommended for optimal detection of environmental aerosols, sound based events, and occupancy visualization.
   4. Orientation shall ensure unobstructed airflow around sensing ports and clear acoustic line of sight.
B. Network Connectivity
   1. Each device shall connect to a dedicated RJ45 network jack.
   2. Daisy chain or pass through networking is permitted only when specifically allowed by the device's PoE requirements and District ITS approval.
   3. Horizontal cabling shall terminate on a patch panel—direct RJ45 plugs on horizontal cable are prohibited per Division 27.
C. Power Requirements
   1. Devices shall be powered via PoE complying with IEEE 802.3at Class 3.
   2. Where multi unit linking is used, the Contractor shall verify that upstream switch ports provide adequate power for the entire chain.
D. Environmental Requirements
   1. Devices shall not be installed near HVAC diffusers causing direct airflow into sensing ports.
   2. Devices shall not be installed above showers, sinks, or other moisture producing fixtures.
   3. Device placement must ensure accurate detection of vaping aerosols, ambient noise levels, and occupancy events.
E. Seismic & Physical Support
   1. All devices and associated mounting hardware shall comply with seismic bracing requirements where applicable.
   2. Devices shall be installed securely to prevent tampering or displacement.

3.3.2 Programming

A. General Configuration
   1. All devices shall be configured to support District approved naming conventions and IP addressing.
   2. Default passwords must be replaced with District approved secure credentials before commissioning.
B. Event Detection Programming
   1. Devices shall be configured to detect and report at minimum the following categories:
      - Vaping, smoke, and aerosol anomalies
      - THC or masking agent detection
      - Air quality thresholds

- Occupancy counts and loitering thresholds
- Noise based aggression indicators
- Keyword based distress events
- Glass break and gunshot events
- Tamper events and device obstruction

C. Response Actions
1. Devices shall be configured to trigger relays, notifications, or system integrations as required by the District ITS Department.
2. Light indicators shall be programmed with specific color patterns per event type.
3. Audible alerts shall be programmed with District approved tones or uploaded audio files.
4. D. Time Synchronization
5. Devices shall synchronize with the District approved NTP servers.

D. Firmware Updates
1. The Contractor shall install the latest manufacturer approved firmware prior to acceptance.

3.3.3 Integration

A. Network Integration
1. Devices shall be added to District monitoring systems, safety dashboards, or environmental analytics platforms as directed by ITS.
2. Relay outputs shall be integrated with access control, intrusion, or other low voltage systems only where approved.

B. VMS Integration
1. Systems shall be integrated with District video platforms.
2. Any live sensor visualization streams shall follow District network segmentation and security requirements.

C. Notification Services
1. Email, SMS gateway, or API based alert delivery shall be configured using District approved services only.
2. No third party cloud notification service shall be used without written District approval.

3.4 LABELING

3.4.1 All devices, cabling, network jacks, and terminations shall be labeled per Division 27 05 53.

3.4.2 Labeling must be machine-printed and permanently affixed. Handwritten labels are not permitted.

3.4.3 Cable labeling shall identify the device at the opposing end.

3.5 TESTING & COMMISSIONING

3.5.1 Contractor Testing

A. Contractor shall test all detection functions including environmental triggers, behavioral events, tamper alerts, network connectivity, PoE performance, and integration triggers.
B. All test results shall be documented and submitted.

3.5.2 District Acceptance Testing

A. The District ITS Department will perform verification testing with the Contractor present.
B. A punch list will be issued for any deficiencies; all corrections must be completed before final inspection.

3.5.3 Final Acceptance

A. Acceptance requires:
B. Successful final testing
C. Submission of complete documentation
D. Demonstration of all programmed features
E. Proper device naming, labeling, and integration

3.6 CLEANUP & RESTORATION

3.6.1 Remove installation debris, scrap cabling, packaging, and unused materials from all equipment rooms and work areas.

3.6.2 Restore building finishes to original condition or better.

3.6.3 All unused hardware, protective caps, manuals, and accessories shall be returned to the District.

3.7 DELIVERABLES

3.7.1 CAD & GIS Map showing the following based on the requirements from 27 05 53

A. Sensor Locations
B. Pathways Used

3.7.2 As-Built Drawings including device locations, network jack associations, switch port assignments, and PoE loading.

3.7.3 Programming Documentation including event logic, thresholds, and integrations.

3.7.4 Warranty Documentation per District requirements.

3.7.5 User & Technical Manuals for all system components.

3.7.6 Final Test Reports including test procedures, results, and device health verification.

END OF SECTION

SECTION 28 70 00
FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 REQUIREMENTS

A. This performance specification provides the minimum requirements for the Fire Life Safety System. The work provided shall include, but not limited to furnishing all equipment, materials, delivery, labor, documentation, testing, inspections by Inspector of Record (IOR) and services necessary to furnish and install a complete, operational Fire Alarm System.
B. At the time of bid, all exceptions taken to these Specifications, all variances from these Specification and all substitutions of operating capabilities or equipment called for in these Specification shall be listed in writing and forwarded to the District and Engineer. Any such exception, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment.

1.02 REFERENCES

A. All work and materials shall conform to all applicable Federal, State and local codes and regulations governing the installation.
B. Fire alarm system, equipment, installation, and wiring materials and methods used shall comply with the following codes and standards:

1. System components proposed in this specification shall be UL listed for its intended use.
2. California State Fire Marshall Listed Components
3. CALIFORNIA CODE OF REGULATIONS (C.C.R.) APPLICABLE CODES AS OF January 1st, 2023

1.03 CONTRACTOR QUALIFICATIONS

A. All work specified in this Section shall be performed (furnished, installed, and connected) by a qualified fire alarm contractor. The fire alarm contractor shall provide the following documentation to show compliance with the contractor qualifications within 7 days after notice of award of contractor.

1. Contractor's License: A copy of the contractor's valid State of California License. The contractor must be licensed in the state of project location and have been incorporated in the business in that state for a minimum of 5 years.
2. Proof of Experience: Proof that the fire alarm contractor has successfully installed similar fire detection system, evacuation voice and visual signaling control components on a previous project of comparable size and complexity. Provide a statement summarizing any pending litigation involving an officer or principal of /or the company, the nature of the litigation and what effect the litigation may carry as it relates to this work in the worst-case scenario. Non-disclosure of this item, if later discovered, may result, at the owner's discretion, in the contractor bearing all costs and any cost related to associated delays in the progress of the work.
3. Insurance Certificates: Copy of fire alarm contractor's current liability insurance and state industrial insurance certificates in conformance with the contract document.
4. Service Capability: The fire alarm contractor shall have in-house engineering, installation and service personnel with a maintenance office within 50 miles of the project location.
5. Authorization Letters: Letters from the fire alarm equipment manufacturer stating that the fire alarm contractor is a Factory Authorized Distributor and is trained and certified for the equipment proposed on this project and is licensed to purchase and install the software

required to provide the specified functions.

6. Certifications:

    a. Documentation that the fire alarm contractor has on staff personnel factory-trained and certified for the equipment proposed for this project.

1.04 SCOPE OF WORK

A. Provide new FA devices & programming to existing EST-3 FA system as indicated on the drawings and specifications related to HVAC Retrofit project. Existing EST-3 system is DSA approved & certified with A # 03- 113046; File # 19H-20. New Devices added to existing system are as identified on the drawings and Fire Alarm Submittals. Provide complete programming and update existing EST-3 FACP program with hardware & software updates as required at school control panel's & Fire Works at District Security office. Validate & confirm that entire system is programmed and annunciated. Provide NFPA 72 completion certificate (all forms are attached to the specifications)>

B. Fire Watch Provisions

    1. Fire watch will be provided by the District in accordance with specific requirements by the State Fire Marshall Guidelines.

C. Operation of buildings. All buildings are provided with existing EST-3 fire control panels installed as specified on the drawings and specifications. All peripherals connected to the EST-3 Fire Alarm Control Panels(s) communicates on the District's LAN network to existing EST Graphics works station located at District's security office. Provide all programming required for EST-3 control panel(s) and all peripherals to communicate with the existing EST Fireworks system via District's LAN network.

D. The system supplied under this specification shall be a microprocessor-based direct wired, multi-priority peer-to-peer networked system. The system shall utilize independently addressed, microprocessor-based smoke detectors, heat detectors, and modules as described in this specification. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer.

E. The fire alarm scope of work shall consist of the following minimum requirements.

    1. Fire Alarm Control Panels and Annunciators (Existing System Reuse)

        a. Fire Alarm Control Panel (FACP): The existing FACP, located as shown on the drawings, shall be reused.
        b. Remote LCD Annunciator: The existing remote LCD annunciator in the main office, as indicated on the drawings, shall be reused. This annunciator reports activity for all buildings.
        c. Network Integration: The existing FACP and remote data gathering panels form a network connecting all areas of the school building(s), enabling common monitoring and control via the EST-3 system.

    2. Initiating Devices

        a. Addressable Devices: All initiating devices shall be new addressable devices as specified. Any conventional initiating devices used shall be equipped with individual addressable monitor modules for unique addressing and annunciation.
        b. Existing Smoke Detectors: Existing smoke detectors shall be reused.
        c. New Multi-Sensor Smoke & CO Detectors: New multi-sensor smoke and CO detectors shall be provided where indicated on the drawings. These detectors shall be EST SIGA-OSCD with SIGA-AB4GT audible (sounder) bases for CO and fire detection, and

SIGA-TCDR temporal pattern generators.

d. Existing manual pull stations: Existing manual pull stations shall be reused.

3. Notification Devices:

   a. Existing notification devices shall be reused. These include:

      1) Temporal Horns
      2) Strobes

4. Booster Power Supplies:

   a. Existing booster power supplies shall be reused.

1.05 SEQUENCE OF OPERATIONS

A. General Alarm Operation: Upon alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler water flow, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel or command center.
2. The LCD Display shall indicate all applicable information associated with the alarm condition including zone, device type, device location and time/date.
3. All system activity/events shall be documented on the system printer.
4. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
5. EST Fireworks (Provide programming of EST-3 control panel at each school site to annunciate and monitor at existing District remote Fire works station.

   a. Display the address of the alarm or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
   b. Display color graphical representation of the area in which the alarm or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
   c. Display a set of written operator instructions for each point.
   d. Log operator's comments for each event to history with time and date.
   e. Log all events and operator actions to history for future review.

6. The following notification signals and actions shall occur simultaneously:

   a. A signal shall be sounded on fire floors (zones). The signal shall be a Temporal 3 tone.
   b. Activate visual strobes on the fire floors (zones). The visual strobe shall stop operating when the "Alarm Silence" is pressed.

7. Transmit signal to the building automation system (if applicable) and/or shutdown all HVAC units serving the floor of alarm.
8. Transmit signal to the central station with point identification.
9. All self-closing fire/smoke doors held open shall be released.
10. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.

B. Supervisory Operation: Upon supervisory activation of any sprinkler valve supervisory switch, fire pump off-normal, clean agent fire suppression system trouble, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel or command center.
2. The LCD display shall indicate all applicable information associated with the supervisory condition including zone, device type, device location and time/date.

3. All system activity/events shall be documented on the system printer.
4. Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
5. Transmit signal to the central station with point identification.

C. Monitor Activation: Upon activation of any device connected to a monitor circuit (fire pump/emergency generator status), the following functions shall automatically occur:

1. The LCD display shall indicate all applicable information associated with the status condition including zone, device type, device location and time/date.
2. All system activity/events shall be documented on the system printer.
3. Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated.

1.06 SYSTEM PARAMETERS

A. Standby power (Reuse Existing)

1. The standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for twenty-four (24) hours and capable of operating the system for five (5) minutes of evacuation alarm on all devices, operating at maximum load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.

B. Voltage Drop

1. The point-to-point Ohm’s Law voltage drop calculations of all alarm system circuits shall not exceed 8%.

C. Spare Capacity (existing)

1. The system shall be engineered to accommodate 25% spare capacity on each individual loop, and 25% spare on system power supplies.

D. Circuiting

1. Initiating Device Circuits

a. Where necessary, conventional initiating device circuits (i.e., water flow switches, valve supervisory switches, fire pump functions, etc.) shall be Class B (Style "B").

2. Notification Appliance Circuits

a. All notification appliance circuits shall be Class B (Style "Y"). The notification circuits shall be power limited. Non-power limited circuits are not acceptable.

3. Signaling Line Circuits: Addressable Analog Devices

a. The signaling line circuit connecting to addressable/analog devices including, detectors, monitor modules, control modules, isolation modules, intrusion detection modules and notification circuit modules shall be Class B (style 4).
b. Each addressable analog loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices.

4. Signaling Line Circuits: Data & Audio for FACP & Annunciator Network

a. The signaling line circuit connecting network panel/nodes, annunciators, command centers, shall be Class A (style 7). The media shall be copper except where fiber optic cable is specified on the drawings.

1.07 SUBMITTALS

A. General

1. It is the responsibility of the contractor to meet the entire intent and functional performance detailed in these specifications.
2. The proposed equipment shall be subject to the approval of the Engineer/District.
3. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications.

B. Equipment Submittal

1. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which will also indicate the manufacturer's part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.
2. Provide manufacturer's ORIGINAL printed data sheets with the printed logo or trademark of the manufacturer for all equipment. Photocopied and/or illegible product data sheets shall not be acceptable.
3. Indicated in the documentation will be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification.
4. Current CSFM listing sheet for each component.
5. Letter or Certificate from the fire alarm manufacturer stating that the fire alarm contractor is an authorized distributor of the specified product.
6. Submit a copy of the system supplier's training certification for the specified product issued by the manufacturer of the integrated life safety system.
7. Equipment submittals and other documentation shall be incorporated bound with the above information indexed and tabbed for quick reference.

C. Shop Drawings

1. A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. This package shall include but not be limited to:

    a. All drawings and diagrams shall include the contractor's title block, complete with drawing title, contractor's name, address, date including revisions, and preparer's and reviewer's initials and DSA application number and District File Number.
    b. Classification per building Ex: Manual, Automatic, etc.,
    c. Sequence of Operations Schedule.
    d. Typical Fire Penetration detail showing methods and codes used.
    e. Complete system bill of material with peripheral device back box size information, part numbers, device mounting height information.
    f. Detailed system operational description. Any Specification differences and deviations shall be clearly noted and marked.
    g. A riser diagram that individually depicts all control panels, annunciators, addressable devices and notification appliances. Field addressable devices and notification appliances may be grouped together by specific type per loop or circuit if allowed by AHJ.
    h. Complete 1/8" = 1'-0 scale floor plan drawing locating all system devices and elevation of all equipment at the Fire Command Station. Floor plans shall indicate accurate locations for all control and peripheral devices as well as raceway size and routing, junction boxes, and conductor size, and quantity in each raceway. All notification appliances shall be provided with a candela rating and circuit address that corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8" scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.

i. All drawings shall be reviewed and signed off by Contractor's individual who is licensed by the State of California for Installation of Fire alarm systems with NICET Level 3 or higher.
j. Control panel wiring and interconnection schematics. The drawing(s) shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data-gathering panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service and location of the control enclosure.
k. Any additional requirements if required by AHJ for approval.
l. Complete calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements. Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws.
m. System (Load & Battery) calculations shall be provided for each system power supply, each notification appliance circuit and each auxiliary control circuit that draws power from any system power supply.

2. The following shall be included in the submittal book:

a. Cover Sheet: Project Name, Project Location, Architect/Engineer of record, System Supplier/System Installer with C-10 License Number, and UL Listing Number with Expiration Dates.
b. Table of Contents: Page numbers of all specification sheets and CSFM Listing Numbers.
c. Specification Sheets for each piece of equipment.
d. CSFM Listing Sheets.

1.08 EQUIPMENT QUALIFICATION

A. The specification is based upon equipment as manufactured by GE Security (Formerly Edwards Systems Technology) as approved by the District. The equipment specified is a District Standard and therefore **NO SUBSTITUTIONS** will be allowed on this project. The equipment specified (per Public Contract Code 3400), is established, in order to communicate with the **EXISTING Fire Works C**entral Monitoring System at the District School Facilities/School Police/Security monitoring Center. There is no known equal.
B. All equipment shall conform to all applicable codes and ordinances and shall be listed by Underwriters Laboratories and the California State Fire Marshall.
C. A pre-approved equipment supplier, installation and service organization for the equipment specified are the authorized installer and distributor from the manufacturer.

1.09 OPERATING AND MAINTENANCE MANUALS

A. The manual shall contain a detailed narrative description of the system architecture, inputs, notification signaling, auxiliary functions, annunciation, and sequence of operations, expansion capability, application considerations and limitations.
B. Manufacturer's data sheets and installation manuals/instructions for all equipment supplied.
C. Minimum two (2) copies of the closeout documents shall be delivered to the building owner's representative at the time of system acceptance.
D. Provide the name, address and telephone of the authorized factory representative.

1.10 QUALIFICATION OF BIDDERS

A. To qualify as an acceptable bidder, whether the bid is submitted to the Owner, his agent, a general contractor or a sub-contractor, the system bidder or contractor shall be a qualified U.L. Listed Fire Alarm contractor (at time of bid) and shall hold a valid C-10 License issued by the Contractors State License Board of California. The system bidder or installing contractor shall herein be referred to as the Contractor. The Contractor shall also hold a State of California Consumer Affairs License - Bureau of Collection and Investigative Services. The Contractor shall also have on staff State Licensed installer for alarm systems under whose supervision the systems will be installed, programmed, and tested in accordance with the DSA regulations and Inspector of Record (I.O. R). This is to insure that licensed installers familiar with this type of installation will be used on this project. The Contractor shall be the factory authorized distributor (at time of bid), for the brand of equipment being installed. The Contractor shall have been in the business of supplying, installing, and servicing Addressable Fire Alarm Systems for the past 10 years, in the State of California. The Contractor shall be able to refer to at least 20 projects of this nature rendering satisfactory service with contact persons, phone numbers and addresses. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall maintain an inventory of all major components in stock at all times. The Contractor's Office shall be located within 50 miles of the jobsite. This will insure an adequate service response, in a timely matter. The Contractor shall maintain on staff for the duration of the project a minimum of two EST-3 and Fire Works Certified Installers. Contractors not pre-approved in writing 21 days prior to bid hour and date will not be considered for this project. Contractors named in 1.08 C above, are considered to be pre approved for this project, and will be able to satisfy warranties already in place, when adding onto the Fire Works Central Monitoring System Program.
B. The responsibility of the installing Contractor is to provide all drawings, submittals, wire, devices, equipment, installation to conduit system furnished and installed under this contract, programming, final test out and certification. Installation of all specialty Fire Alarm Back-boxes for the conduit system, Terminal cabinets, pull boxes, etc. provided shall conform to Division16 shall be provided under this section.

1.11 AS-BUILT PROJECT DRAWINGS AND DATA

A. Drawings consisting of a scaled plan of each building showing the placement of each individual item of the Integrated Life Safety System equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
B. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
C. All drawings shall be provided in standard .DXF or AutoCAD format exportable to EST fireworks station.

1.12 WARRANTY

A. The contractor shall warranty all materials, installation, and workmanship for one (3) year from date of acceptance, unless otherwise specified.
B. A copy of the manufacturer's warranty shall be provided with closeout documentation and included with the operation and installation manuals.
C. The System Supplier shall maintain a service organization with adequate spare parts stock within 50 miles of the installation. Any defects that render the system inoperative shall be

repaired within 24 hours of the owner notifying the contractor.

1.13 EXTRA MATERIALS

A. Provide10% of each type of new devices provided.

1.14 SYSTEM LAYOUT

A. SYSTEM DESCRIPTION

1. The Fire Alarm System as outlined on the drawings shall be a Life Safety System as manufactured by GE Security EST-3 system. It shall be complete with all necessary hardware, software and memory specifically tailored for this project.
2. Provide a new Network System, Remote Panels, Remote Annunciators, Printers, Devices, etc. in accordance with specifications and drawings. Counts for devices to be in accordance with submitted shop drawings and approved by the Engineer.
3. All equipment needed for a complete operable system, (whether specifically indicated or not) shall be included in this section. It shall be the Installing Contractors responsibility for a COMPLETE AND OPERABLE SYSTEM upon completion of this project.

1.15 AUTOMATIC ALARM OPERATIONS

A. The fire alarm system operation subsequent to the alarm initiation via pull station, smoke detector, heat detector, sprinkler flow switch, etc., shall be as follows:

1. All audible alarm indicating devices shall sound the Temporal Signal Code in synchronization with each other, until silenced at the control panel or at the remote annunciator.
2. All visual alarm indicating devices shall flash per NFPA requirements in synchronization with each other, until reset at the control panel or at the remote annunciator.
3. Alarm audible devices and alarm visual devices shall operate on the same circuit.
4. The alarm signals shall be inhibited from being silenced for a period of at least 1 minute after commencing operation. This rate is to be field programmable for actual AHJ requirements.
5. Display type and location of alarm per point on the Main Control Panel LCD display.
6. Display type and location of alarm per point on Remote LCD Annunciator.
7. List on printer the time, date, type and user defined message for each event printed.
8. Graphically display on the Fire Works Station, school diagram showing whole school, with graphic scrolling thru system prompts, down to point of alarm activation.
9. Subsequent alarms are to report to the Main Control Panel and Fire Works, shall indicate to the operator that a subsequent alarm is present, and also indicate the number of subsequent alarms.
10. Shut down all associated air handlers in Alarm Zone.

1.16 AUTOMATIC SUPERVISORY OPERATION

A. All data, initiating, indicating and supervisory lines shall be constantly monitored for integrity. Indicate opens, shorts, grounds, at Main Control Panel, Remote Annunciator and Fire Works Station.

1.17 OPERATION

A. During the normal state, the NORMAL LED (green) shall flash. The first line of the LCD shall display the time in (HH:MM: SS) as well as the number of active points (AP) and the number of disabled points (DP) in the system.
B. When the control panel goes into alarm condition, the NORMAL LED (green) extinguishes and

the ALARM LED (red) shall light, the buzzer pulsates and the LCD indicates the time, the number of messages waiting, the type of alarm, the point ID number of device, and the time that the alarm occurred. The second line is dedicated to the user specified message.

C. To silence the panel buzzer, the operator shall press the LOCAL SILENCE button and the buzzer will silence.
D. To silence the audible devices, the operator shall press the ALARM SILENCE button. A new alarm shall cause the audible to resound.
E. During the TROUBLE condition, the amber TROUBLE LED shall light, the NORMAL LED shall go out, and the buzzer shall pulsate. The display shall indicate the point ID number of the device, the time the event occurred and up to a 40 character custom user description.
F. During the MONITOR or SUPERVISORY condition, the appropriate LED shall light, the NORMAL LED shall go out, and the buzzer shall pulsate. The display shall indicate the point ID number of the device, the time the event occurred and up to a 40 character custom user description.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. GE Security: EST Fire & Life Safety – EST3 (District Standards, No Substitutions are acceptable).

2.02 GENERAL

A. All FACP and remote data gathering panels shall complete the “network” between all areas of the School site and building(s) allowing for common monitoring and control by the EST FireWorks system at Maintenance & Operations/District Security building via LAN Network.
B. All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment, and devices shall be tested and listed by a nationally recognized approval agency for use as part of a protected premises (fire alarm) system).
C. The contractor shall provide, from the acceptable manufacturer's current product lines, equipment, software, and components, which comply, with the requirements of these specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.
D. All System components shall be the cataloged products of a single supplier. All products shall be UL and CSFM listed by the manufacturer for their intended purpose.
E. All control panel assemblies and connected field appliances shall be both designed and manufactured by the same company and shall be tested and cross-listed as to ensure that a fully functioning system is designed and installed.

2.03 FIRE ALARM CONTROL PANEL EST-3/CAB7/CAB14/CAB21 (Reuse Existing):

A. General

1. The fire alarm control panel or panels and all system devices (Horn-strobes, strobes, pull stations, smoke and heat detectors, etc. shall be GE Security (EST) type EST3 series. All under one label “UL/UOJZ listed and CSFM approved” for the use of fire alarm systems in

State of California.

2. The operating controls shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified.
3. The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 64 network nodes. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, LCD/LED annunciation nodes, and workstations. Each node is an equal, active functional node of the network, which is capable of making all local decisions and generating network tasks to other nodes in the event of node failure or communications failure between nodes. When utilizing a network and multiple wiring faults occur, the network shall re-configure into many sub-networks and continue to respond to alarm events from every panel that can transmit and receive network messages.
4. The Main Controller Module shall control and monitor all local or remote peripherals. It shall support a large 168-character LCD, power supply, remote LCD and zone display annunciators, printers, and support communication interface standard protocol (CSI) devices such as color computer annunciators and color graphic displays.
5. The programmer shall be able to download all network and firmware applications from the configuration computer to all the network panels from a single location on the system.
6. The panels shall have the ability to add an operator interface control/display at each node that shall annunciate command and control system functions.
7. The system shall store all basic system functionality and job specific data in non-volatile memory. All site specific and operating data shall survive a complete power failure intact. Passwords shall protect any changes to system operations.
8. The control panel shall contain a standby power supply that automatically supplies electrical energy to the system upon primary power supply failure. The system shall include a charging circuit to automatically maintain the electrical charge of the battery.

B. Signaling Line Circuits

1. The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 125 detectors and 125 remote modules per addressable Signaling line Circuit (SLC). The CPU shall support up to 10 SLC's per panel for a total system capacity of 2500 Intelligent Addressable points. Provide additional signaling line circuit modules as required for the number of detectors and modules provided. The system shall be designed with peer-to-peer networking capability for enhanced survivability, with support for up to 64 nodes, each with up to 2500 points and an overall capacity of 160,000 points.
2. The system shall provide electronic addressing of analog/addressable devices.
3. The system shall have built-in automatic system programming to automatically address and map all system devices attached to the main controller.
4. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of “same type” devices without the need of addressing and impose the “location” parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is mapped and defined into the system.
5. The system shall have a UL Listed Detector Sensitivity test feature, which will be a function of the smoke detectors and performed automatically every 4 hours.
6. The Master Controller shall have the following additional features without any changes in hardware or firmware:

    a. Auto Programming and Electronic Addressing of Field Devices.
    b. Logic Statements.
    c. Time Controls.
    d. Sequences.
    e. Actions.
    f. Analog Value reporting of all analog sensors and traditional zones.
    g. Maintenance Reporting by Intelligent Sensor.
    h. Sensitivity Setting by Sensor (Within UL Limits).

i. Sensitivity Setting changed by time (Day/Night Mode).
j. Alarm Verification by point or zone. (0-60 Seconds).
k. Print a history of Sensors Activating the Verification Cycle.
l. On demand system condition printouts (status).
m. Enabling and disabling of any system device or function.
n. Ground Fault Detection by Panel, by Signature Data Circuit, and by Device Module.
o. Normal and Silent One Man Test.
p. Windows Based Programming.
q. Network Response Time Under 3 Seconds.
r. Loop Response Time Under 750 Milliseconds.
s. Device Mapping Feature for As-Builts.
t. Up to 1750 History Events
u. Remote Systems Diagnostic via Phone Line

C. DACT:

1. The system shall provide off premise communications capability (DACT) for transmitting system events to multiple Central Monitoring Station (CMS) receivers.
2. The system shall be capable of providing the CMS(s) with point identification of system events using Contact ID or SIA DCS protocols.
3. In the event of a panel CPU failure during a fire alarm condition, the DACT degrade mode shall transmit a general fire alarm signal to the CMS.

D. User Interfere

1. Main Control & Display

a. The main display shall be a large 168-character LCD with normal, alarm, trouble, supervisory, disabled point and ground fault indicators.
b. The interface shall show the first and most recent highest priority system events without any operator intervention. All system events shall be directed to one of four message queues. Messages of different types shall never intermix to eliminate operator confusion. A "Details" switch shall provide additional information about any device highlighted by the operator.
c. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.
d. The internal audible signal shall have different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
e. The annunciator shall contain the following controls:

1) System Reset Switch with Indicator
2) System Alarm Silence Switch with Indicator
3) System Panel Silence Switch with Indicator
4) Programmable Switch with Indicator
5) Details Switch
6) System Message Queue Scroll Switches.

2. 10-Digit Keypad to Enable/Disable System and Functions.

a. An authorized operator shall have the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
b. An authorized operator shall be capable of performing test functions within the installed system.

3. Additional Annunciation & Control:

a. The system shall be capable to receive, monitor, and annunciate signals from individual devices and circuits installed throughout the building.
b. Manufacturers' standard control switches shall be acceptable if they provide the required operation, including performance, supervision and position indication. If the manufacturers' standard switches do not comply with these requirements, fabrication of custom manual controls acceptable to the Owner is required.

E. Internal Modular Power Supply

1. System power supply(s) shall provide multiple power limited 24 VDC output circuits as required by the panel.
2. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions.
3. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.
4. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciate as battery trouble and identify the specific power supply affected.
5. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.
6. All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 72 - The AC power circuit shall be installed in conduit raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside each control panel the disconnect serves.

F. Reports

1. The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD and shall be capable of being printed on any system printer.
2. The system shall provide a report that gives a sensitivity listing of all detectors that have less than 75% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.
3. The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given analog/addressable device loop within any given panel.
4. The system shall provide a report that gives a chronological listing of up to the last 1740 system events.
5. The system shall provide a listing of all of the firmware revision listings for all of the installed network components in the system.

2.04 ANNUNCIATORS (Reuse Existing):

A. General

1. The system shall have the capacity to support 64 network annunciators or EST3 network panel nodes.

B. Remote LCD Annunciator, 3-LCDANN

1. Remote LCD annunciators shall display each and every point in the system and be sized with the same number of characters as in the main FACP display. Annunciators not capable of displaying each point will not be considered equal. Grouping points to “zones” will not be acceptable.
2. Network alphanumeric annunciators shall be located throughout the facility as indicated on

the plans and in the fire safety director's office. This annunciator shall be an Integral part of the Peer-to-Peer Network for survivability. Systems that require a “host” Network Node to control remote annunciators shall not be considered acceptable.

3. Each annunciator shall contain a supervised; back lit, liquid crystal with a minimum of 8 line with 21 characters per line. Where required, the annunciator shall include additional zonal annunciation and manual control without additional enclosures. The annunciator shall support full ability to serve as the operating interface to the system and shall include the following features.

    a. Matched appearance with other system displays.
    b. Each LCD Display on each node (cabinet) in the system shall be configurable to show the status of any or all of the following functions anywhere in the system:

        1) Alarm
        2) Supervisory
        3) Trouble
        4) Monitor

4. Each annunciator must be capable of supporting custom messages as well as system event annunciation. It must be possible to filter unwanted annunciation of trouble, alarm or supervisory functions on a by point or by geographic area. The annunciators shall be mounted in stand-alone enclosures or integrated into the network panels as indicated on the plans.

2.05 INTELLIGENT ADDRESSABLE DETECTORS

A. General

1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device’s address by physical means shall not be necessary.
3. The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.
4. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.75 seconds.
5. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status.
6. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

7. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.
8. Each detector microprocessor shall contain an environmental compensation algorithm, which identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long-term and 4 hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.
9. The intelligent analog detectors shall be suitable for mounting on any Signature Series detector mounting base.
10. The Fire alarm system shall have the ability to set individual smoke detectors for alarm verification. Detector in the alarm verification mode shall indicate, by point in a text format at the main control and at the remote LCD annunciators.

B. Photoelectric Smoke Detector, SIGA-PS (Reuse Existing)

1. Provide intelligent photoelectric smoke detectors SIGA-PS. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGA-PRO Signature Program/Service Tool. The photo detector shall be rated for ceiling installation at a minimum of 30 ft centers and be suitable for wall mount applications. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft high and 3 ft wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes.
2. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:

   a. Temperature: 32^{o}F to 120^{o}F (0^{o}C to 49^{o}C)
   b. Humidity: 0-93% RH, non-condensing
   c. Elevation: no limit

C. Fixed Temp/Rate of Rise Heat Detector, SIGA-HFS OR SIGA –HRS (Reuse Existing),

1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors SIGA-HRS. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135^{o}F (57^{o}C) and a rate-of-rise alarm point of 15^{o}F (9^{o}C) per minute. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.

D. Multisensor Smoke and CO Detector, EST # SIGA-OSCD:

1. New multi-sensor smoke and CO detectors shall be provided where indicated on the drawings. These detectors shall be EST SIGA-OSCD with SIGA-AB4GT audible (sounder) bases for CO and fire detection, and SIGA-TCDR temporal pattern generators.

EST # SIGA-AB4GT: Audible (Sounder) Base for CO and Fire Detectors
EST # SIGA-TCDR : Temporal Pattern Generator
CSFM # 7275-1657:0334
CSFM # 7300-1657:0307
CSFM # 7300-1657:0308

E. Standard Detector Bases, SIGA-SB/SIGA-SB4 (Reuse Existing),

1. Provide standard detector mounting bases SIGA-SB suitable for mounting on North American 1-gang, 3½" or 4" octagon box and 4" square box. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements:

   a. Removal of the respective detector shall not affect communications with other detectors.
   b. Terminal connections shall be made on the room side of the base. Bases, which must be removed to gain access to the terminals, shall not be acceptable.
   c. The base shall be capable of supporting one (1) Signature Series SIGA-LED Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

2.06 CONVENTIONAL INITIATING DEVICES

A. General

1. All initiating devices shall be UL Listed for Fire Protective Service.
2. All initiating devices shall be of the same manufacturer as the Fire Alarm Control Panel specified to assure absolute compatibility between the devices and the control panels, and to assure that the application of the initiating devices is done in accordance with the single manufacturer's instructions.

B. Fixed Temperature Low Profile Attic Heat Detectors, 284B-PL WITH SIGA CT-1 (Reuse Existing)

1. Detectors shall be rated for a maximum smooth ceiling rating of 2,500 sq. ft.
2. The detector shall have a white finish and positive identification for the operation of the fixed temperature element.
3. The detectors shall be rated at 194°F fixed temperature.
4. Detectors shall be suitable for mounting to 1-gang, 4" square, octagonal, BESA, or European single-gang.

2.07 INTELLIGENT ADDRESSABLE MODULES

A. General

1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
2. Each device shall be capable of electronic addressing, either automatically or application

programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.

3. It shall be possible to address each Intelligent Signature Series module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults.
4. The module shall be suitable for operation in the following environment:

    a. Temperature: 32^{o}F to 120^{o}F (0^{o}C to 49^{o}C)
    b. Humidity: 0-93% RH, non condensing

B. Single Input Module, SIGA-CT1,

1. Provide intelligent single input modules SIGA-CT1 for monitoring of PIV's, Fan Status, Tamper Switches, Flow Switches, Generator & Fire Pump Status, Preaction System Alarm or Trouble or any other dry contact required to be monitored.
2. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square box with 1-gang covers.
4. The single input module shall support the following circuit types:

    a. Normally Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
    b. Normally Open Alarm Delayed Latching (Waterflow Switches)
    c. Normally Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
    d. Normally Open Active Latching (Supervisory, Tamper Switches)

C. Dual Input Module, SIGA-CT2,

1. Provide intelligent dual input modules SIGA-CT2 for monitoring of sets of PIV's, Fan/Damper Status, Tamper Switches, Flow Switches, Preaction System Alarm or Trouble or any other sets of dry contacts required to be monitored.
2. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.
4. The dual input module shall support the following circuit types:

    a. Normally Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
    b. Normally Open Alarm Delayed Latching (Water flow Switches)
    c. Normally Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
    d. Normally Open Active Latching (Supervisory, Tamper Switches)

D. Signal Module, SIGA-CC1,

1. Provide intelligent single input signal modules SIGA-CC1 for activation of booster power supplies, audible/visual circuits, speaker circuits or for monitoring and communication of phone jacks.
2. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang

boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes.

4. The single input signal module shall support the following operations:
    a. Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
    b. Telephone Power Selector with Ring Tone (Fire Fighter's Telephone)
5. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone".

E. Synchronized Signal Module, SIGA-CC1S,

1. Provide intelligent single input signal modules SIGA-CC1S for activation of booster power supplies and/or audible/visual circuits that require synchronization.
2. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes.
4. The single input signal module shall support the following operations:
    a. Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
    b. Telephone Power Selector with Ring Tone (Fire Fighter's Telephone)
5. Provides UL1971 auto-sync output for synchronizing multiple notification appliance circuits.

F. Control Relay Module, SIGA-CR, CSFM 7300-1657:0121

1. Provide new where indicated on the drawings: Intelligent control relay modules SIGA-CR for activation and/or shutdown of fans, dampers, door holder circuits, door locks, shunt trip, elevator recall or any other fail safe system requiring control or activation.
2. The Control Relay Module shall provide one form "R" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown.
3. The control relay shall be rated for pilot duty and releasing systems.
4. The position of the relay contact shall be confirmed by the system firmware.
5. The control relay module shall be suitable for mounting on North American 4S -2 ½" deep 1or 2 gang boxes as required with 1 ½" deep 4" square boxes with 1-gang covers.

G. Manual Pull Station, SIGA-270

1. Provide intelligent single action, single stage fire alarm stations SIGA-278. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver "PULL IN CASE OF FIRE" English lettering.
2. The manual station shall be suitable for mounting on North American 2 1/8" deep ½"1-gang boxes and 1 ½" (38mm) deep 4" square box with 1-gang covers.
3. Provide compatible surface mount red box, 276B-RSB with STI-3100 conduit spacer at all surface mount locations. Standard electrical boxes are not acceptable.
4. The manual stations shall be complied with CBC section 1117B.6 and 1118B.

2.08 NOTIFICATION APPLIANCES (Reuse Existing),

A. General

1. All appliances shall be UL Listed for Fire Protective Service.
2. All strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act

accessibly guidelines (ADA (AG)) and shall be UL 1971.

3. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.
4. Any appliances, which do not meet the above requirements, and are submitted, for use must show written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended.

B. Wall Strobes, Genesis G1RF -VM Series,

1. Strobes shall provide synchronized flash outputs. The light output shall be an even "Full Light" pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the Chime and meet the intent of UL Private Mode signaling.
3. The strobe shall have selectable 15, 30, 75 or 110 cd settings.
4. It shall be possible to change the strobe setting without removing the device from the wall
5. The strobe shall be a low-profile design, finished in neutral white and shall not protrude more than 1" off the wall. In-out screw terminals shall be provided for wiring.
6. The strobe shall be suitable for wall mounting and shall mount in a standard North American 4S box 2 1/8" deep with 1-gang ring. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
7. For Surface mount applications, use single gang Wiremold box V5748.

C. Ceiling Strobes, Genesis GCF-VM Series,

1. Strobes shall provide synchronized flash outputs. The light output shall be an even "Full Light" pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the Chime and meet the intent of UL Private Mode signaling.
3. The standard ceiling strobe shall have selectable 15, 30, 75 or 95 cd settings.
4. The high output ceiling strobe shall have selectable 95, 115, 150 or 177 cd settings.
5. It shall be possible to change the strobe setting without removing the device from the ceiling.
6. The strobe shall be a low-profile design, finished in neutral white and shall not protrude more than 1.6" off the ceiling. In-out screw terminals shall be provided for wiring.
7. The strobe shall be suitable for ceiling mounting and shall mount in a standard North American 4S box 2 1/8" deep with 4-S extension ring. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
8. For Surface mount applications, use single gang Wiremold box V5753.

D. Wall Horn-Strobes, Genesis G1RF-HDVM Series,

1. Strobes shall provide synchronized flash outputs. The light output shall be an even "Full Light" pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the horn and meet the intent of UL Private Mode signaling.
3. The strobe shall have selectable 15, 30, 75 or 110 cd settings.
4. It shall be possible to change the strobe setting without removing the device from the wall.
5. The horn shall provide an 84 dBA sound output at 10 ft. when measured in reverberation room per UL-464.
6. The horn can also be set for low dB output with a jumper cut that reduces horn output by about 5 dB.
7. The horn shall have a selectable steady or synchronized temporal output.
8. It shall be a low-profile design, finished in neutral white and shall not protrude more than 1" off the wall. In-out screw terminals shall be provided for wiring.

9. The Horn/strobe shall be suitable for wall mounting and shall mount in a standard North American 4S box 2 1/8” deep with 1-gang ring.
10. For Surface mount applications, use single gang Wiremold box V5748.

E. Ceiling Horn-Strobes, Genesis GCF-VM Series,

1. Strobes shall provide synchronized flash outputs. The light output shall be an even “Full Light” pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the horn and meet the intent of UL Private Mode signaling.
3. The standard ceiling strobe shall have selectable 15, 30, 75 or 95 cd settings.
4. The high output ceiling strobe shall have selectable 95, 115, 150 or 177 cd settings.
5. It shall be possible to change the strobe setting without removing the device from the ceiling.
6. The horn shall provide an 84 dBA sound output at 10 ft. when measured in reverberation room per UL-464.
7. The horn can also be set for low dB output with a jumper cut that reduces horn output by about 5 dB.
8. The horn shall have a selectable steady or synchronized temporal output.
9. The strobe shall be a low-profile design, finished in neutral white and shall not protrude more than 1.6” off the ceiling. In-out screw terminals shall be provided for wiring.
10. The Horn/strobe shall be suitable for ceiling mounting and shall mount in a standard North American 4S box 2 1/8” deep with 4-S extension ring. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
11. For Surface mount applications, use single gang Wiremold box V5753.

F. Weatherproof Horn, 757 -1A-T Series,

1. Horns shall be selectable for high or low dBA output and steady or temporal output.
2. At the high output setting, the horn shall provide a 85 dBA continuous sound output or a 82 dBA temporal sound output, when measured in reverberation room per UL-464.
3. In and out screw terminals shall be provided for wiring.
4. Weatherproof wall boxes (757A-WB) shall be provided for outdoor applications.
5. For flush mount applications indoor - Use 4S 2-1/8" boxes with 2-Gang Ring
6. For surface mount applications indoor - Use 757A-SB Back-box
7. For surface mount applications outdoor - Use 757A-WB Back-box

2.09 ACCESSORY EQUIPMENT

A. Multi-Voltage Control Relays,

1. Functional Devices, Inc. # RIBU1C: Relay 10 Amp SPDT with 10-30 Vac/Dc/120 Vac Coil CSFM # 7300-1555:0100
2. General
    a. Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc.
    b. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac.
    c. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac,
    d. A red LED shall indicate the relay is energized.
    e. A metal enclosure shall be provided.

B. Remote Booster Power Supplies, BPS6A/10A **(Reuse Existing),**

1. Unit shall be a self contained with 24Vdc power supply and batteries housed in its own locked enclosure. Keys provided shall be identical to the keys provided for all other fire alarm equipment provided.
2. Power supply shall be available in both 10 Amp or 6.5 Amp models and 110 Vac or 220Vac.

3. On board LED indicators for each resident NAC, battery supervision, ground fault and AC power.
4. The power supply shall provide four (4) independent 3Amp NACs. Each circuit can be configurable as an auxiliary output.
5. Configurable for any one of three signaling rates: 120SPM; 3-3-3 temporal; or, continuous.
6. Two independent and configurable inputs switch selectable to allow correlation of the two (2) inputs and the four (4) outputs.
7. NAC's shall be configurable for four Class B circuits.
8. The unit shall be compatible with SIGA-CC1S for synchronization of multiple power supplies without inter-connects wiring.
9. Brackets shall be provided inside the enclosure to allow mounting the signaling modules. All signaling modules shall be listed to be located inside the booster power supply enclosure.
10. A selectable dip switch shall enable built in synchronization for horns and strobes which may be used to synchronize downstream devices, as well as other boosters and their connected devices.

2.10 CONDUCTORS

A. The requirement of this section apply to all system conductors, including all signaling line, initiating device, notification appliance, auxiliary function, remote signaling, AC and DC power and grounding/shield drain circuits, and any other wiring installed by the Contractor pursuant to the requirements of these Specifications.
B. All circuits shall be rated power limited in accordance with NEC Article 760.
C. Installed in conduit or enclosed raceway.
D. All new system conductors shall be of the type(s) specified herein.

1. All initiating circuit, signaling line circuit, AC power conductors, shield drain conductors and grounding conductors, shall be solid copper, stranded or bunch tinned (bonded) stranded copper.
2. All signaling line circuits, including all addressable initiating device circuits shall be 18 AWG minimum multi-conductor jacketed twisted cables or as per manufacturer's requirements.
3. All non-addressable initiating device circuits, 24 VDC auxiliary function circuits shall be 18 AWG minimum or per manufacturer's requirements.
4. All notification appliance circuit conductors shall be solid copper or bunch tinned (bonded) stranded copper. Where stranded conductors are utilized, a maximum of 7 strands shall be permitted for No. 16 and No. 18 conductors, and a maximum of 19 strands shall be permitted for No. 14 and larger conductors.
5. All audible notification appliance circuits shall be 12 AWG THHN minimum twisted pairs or per manufacturer's requirements.
6. All visual notification appliance circuits shall be 12 AWG minimum THHN twisted pairs or per manufacturer's requirements.
7. All wiring shall be color-coded throughout, to California Electrical Code standards.

2.11 CONDUIT RACEWAY

A. All systems and system components listed to UL864 Control Units for Fire Protective Signaling Systems maybe installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System(s)or system components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.
B. The requirements of this section apply to all system conduits, raceways, electrical enclosures, junction boxes, pull boxes and device back boxes.

C. All system conduits shall be of the sizes and types specified.
D. All system conduits shall be EMT, 3/4 -inch minimum, except for flexible metallic conduit used for whips to devices only, maximum length 6 feet, 3/4-inch diameter, minimum.
E. All system conduits, which are installed in areas, which may be subject to physical damage or weather, shall be IMC or rigid steel, 3/4 -inch minimum.
F. Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.
G. Existing conduit raceway system may be re-used where possible.
H. All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical or by fire damage, and so as not to interfere with existing building systems, facilities or equipment, and to facilitate service and minimize maintenance.
I. All conduits, except flexible conduit whips to devices, shall be solidly attached to building structural members, ceiling slabs or permanent walls. Conduits shall not be attached to existing conduit, duct work, cable trays, other ceiling equipment, drop ceiling hangers/grids or partition walls, except where necessary to connect to initiating, notification, or auxiliary function devices.
J. All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back boxes shall be readily accessible for inspection, testing, service and maintenance.
K. All penetration of floor slabs and firewalls shall be sleeved (1” conduit minimum) fire stopped in accordance with all local fire codes.
L. All junction box covers shall be painted red.

2.12 INSTALLATION
2.13 INSTALLATION CONDITIONS

A. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation.
B. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer’s wiring diagram.

2.14 INSTALLATION REQUIREMENTS

A. All pull stations shall be mounted 48 inches above the finished floor, as measured on handle.
B. Pull stations currently mounted at the incorrect height shall be lowered accordingly when replaced.
C. All new audio/visual devices shall be mounted at a minimum of 80 inches above the finished floor, as measured on strobe center. Devices shall be mounted no less than 6 inches from the ceiling.
D. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.

E. No area smoke or heat detector shall be mounted within 12 inches of any wall.
F. All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the Contract Drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer. Failure to bring such issues to the attention of the Project Engineer shall be the exclusive liability of the installing Electrical Contractor.
G. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.
H. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.
I. Power-limited/Non-power-limited NEC wiring standards SHALL BE OBSERVED.
J. Auxiliary relays shall be appropriately labeled to indicate “FIRE ALARM SYSTEM” and their specific function (i.e., FAN S-1 SHUTDOWN).

2.15 SYSTEM VERIFICATION

A. Upon completion of the installation, the fire alarm contractor shall place into operation and test all operational features, functions and devices.
B. The system shall be pre-tested and documented prior to the final inspection by the AHJ. The owner shall be notified of the pretest 48 hours in advance and shall witness this test if desired.
C. The pre-test shall include the following:

    1. All intelligent analog addressable devices shall be tested for current address, sensitivity, and user defined message.
    2. All wiring shall be tested for continuity, shorts, and grounds before the system is activated.
    3. Proper operation and execution of all its sequences.
    4. Prior to scheduling field acceptance, the fire alarm system contractor shall certify in writing, and record the method of testing, the results of all tests and certify that the system has been in operation a minimum of 5 days.

D. Upon completion of testing and after the system has been in operation for a minimum of 5 days without failure, the fire alarm contractor shall schedule with the Authority Having Jurisdiction (DSA INSPECTOR), District and Engineer, a demonstration and field acceptance test.
E. Field acceptance and approval of the fire alarm system shall be evidenced in writing by the Authority Having Jurisdiction.
F. All testing shall be conducted in accordance with NFPA-72, contract document manufacturer's instructions and per the requirements of the Authority Having Jurisdiction.

2.16 GUARANTEE AND SERVICE

A. Fire alarm system contractor shall provide written guarantees for all fire alarm equipment and devices used on this project for a period of THREE (3) YEARS from the date of final acceptance.

B. During the guarantee period the contractor shall repair or replace any defective material at no additional cost to the Owner.

2.17 OPERATION MAINTENANCE MANUALS

A. The fire alarm contractor shall provide to the Engineer, three (3) weeks after the field acceptance test, two (2) sets of operating/maintenance manuals and TWO (2) sets of as-built drawings.
B. As-built drawings shall indicate the location of all devices, appliances, coding, zoning, wiring sequences, wiring methods, color coding, identification, labeling and connections of the components of the fire alarm system as installed. The as-builts shall include a mapping sequence as generated by the Fire Alarm Control Panel and connected computer. Systems not capable of this feature shall generate TRUE Device mapping sequences as-builts on Auto Cad 2006. These as-builts shall show the physical layout of all addressable devices as they were actually installed on the loop.

2.18 TRAINING

A. The System Supplier shall schedule and present a minimum of (1) 4-hour segments of documented formalized instruction for the building owner, detailing the proper operation of the installed System. One training segment shall be available at the completion of the project. The second training segment may be required within the warranty period.
B. The instruction shall be presented in an organized and professional manner by person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.
C. The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.
D. Instruction shall be made available to the Local Fire Department if requested by the Local Authority Having Jurisdiction.

END OF SECTION

Fire Watch Guideline

INSTRUCTIONS:

The owner, manager, or person in charge or control of the building/premises shall assign to the fire watch as many personnel as are required by the Deputy and shall instruct fire watch personnel as to:

- The procedure for notifying the State Fire Marshal
- The area(s) to be patrolled
- Training necessary to insure Fire Watch personnel are capable of activating fire alarm/sprinkler systems when required or necessary
- Any special instructions required by the State Fire Marshal
- Procedures for notifying the building or facility occupants
- A method of calling or notifing the fire service of an emergency

LOG BOOK:

- The owner, manager, person in charge, or in control of the premises shall provide a log book which contains a directory of names, telephone numbers and other information to assist in making emergency calls.

- The log book shall be the official document used to record a history of patrol rounds.

- The log book shall be maintained on the premises and be available for inspection by the Deputy State Fire Marshal.

Fire Watch log

Visually inspect each room and/or space in the facility at _____ minute intervals.

Visually inspect the perimeter (outside) of the facility when directed by the Deputy State Fire Marshal, which may include mechanical/electrical rooms and outbuildings at _____ minute intervals.

DATE	TIME	PERSON COMPLETING INSPECTION (Signature required)	COMMENTS (Upon visual inspection no evidence of a any smok or fire noted)

Fire Watch Guideline

(Complete and return to the Deputy State Fire Marshal)

Assigned fire watch personnel shall:

1. Be thoroughly familiar with the area they are patrolling.
2. Perform patrol operations according to instructions from State Fire Marshal.
3. Utilized the attached fire watch log to document patrol rounds any significant findings.
4. Assigned fire watch personnel shall perform fire watch duties only and have no other responsibility.
5. Relay any special orders or pertinent information to relief personnel and management.

NOTE: The fire watch conditions shall not be terminated without the Deputy State Fire Marshal's written authorization.

FACILITY:

_____

_____

_____

_____

FIRE WATCH FOR ENTIRE BUILDING:

[ ] YES

[ ] NO

SPECIFIC AREAS _____

PERSON RESPONSIBLE TO OVERSEE FIRE WATCH:

Name: _____

Title: _____

Date: _____

DSA IR F-2

FIRE WATCH REQUIREMENTS DURING SCHOOL CONSTRUCTION PROJECTS

Disciplines: Fire & Life Safety, Structural **History:** Issued 12-20-17

PURPOSE: This Interpretation of Regulations (IR) clarifies code requirements based on the California Building Code (CBC), California Fire Code (CFC) and California Code of Regulations (CCR) Title 19 as related to non-operable fire protection/life safety systems requiring a fire watch.

BACKGROUND: 2016 CFC section 901.7 and CCR Title 19 section 1.14 require fire detection and alarm systems, fire hydrant systems, extinguishing systems, mechanical smoke exhaust systems, and smoke and heat vents to be maintained in an operative condition at all times. CFC section 901.7 directs that when a fire protection system is out of service, the fire department and fire code official be notified immediately and the school district shall establish a fire watch. For purposes of application, the Division of the State Architect (DSA) is the fire code official.

SCOPE: During the course of a construction project under the jurisdiction of DSA, DSA is the fire code official. The scope of this IR is confined to those situations where DSA has jurisdiction.

GENERAL: It is the intent of the CFC that fire protection/life safety systems in schools be maintained and fully operable at all times. In the event that a public school (grades K–12 or community colleges) within the jurisdiction of DSA has a fire protection/life safety system that is not operating in a dependable manner, that campus, or the affected portion of the campus, shall be provided a “fire watch.”

A fire watch is intended as a temporary alternate to a fire protection/life safety system and allows a building to be temporarily occupied while the fire protection system is out of service. The purpose of a fire watch is to protect human life and property and transmit an immediate alarm to the building occupants and fire department. 2016 CFC, Chapter 9, Section 901.7, directs that where utilized, fire watches shall be provided with at least one approved means for notifying the fire department. The sole duty of the fire watch shall be dedicated to performing constant patrols of the protected premises and keep watch for evidence of fires such as smoke or flames.

1. REQUIRED FIRE WATCH: When, as part of an alteration or modernization project or construction of a new building a fire protection/life safety system is placed out of service and affects any occupied portion of an existing building undergoing renovation or occupied buildings or portions of the campus, then the school district, DSA, and the Architect/Engineer in general responsible charge of the construction project shall be notified immediately by the project inspector. It will be the school district’s responsibility to establish, instruct and maintain fire watch personnel in/at the affected building(s).

Where a fire alarm system is out of service, warning signs shall be posted at all entrances to any building to inform the occupants (see paragraph 1.3).

FIRE WATCH REQUIREMENTS DURING SCHOOL CONSTRUCTION PROJECTS

Modernizations of existing buildings or construction of new buildings that are not occupied by the public, staff or students during construction, shall not require a fire watch as long as the construction efforts do not affect other occupied areas of the building.

1.1 Fire Watch Plan: The school district shall develop a fire watch plan with the applicable building(s) identified on a site and building plan, and coordinate with the local fire department.

When requested, the school district shall provide a copy of the fire watch plan to the DSA Field Engineer for the region in which the construction is taking place.

A copy of the fire watch plan shall be made available to the local fire authority upon request.

1.2 Requirements of a Fire Watch Plan:

- Include a procedure for notifying the fire department and other contacts deemed necessary by the school district for notification.
- Indicate area(s) to be patrolled and locations of portable fire extinguishers, means of egress and areas of special hazards. If a kitchen hood extinguishing system is included in the non-operable alarm system, the kitchen shall be included in the patrol route during cooking activities.
- The method of sounding an alarm shall be described to initiate the evacuation of building(s). The manner of alarm shall be conveyed to staff and students.
- Determine at least one means of direct communication with the local fire department; a telephone/cell phone is acceptable provided that a test run of the designated routes verifies signal strength of the cell phone at all locations.

1.3 Posting: Signs shall state,

"WARNING, FIRE ALARM SYSTEM IS CURRENTLY INOPERABLE.

A FIRE WATCH IS BEING CONDUCTED.

FIRE WATCH PERSONNEL WILL NOTIFY YOU BY

_____

(State means of notification.)

IN THE EVENT THAT BUILDING EVACUATION IS REQUIRED."

1.4 Fire Watch Personnel: The school district shall designate the fire watch personnel who are familiar with and are able to perform the duties as described in the fire watch plan.

The fire watch personnel shall not perform firefighting duties beyond the scope of an ordinary citizen. (Use of portable fire extinguishers is permitted, provided proper training in the use of fire extinguishers has been received and fire watch personnel feel confident in their ability to suppress a fire.)

1.5 The Fire Watch Personnel Duties: Duties shall include, but not be limited to, the following:

- Fire watch personnel are to be thoroughly familiar with facilities and areas they are patrolling. Route shall be a roving and continuous observation of the entire facility at least once each hour. Where hazardous operations (welding, use of open flame) are occurring, the frequency shall be every thirty minutes.
- Identify any fire, life or property hazards to appropriate contact per the fire watch plan.
- If a fire is discovered, the fire watch shall immediately:
  - Notify the fire department.
  - Notify occupants of the facility of the need to evacuate by a pre-described signal as outlined in 1.2 above. If the horns or public address function of the alarm system are still functional, use them to assist with evacuation of the building.
- Follow the provisions of the fire watch plan.
- Have knowledge of the location and use of fire protection equipment such as fire extinguishers.
- Be familiar with and manually activate fire door releases and/or stage roof vents or stage fire curtain as necessary when, in the judgment of the fire watch personnel, those portions of the building are affected.
- Update the fire watch log at the conclusion of each fire watch route.

1.6 Fire Watch Log: A fire watch log should be maintained at the facility and available to the local fire department and DSA field staff at all times during the fire watch. The school district shall determine the specific hours the fire watch will be on duty. At a minimum, the fire watch shall be on duty during all periods when the building(s) is/are occupied.

The log shall contain a directory of contact names, telephone numbers and other information necessary for making emergency calls.

The log shall indicate the following:

- Address of the facility.
- Name of the person conducting the fire watch.
- Times that the patrol has completed each tour of the facility.
- Record of communication(s) to the fire department.

2. TERMINATION OF FIRE WATCH: Where the fire watch is required due to a fire alarm system installation or modification, the completed or repaired fire alarm system shall be tested per National Fire Protection (NFPA) standard 72 and the system manufacturer's installation requirements. Testing and inspection of the system shall be documented utilizing the NFPA 72 Testing and Inspection Form. The project inspector

shall submit to the school district, A/E in general responsible charge, the local fire authority and DSA, as applicable, copies of the NFPA 72 "Record of Completion."

- It is the school district's responsibility to cancel the fire watch once the fire protection system has been deemed operable as communicated by the project inspector.
- Once the fire watch has been cancelled, the project inspector shall:
  - Notify the local fire department.
  - Notify DSA field engineer.
  - Verify removal of signs.

REFERENCES:

California Code of Regulations Title 19, Section 1.14

California Code of Regulations Title 24

Part 1, California Administrative Code, Section 4-304

Part 9, California Fire Code, Section 901.7

This Interpretation of Regulations (IR) is intended for use by the Division of the State Architect (DSA) staff and by design professionals to promote more uniform statewide criteria for plan review and construction inspection of projects within the jurisdiction of DSA which includes State of California public elementary and secondary schools (grades K–12), community colleges and state-owned or state-leased essential services buildings. This IR indicates an acceptable method for achieving compliance with applicable codes and regulations, although other methods proposed by design professionals may be considered by DSA.

This IR is reviewed on a regular basis and is subject to revision at any time. Please check DSA's website for currently effective IRs. Only IRs listed on the webpage at www.dgs.ca.gov/dsa/Resources/IRManual.aspx at the time of plan submittal to DSA are considered applicable.

FIRE ALARM SUBMITTALS

PREPARED FOR:

POMONA UNIFIED SCHOOL DISTRICT
800 S GAREY AVENUE
POMONA, CA 91766

SCIENCE LABS RENOVATION

AT

GAREY HIGH SCHOOL
321 W LEXINGTON AVE,
POMONA, CA 91766

DSA A # 03- 125098
File # 19H-20

PREPARED BY:

ELECTRICAL ENGINEER

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5101 E La Palma Ave., Suite 205
Anaheim Hills, CA 92807-2056
RUNGSUB SUMETHASORN
E-19325

FIRE ALARM EQUIPMENT

1. (Existing A#03-113046) EST3 Fire Alarm Control Panel
   3-CPU3 : Central Processing Unit Module
   3-RS485B : Network Communication Card
   3-RS232 : Communication Card
   3-PPS/M : Primary Power Supply 120V
   3-BPS/M : Booster Power Supply 120V
   3-LCD : Liquid Crystal Display Module
   3-12SR : 12 switches with 12 Red LED Display/Control Module
   3-SSDC1 : Single Signature Driver Controller Module
   3-SDDC1 : Dual Signature Driver Controller Module
   3-MODCOM : Modem Communicator
   MN-COM1S : MNEC Serial Communications/LAN interface
   MN-BRKT2 : Mounting Bracket
   3-CAB21B (R) : Red Cabinet with 3 chassis
   3-CAB21D (R) : Red Door Cabinet with 3 chassis
   3-CHAS7 : Chassis with 7 Local Rail Modules (LRM)
   3-FP : Blank Filler Plate
   12V60A : (2) 12V 60Ah Seal Lead Acid Battery
   CSFM # 7165-1657:0186

2. (Existing) EST # BPS6A : Remote Booster Power Supply with SIGA-CT1
   CSFM # 7300-1657:0229
   EST # SIGA-CC1S : Synchronization Output Module
   EST # 12V7A : (2) 12V 7Ah Seal Lead Acid Battery

3. **EST # SIGA-OSCD : Multisensor Smoke and CO Detector**
   EST # SIGA-AB4GT: Audible (Sounder) Base for CO and Fire Detectors
   EST # SIGA-TCDR : Temporal Pattern Generator
   CSFM # 7275-1657:0334
   CSFM # 7300-1657:0307
   CSFM # 7300-1657:0308

4. (Existing) EST # G1-HDVM : Genesis Wall Mounted Horn-Strobe, Red Finish, (selectable 15, 30, 75, or 110 candela output)
   CSFM # 7125-1657:0202

LIFE SAFETY & INCIDENT MANAGEMENT

EST3 Base Platform

With Signature Series Fire Alarm

Overview

EST3 is a modular control platform uniquely designed to meet the needs of applications ranging from standalone single panel fire alarm systems to multi-panel networks with unified fire alarm, security, and Mass Notification functions. Each function uses many of the same components, simplifying system layouts.

Virtually all EST3 operating features are software-controlled. A powerful System Definition Utility program helps define system operations in a fraction of the time required by previous methods. This gives EST3 great site flexibility and ensures operational changes and upgrades will be possible years after the initial installation.

EST3 is uniquely designed to meet the life safety needs of any size facility. The function of each panel can be customized by using an extensive selection of plug and play local rail modules.

With support for 64 nodes of up to 2,500 devices each, this network's multi-priority peer-to-peer token ring protocol delivers a fast alarm response time across any size network. Add to that the ability to network panels with fiber or copper connections with an overall length of 160000 ft - that's 30 miles - and you've got virtually unlimited networking options.

The EST3 is modularly listed under the following standards: UL 864 categories: UOJZ, UOXX, UUKL and SYZV, UL 294 category ALVY, UL 609 category AOTX, UL 636 category ANET, UL 1076 category APOU, UL 365 category APAW, UL 1610 category AMCX, UL 1635 category AMCX, UL2572 Mass Notification.
In Canada it is listed to ULC-S527, ULC-S303, and ULC/ORD-C1076.
In Europe it is listed to EN 54-2: 1997 + A1: 2006, EN 54-4: 1997 + A1: 2002 + A2: 2006, and to EN 54-16: 2008.

Standard Features

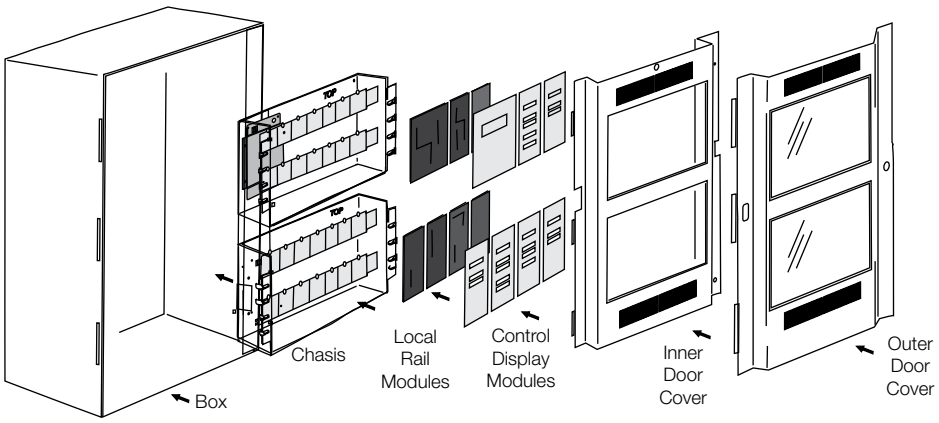
- Listed for Mass Notification/Emergency Communication, Fire, Security, and Emergency Voice Alarm
- Part of an end-to-end audio solution suitable for low frequency signaling in sleeping areas
- 168-character LCD
- Exceptional alarm response times
- Network supports copper, multi-mode fiber, single-mode fiber, or a combination of all three
- Total network wiring over 160,000 feet
- Eight channels of multiplexed digital audio on a single pair of wires or fiber filiment
- Zoned, distributed and banked audio amplifier options
- Local, Proprietary, and Central Station system operations
- In retrofit applications, existing wiring may be used if code compliant
- Supports EDWARDS Signature Series detectors and modules
- Designed in accordance with ISO-9000 quality standards
- UL864 Listed
- UL2572 Listed for Mass Notification
- Optional earthquake hardening: OSHPD seismic pre-approval for component Importance Factor 1.5

DATA SHEET E85010-0145
Not to be used for installation purposes. Issue 1.3

Outstanding Features

EST3 system components are arranged in layers, starting with the backbox and finishing with inner and outer doors. Cabinets are available with room for up to 20 modules and system batteries up to 65 AH. A single 24-volt battery can act as the secondary power supply for all four internal power supplies. Once the backbox is installed, up to four power supplies can be installed in the chassis assembly. The power supplies use a unique paralleling arrangement that ensures the optimum use of each supply. Each supply has the capacity to deliver up to 7 amps at 24 Vdc (28 amps total).

The function of each life safety network panel is determined by the Local Rail Modules (LRMs) plugged into the panel's chassis. An extensive variety of modules are available, including central processing units, input/output circuit modules, communication modules, security modules, and audio amplifier modules.



The top layer of the LRMs is referred to as the user interface layer. This layer is made up of the Main Display Interface module and a system of generic control/display modules. Any control/display module can mount on any LRM. This maximizes flexibility of design for custom systems. The inner and outer doors finish and secure the enclosure.

A single panel can support up to 2,500 addressable points, provide 28 amps @ 24 Vdc and still have room for future expansion. If a single panel is not large enough or you need to distribute functionality throughout the project, then you can network up to 64 panels together!

Networking/Communications

The EST3 Life Safety Network uses a multi-priority peer-to-peer token ring protocol. The protocol gives EST3 the exceptionally fast alarm response time of less than three seconds across the network, virtually independent of the total number of nodes. The EST3 token ring network configuration also affords long distances between panels. The distance between any three panels on #18 AWG (1.0 mm^2) is 5,000 ft (1,523m) for both network control and digital audio signals. Supporting a maximum of 64 panels on a network, the total network length can be in excess of 160000 ft (48768m). Network and audio communication are via RS-485 serial ports. Each two-wire circuit supports Class A (Style 7) or Class B (Style 4) wiring configurations. Fiber optic media is also available.

As an indication of the high level of system integration, off-premise communications is handled by the Modcom modem communicator module. This module provides the Digital Alarm Communicator Transmitter (DACT) function, sending system status signals for up to 255 accounts to up to 80 different central monitoring stations and/or commercial paging carriers.

Digital Audio

EST3 digitized audio can deliver up to eight audio messages *simultaneously* over a single pair of wires! This is plenty of capacity for both live and pre-recorded messages. EST3 easily supports the needs of mass notification messaging, and fire alarm messaging by providing the ability to bring not only pre-recorded messages but also live voice messaging supporting not only evacuation announcments but the messaging needed to support the risks that may require shelter-in-place and relocation messaging.

All audio messages and live pages originate at the Audio Source Unit (ASU) that can store up to 100 minutes pre-recorded audio messages as .wav files. These messages can be automatically directed to various areas in a facility under program control. On the receiving end, zoned amplifiers installed in remote fire alarm cabinets receive and decode the digital messages. The messages are then amplified and sent out to the speakers.

The availability of eight different channels opens a number of new *simultaneous* notification possibilities:

1) Live voice page for MNEC or fire-related instructions;
2) Emergency floor evacuation/notification message;
3) Alert message on floors above and below the emergency;
4) Stairwell evacuation reinforcement message;
5) Elevator cab information messages;
6) Lobby message instructing occupants to exit the building;
7) Concourse instructions to occupants not to enter the lobby;
8) Other instructions to areas not directly affected by the emergency.

Any combination of the eight audio channels can be automatically directed to any or all areas of the building, with total manual override as required. Eight channel capability assures that one message is never interrupted in order to process another, a common fault with two-channel systems. This eliminates any chance of confusing the occupants with conflicting messages.

Survivability is also an integral part of EST3's digitized audio system. Default audio messages are continuously transmitted to all network amplifiers by the ASU. These messages provide audio supervision for the digital audio chain, and act as a default signal if the network data circuit fails or should message control information fail to reach the ASU. If the audio data circuit fails, each amplifier generates a 1KHz temporal (3-3-3) tone that is transmitted during an alarm. In the event of an amplifier failure, a backup audio amplifier is automatically substituted for the failed amplifier in the cabinet, restoring audio capability. In the unlikely event of multiple amplifier failures, the backup amp replaces the amplifier actively processing the highest priority message in the cabinet. When messages are no longer directed to a failed amplifier such as when a high priority page message ends, the backup amp is

dynamically reassigned to the next highest priority failed amplifier actively processing messages

The Firefighters Telephone Control unit (FTCU) provides two-way communications between remotely located phones and the fire command center. The alphanumeric display makes operation intuitive, and a single switch permits the phone signals to be used to issue pages in the facility.

Digitized audio increases notification messaging flexibility, reduces wiring and installation costs, provides enhanced supervision and survivability, and is easy to use.

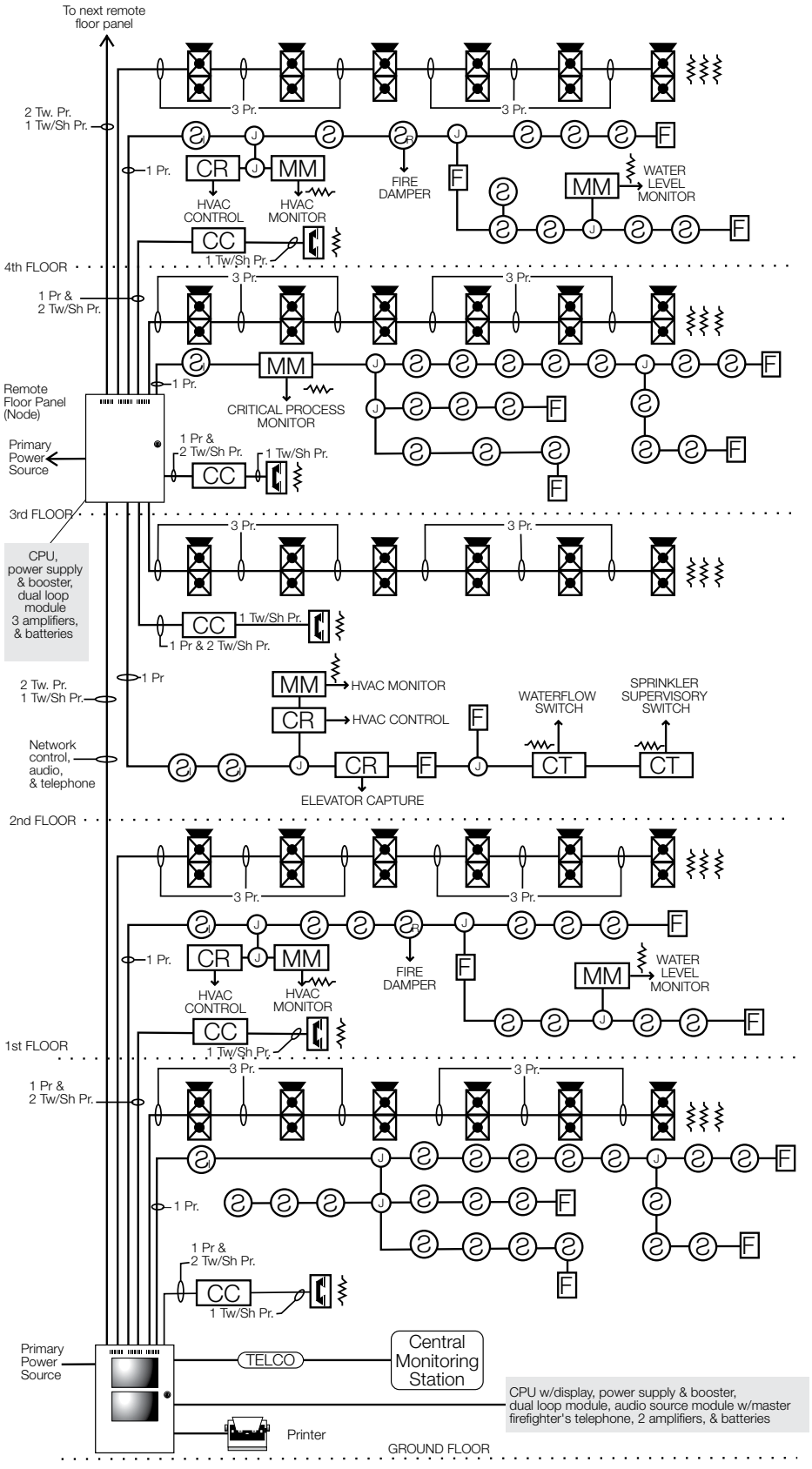
Enhanced Reliability & Survivability

The EST3 uses distributed technology, designed to survive expected and unexpected events including earthquakes. Simple-to-install kits provide internal hardening that meets ;requirements defined by *Uniform Building Code* (UBC 1997); *International Building Code* (IBC 2006); and, *Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems* (AC-156). Seismic component importance factor of 1.5 can be met by adding appropriate anchorage for local conditions. There is no need for special installation methods for EST3 field devices including signals and detection devises. By following standard mounting methods, along with any local requirements, seismic Importance Factor 1.5 may be gained in order to further enhance system survivability.

On the initiating side, intelligent Signature Series detectors can make alarm decisions on their own, and do not involve other system components in this important decision-making process. Sensor-based technology must communicate data to a remotely located common panel where alarm decisions are made. Failure of this centralized processor can cripple sensor-based systems. With EST3, a panel CPU failure does not disable a panel's ability to provide protection. In the event of a CPU failure, the intelligent device controllers can still receive alarms and distribute the alarm information to all other modules in the panel. Modules in the panel are capable of responding with a programmed standalone alarm response.

When a network is wired in a Class B configuration, a single break or short on the wiring isolates the system into two groups of panels. Each group continues to function as a peer-to-peer network, working with their combined databases. When wired using a Class A configuration,

Typical Wiring



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a single break or short on the network wiring causes the system to isolate the fault, and network communication continues uninterrupted – without any loss of function. Should multiple wiring faults occur, the network reconfigures into many sub-networks and continues to respond to alarm events from every panel that can transmit and receive network messages. Survivability is maximized as responses originating and executed by a single panel are always carried out because a copy of the system database is stored in the panel's memory.

Scheduled maintenance improves system availability, and EST3 is designed to make system maintenance easy. System components are designed to assist in routine and time-consuming service functions.

- EST3 service groups are defined by location, not by system wiring. There is no need to disable an entire floor to test a single device.
- According to their UL listings, Signature Series detectors do not require routine sensitivity testing – a real timesaver.
- Comprehensive internal and external monitoring quickly identifies most problems to a component level, including ground faults that can be identified down to the module.
- Parts are easy to replace. Modules plug in and use automatic addressing and plug-in field wiring. No DIP switches are used.
- Firmware in system modules and Signature devices is easily upgraded as new advances in detection and control technology are made available.
- Advanced system diagnostics are provided in the EST3 System Definition Utility.

User Friendly

A comprehensive survey of users resulted in system features and controls that are easy to use.

The main display interface shows the operator the first and most recent system events – without ever touching a single control! All system events are sent to one of four message queues. Alarm messages are never intermixed with trouble or supervisory signals, eliminating confusion. For more information the *Details* switch provides additional information about the highlighted device. The operator can easily review supervisory, trouble, and monitor messages by simply selecting the appropriate message queue. After a few minutes of inactivity, the system automatically returns to displaying the first and most recent events.

Optional manual control switches and display modules can be arranged on the system operator layer to suit the application. These modules can be used to provide additional HVAC controls, manual selection of audio circuits, or other required manual control functions.

The digital audio system uses only five basic controls to direct all paging messages.

The Firefighters' Telephone Control Unit (FTCU) uses an alphanumeric display to indicate the source of incoming calls. Operators simply scroll through the list and hit the "Connect" button when the desired call is highlighted. There is no need to look through rows of lamps and switches to determine the source of calls. Up to five remote locations can be in simultaneous two-way communications with the FTCU.

IP and Cellular Communications

Several popular third-party IP/Cellular communicators have been tested with the EST3 control panel and are compatibility listed to UL864. The IP/Cellular communicators meet NFPA72 2013 edition requirements for sole or secondary transmission paths. Using IP/Cellular communicators can reduce the cost of ownership by eliminating POTS lines. Please see the EST3 control panel compatibility documentation part number 3100427-EN for a full list of compatible communicators.

System Configuration

The powerful EST3 System Definition Utility (SDU) helps define flexible system operations in a fraction of the time required by other systems. Based on an object-oriented system of rules, virtually all EST3 operating features are software-controlled. This gives the designer great flexibility in integrating mass notification, fire, and security functions into a single seamless design.

A report generator provides a complete library of system reports that are invaluable for troubleshooting, including a printout of Signature device connections as the devices are actually wired.

Use of software-based components permits the SDU to add new features to the system. Even the Signature Series devices are capable of upgrading firmware as new detection algorithms become available.

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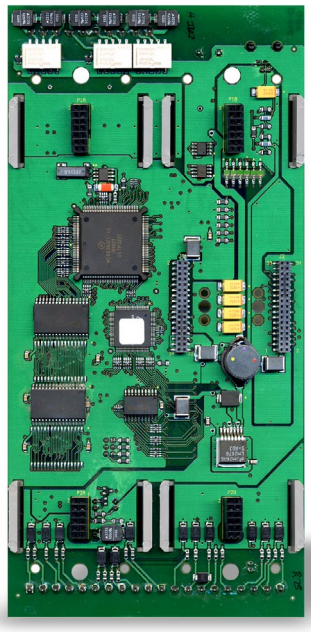
EST3 Central Processor Unit

3-CPU3, 3-RS485A, 3-RS485B, 3-RS232



7165-1657: 0186

EN 54-2: 1997 + A1: 2006
EN 54-4: 1997 + A1: 2002 + A2: 2006
EN 54-16: 2008

Overview

The 3-CPU3 is the Central Processing Unit Module monitoring the status of all modules and providing the link for network communications. Although each local rail card contains their own microprocessor, the 3-CPU3 provides all inter-module communication and has the ability to download rail module operating parameters. Upon power up the 3-CPU3 automatically learns all local rail module attributes and locations. Site specific software is loaded into the 3-CPU3 which then downloads data to each local rail module. Firmware upgrades are also done from the 3-CPU3 eliminating the need to unplug chips on rail modules.

Mounting must be in the first two local rail spaces of the upper 3-CHAS7 (module chassis). Options for the 3-CPU3 include the addition of an LCD display and User Interface, RS-232 Communication Card, and RS-485 Series Network Communication Cards.

The 3-CPU3 is fully compatible on the same network with the 3-CPU and 3-CPU1 modules.

Standard Features

- Up to 1,000 history events
- RS-485 local rail communications
- Multiplexed audio channels
- Network communication media can consist of twisted copper RS485, short-haul modems and/or single or multimode fiber optic cables
- RS-232 communication card
- Form ‘C’ contacts for: Alarm, Supervisory and Trouble
- Low voltage memory write protection
- Non-volatile memory

DATA SHEET E85010-0133
Not to be used for installation purposes. Issue 1.2

Application

The 3-CPU3 helps make EST3 an extremely powerful and flexible system. As a single node, stand alone system a single 3-CPU3 controls 1 to 19 additional local rail modules. For larger systems, up to 64 nodes interconnect on a peer-to-peer multi-priority token ring protocol network.

The 3-CPU3 controls all local panel responses to automatic, user initiated, or network reported events. As a network node, it is an equal among peers, there is no master on the network. This gives exceptional response times over the network, less than three seconds.

Each 3-CPU3 provides slots at the back for mounting Network, and RS-232, cards. Removable terminal blocks on the 3-CPU3 support connection of network and audio data wiring. On board common relays also terminate at the 3-CPU3 terminals. To aid in trouble shooting and service, status LEDs monitor local rail, network, RS232 and audio data communications.

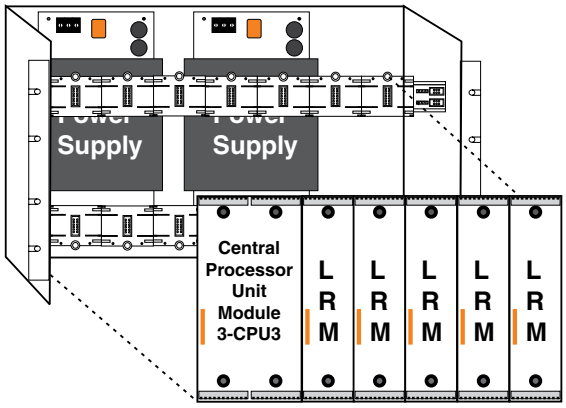
The **Network Communications** card mounts to the back of the Central Processor Unit. The 3-RS485A card provides a Class A, Class X or Class B circuit for network communications signals and support for a Class B, Class A or Class X circuit for the digitized audio signals. The 3-RS485B card provides a Class B, Class A or Class X circuit for network communications signals and a second Class B circuit for the digitized audio signals. The 3-RS485B card provides a Class B or Class A circuit for network communications signals and a second Class B circuit for the digitized audio signals. Network messages received by the Network Communications card are re-transmitted to the next network node. Re-transmission maximizes the wire run lengths between nodes. With 64 nodes miles of network length is possible. Fail safe mechanisms built into the card direct connect the data input and output ports should the network card or its related Central Processor fail. Network communications may be configured via copper or fiber media using the 3-FIBMB.

The **3-RS232 Communication Card** mounts to the back of the 3-CPU3. The 3-RS232 has two optically isolated RS-232 ports. The ports support connection of a printer and/or an external command center. Entire network downloading from one location (to all 64 nodes) is available through the RS-232 card.

Engineering Specification

It must be possible to support a single stand alone node or up to 64 nodes communicating on a peer-to-peer token ring protocol network. Network and digitized audio wiring shall be run in a [choose one: Class A, Class X or Class B] configuration. Network alarm response from alarm input to signal activation must be under 3 seconds. All field wiring must be to removable terminal blocks. Status LEDs must be provided for communications of network and internal rail communications. Inter-node communication speed must be programmable. Internal rail communications speed must be programmable.

Installation and Mounting



Data

Maximum resistance between any 3 panels	90 Ohms
Maximum capacitance between any 3 panels	0.3 µF
Maximum distance between any 3 panels via RS485	5,000 ft. (1,524 m)

Capacitance, entire network

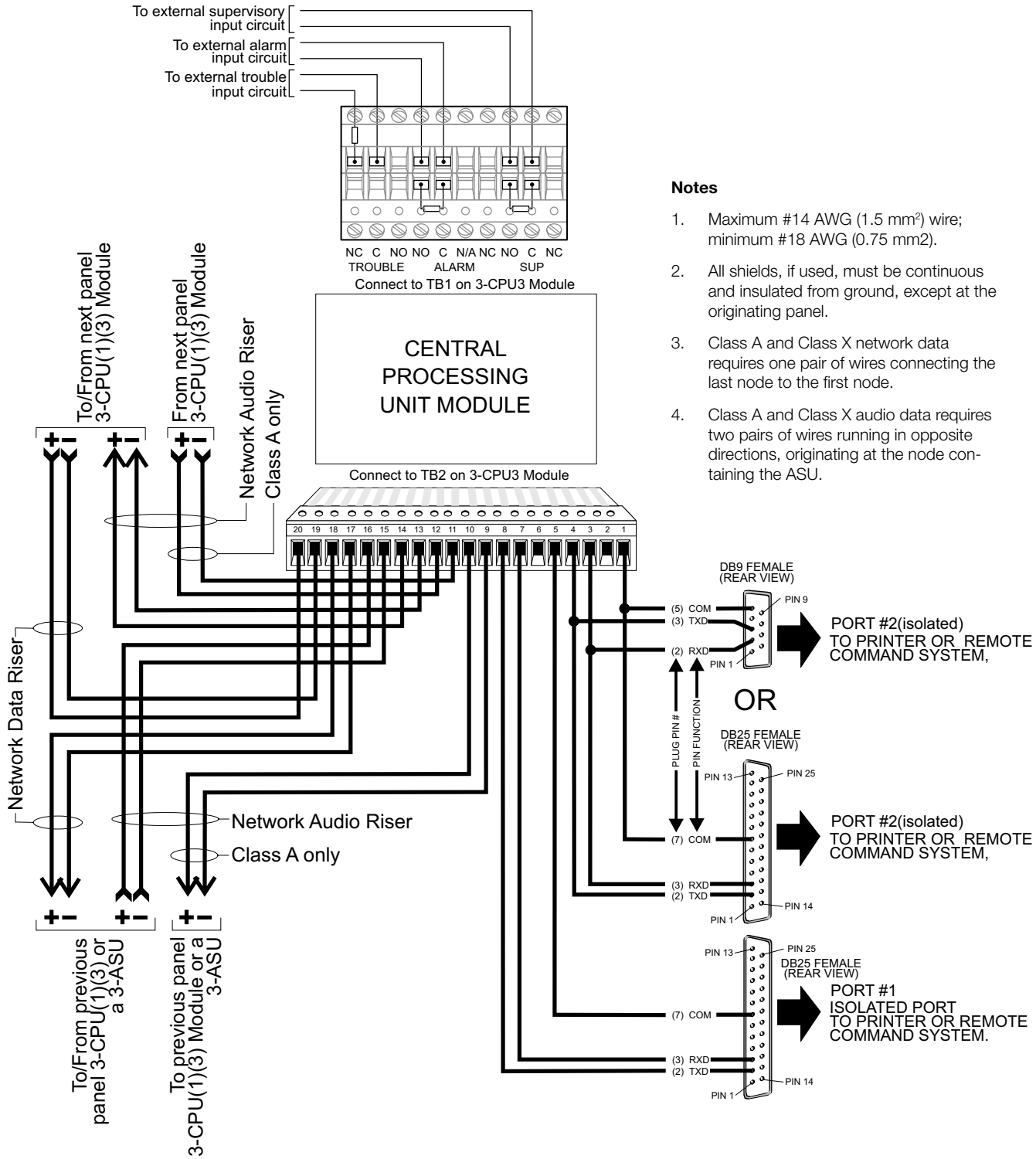
Maximum Accumulative Capacitance

Wire Size	38.4K Baud	19.2K Baud
18 AWG	1.4 µF	2.8 µF
16 AWG	1.8 µF	3.6 µF
14 AWG	2.1 µF	4.2 µF

Audio

Maximum resistance between any 3 panels	90 Ohms
Maximum capacitance between any 3 panels	0.09 µF
Maximum distance between any 3 panels via copper RS485	5,000 ft. (1,524 m)

Typical Wiring



Notes

1. Maximum #14 AWG (1.5 mm^2) wire; minimum #18 AWG (0.75 mm2).
2. All shields, if used, must be continuous and insulated from ground, except at the originating panel.
3. Class A and Class X network data requires one pair of wires connecting the last node to the first node.
4. Class A and Class X audio data requires two pairs of wires running in opposite directions, originating at the node containing the ASU.

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Specifications

3-CPU3

Agency Listings	UL, ULC, CSFM, CE, LPCB EN54*.
Mounting	2 - Left most local rail spaces
Terminal Size	18-12 AWG (1.0mm² to 2.5mm²)
Standby Current	155 mA
Alarm Current	165 mA
Contact Ratings	Nonbypassable Alarm, Supervisory and Trouble Form 'C' 1A at 30 Vdc
Data Down Loading	RJ14 Jack
Operating Environment	0°C - 49°C (32° F - 120° F); 93% at 40° C Non-Condensing

**For EN 54-2: 1997 + A1: 2006, EN 54-4: 1997 + A1: 2002 + A2: 2006, and EN 54-16: 2008 compliant product add suffix -E to model eg. 3-CPU3-E.*

Note: CPU current includes the main power supply, since the CPU and PPS cannot be measured separately.

Option Cards

Catalog number	3-RS232	3-RS485A	3-RS485B
Standby Current	58 mA	98 mA	98 mA
Alarm Current	58 mA	98 mA	98 mA
Communication Ports	Two optically isolated RS-232	Three RS-485 Class A or Class X	One Class A or Class X network data circuit and one Class B audio data circuit
Agency Listings	UL, ULC. CSFM, CE, LPCB. EN54*.		
Mounting	Back of 3-CPU3		
Operating Environment	0° C - 49° C (32° F - 120° F); 93% at 40° C Non-Condensing		

**For EN 54-2: 1997 + A1: 2006, EN 54-4: 1997 + A1: 2002 + A2: 2006, and EN 54-16: 2008 compliant product add suffix -E to model eg. 3-RS485A-E*

Ordering Information

Catalog Number	Description	Ship Wt. lb (kg)
3-CPU3	Central Processor Unit Module. Add suffix "-E" for EN54 compliant versions.	0.7lb (0.32kg)
3-RS485A	Network Communications Card, Class A or Class X . Add suffix "-E" for EN54 compliant versions .	0.33lb (0.15kg)
3-RS485B	One Class A,X/B network data circuit and one Class B audio data circuit. Add suffix "-E" for EN54 compliant versions.	0.33lb (0.15kg)
3-RS232	RS-232 Communication Card. Add suffix "-E" for EN54 compliant versions.	0.33lb (0.15kg)
3-CPUDR	CPU doors with filler plates. Order separately, one required per CPU where no LCD display is installed.	0.25lb (0.11kg)

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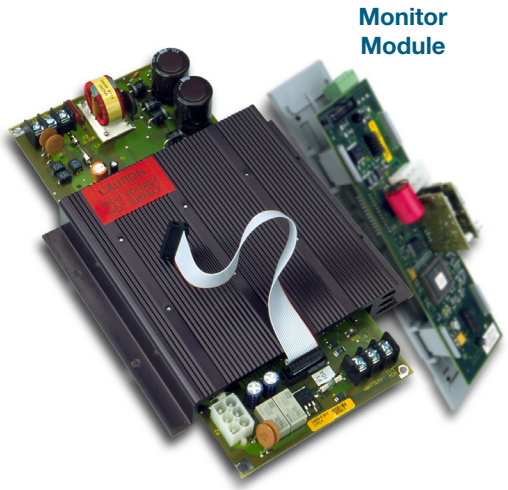
System Power Supplies

3-PPS/M series, 3-BPS/M series, 3-BBC/M series



Approvals

EST4: UL, ULC S3000, 7165-1657: 0186, NYC FIRE DEPT. COA # 6314, FM APPROVED

EST3: UL, ULC S3000, 7165-1657: 0186, FDNY APPROVED, FM APPROVED, CE, LPCB

EN 54-2: 1997 + A1: 2006
EN 54-4: 1997 + A1: 2002 + A2: 2006
EN 54-16: 2008

Overview

Systems power supplies consist of two assemblies: a high efficiency switch mode power supply card, and a power supply monitor module. The monitor module mounts to the local rail and distributes the power from its supply to the local rail. The local rail distributes power from all power supplies to other local rail modules and user interface cards resulting in “Shared Power” throughout the system.

Maximum use of available power is achieved by configuring the power supplies in parallel. This results in a potential reduction in the number of power supplies necessary to meet requirements.

As many as four power supplies combine in a single enclosure providing up to 28 amps of available power. Battery backup is provided using one to four sets of batteries, depending on standby power requirements.

System power supplies mount to the back of the chassis units or wallboxes. Access to auxiliary power is via easily accessible terminal blocks located on the power supply monitor module. Each power supply produces 7 Amps of filtered and regulated power.

With four power supplies located in an enclosure (one primary and three booster power supplies) 28 amps of current is available for local rail modules, control display modules and the eight auxiliary 3.5 amp power outputs (two per supply).

Standard Features

- High efficiency switch mode
- Increased power distribution efficiency
  - power supplies parallel allowing up to 28 amps in a single node
- 120 or 230 Vac operation
- 7 AMP filtered and regulated
- Two 3.5 AMP outputs
- Temperature compensated, dual rated battery charger
- Electronic power limiting
- Automatic load testing of batteries
- Fully approved UL, ULC and EN standards (see Specifications section)

DATA SHEET E85010-0059
Not to be used for installation purposes. Issue 3.0

Application

The primary power supply provides the system with battery charging and voltage regulation. Software configures the charger to either 10-24 AH batteries or 30-65 AH batteries and controls the high/low charge rates. Batteries mounted in the same enclosure as the power supply, have their charge rate monitored and adjusted based on the local enclosure temperature, keeping charging rates within battery specification. For remote batteries a temperature probe is monitored in the remote battery cabinet and charge rates are adjusted automatically. Battery damage is unlikely to occur when environmental short term conditions are outside of normal operating ranges.

System Power Supplies automatically load test batteries by shutting down the battery charger and placing a load across the battery. If the battery voltage is outside the specification range the power supply reports a trouble. The trouble clears if the battery is able to recover and pass future load tests.

Battery leads are electronically short circuit protected. If a short occurs in the battery leads the charger automatically disables itself and causes a trouble. The system will constantly look to see if the short has cleared. If the short clears the system automatically restores.

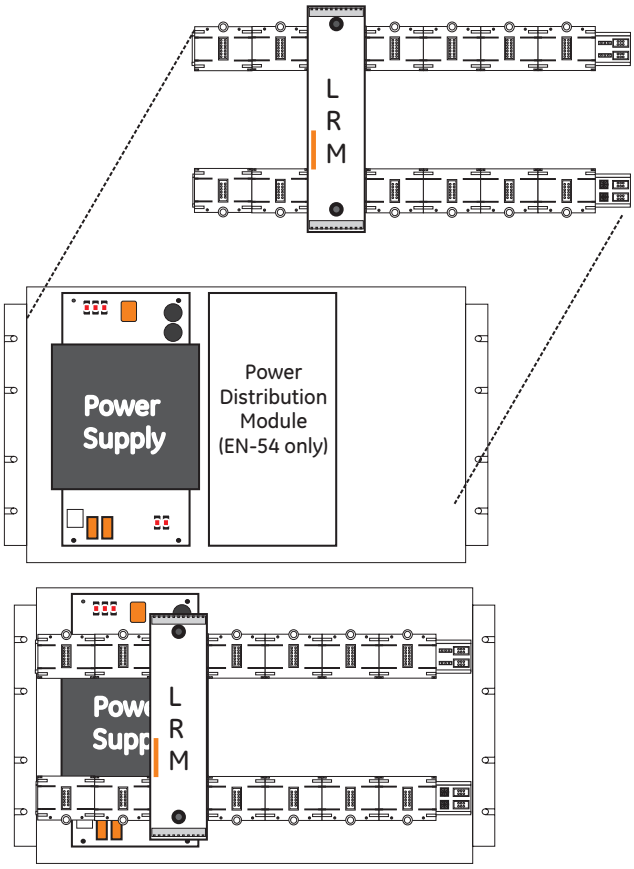
During operation on standby batteries, battery voltage is constantly monitored. A trouble is reported if the battery voltage falls below a specified value.

System Power Supplies provide specific information back to the main panel CPU designed to help speed trouble shooting of system functions. Should a power supply detect a fault, specific diagnostic codes are available to speed trouble shooting. The panel LCD will display the power supplies address, a specific trouble code, and a text message describing the specific trouble. Text messages are easy to understand and include items like: Battery Trouble, Aux Power Overload Circuit 1, Aux Power Overload Circuit 2.

Engineering Specification

The fire alarm power supplies must be capable of being paralleled and to load share. Multiple power supplies must be capable of being backed up with a single 24 volt battery set. Each power supply shall be capable of charging up to 65 AH batteries. The power supply must be able to perform an automatic load test of batteries and return a trouble if the batteries fall outside a predetermined range. Power supplies must incorporate the ability to adjust the charge rate of batteries based on ambient temperatures. It shall be possible to adjust for ambient temperature changes in local cabinets as well as remote cabinets.

Installation and Mounting



Power Supply Rules

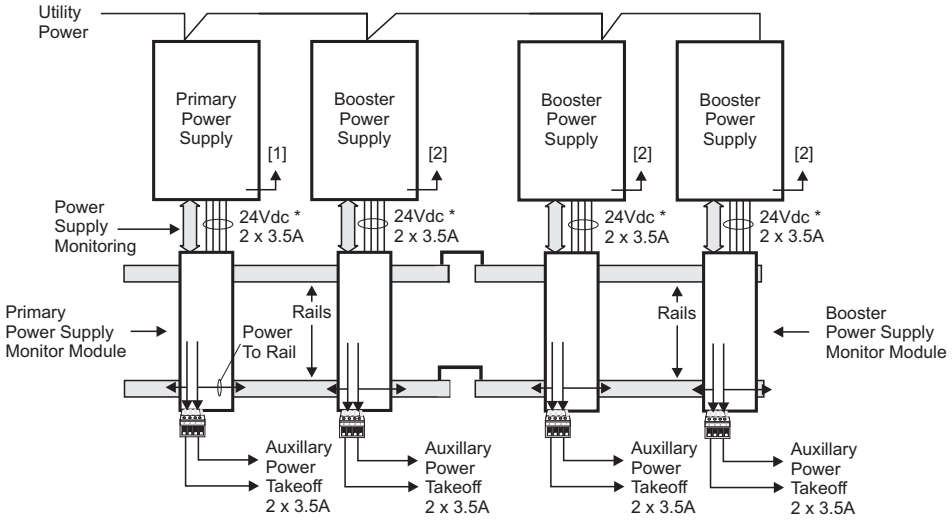
1. Each battery set needs one charger, either a 3-PPS/M or a 3-BBC/M.
2. Each power supply must be connected to a battery set using an identical length and gauge of wire to keep voltage drops identical.
3. Distribute power supplies and loads evenly across rails.
4. **All battery sets for a panel must be the same capacity (AH), same manufacturer, and same manufacturing date code.**

The Table below illustrates the combinations of power supplies and batteries that meet all the power supply rules.

24 VDC Power Supply Output Current

	7A	14A		21A		28A	
Battery Requirements	One Set, 65 AH max	One Set, 65 AH max	Two Identical Sets, 65 AH max	One Set, 65 AH max	Three Identical Sets, 65 AH max	One Set, 65 AH max	Four Identical Sets, 65 AH max
Required Modules	1 3-PPS/M	1 3-PPS/M 1 3-BPS/M	1 3-PPS/M 1 3-BBC/M	1 3-PPS/M 2 3-BPS/M	1 3-PPS/M 2 3-BBC/M	1 3-PPS/M 3 3-BPS/M	1 3-PPS/M 3 3-BBC/M

Typical Wiring



[1] From battery temperature probe terminals.

[2] From battery and from temperature probe terminals if 3-BTSEN-E used.

* Nominal Voltage

Specifications

Catalog Number	3-PPS/M & 3-BBC/M	3-BPS/M	3-PPS/M-230 & 3-BBC/M-230	3-BPS/M-230	3-PPS/M-230-E & 3-BBC/M-230-E	3-BPS/M-230-E
Agency Approvals	UL, ULC	U L, ULC	UL, ULC	UL, ULC	LPCB EN54*, CE	EN54*
Input Voltage	120 Vac (+10%, -15%), 50-60 Hz		230 Vac (+10%, -15%), 50-60 Hz			
Brownout Level	< or = 102 Vac	96 Vac	< or = 195 Vac	184 Vac	< or = 195 Vac	188 Vac
Current Requirements	3-PPS/M included with 3-CPU3 current 3-BBC/M Alarm: 70 mA Standby: 70 mA	Alarm 50mA Standby 50mA	3-PPS/M-230 included with 3-CPU3 current 3-BBC/M-230 Alarm: 70 mA Standby: 70 mA	Alarm: 50 mA Standby: 50 mA	3-PPS/M-230-E included with 3-CPU3 current 3-BBC/M-230-E Alarm: 70 mA Standby: 70 mA	Alarm: 50 mA Standby: 50 mA
Input Current	3.0 A		1.5 A			
Total Output Current	Special Applications: 7.0 Amps Regulated: 4.5 Amps total (including internal panel and auxiliary outputs). Maximum regulated NAC power via 3-IDC8/4: 1 Amp (see note).					
Battery Charging Capacity	65 AH Sealed Lead-Acid	None	65 AH Sealed Lead-Acid	None	30 AH Sealed Lead-Acid	None
Low Battery Trouble	24 Vdc				22.5 Vdc	
Deep Discharge Cutoff	19.5 Vdc				20.0 Vdc	
Mounting Requirements	1 LRM space, 1 chassis footprint				1 LRM Space + 3-PPS: 2 footprints 3-BBC: 1 footprint	1 LRM space, 1 chassis footprint
Output Voltage	24 Vdc Nominal					
Auxiliary Output Current	Two sources of 3.5 Amps each taken from total output current					
Auxiliary Output Terminal Capacity	18 AWG to 12 AWG (1 mm^2 to 2.5 mm^2)					
Output Protection	Electronic power limiting & heat sink temperature					
Ground Fault Detection	< 10K Ohms					

Note: Each power supply can support 7 Amps with special application devices. Up to one regulated NAC circuit via 3-IDC8/4 can be supported per 3-PPS power supply. Total power supply current available when supporting a regulated NAC is 4.5 Amps. Maximum regulated NAC current available from the 4.5A supply is 1 Amp.

* **EN54-2: (1997) +A1: (2006)** *Control and Indicating Equipment;* **EN54-4: (1997) +A1: (2002) +A2: (2006)** *Power Supply Equipment;* **EN54-16:(2008)** *Voice Alarm Control and Indicating Equipment when used with EST3*

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Ordering Information

Catalog Number	Description	Ship Wt., lb. (kg)
3-PPS/M	Primary Power Supply w/ local rail module 120V 50/60 Hz	5 (2.3)
3-BPS/M	Booster Power Supply w/ local rail module 120V 50/60 Hz	5 (2.3)
3-PPS/M-230	Primary Power Supply w/ local rail module 230V 50/60 Hz	5 (2.3)
3-BPS/M-230	Booster Power Supply w/ local rail module 230V 50/60 Hz	5 (2.3)
3-PPS/ M-230-E	Primary Power Supply w/local rail module 230V 50 Hz, EN54* Certified, CE. Comes with one EFM-2 and 15 ferrite clamps.	5 (2.3)
3-BPS/ M-230-E	Booster Power Supply w/local rail module 230V 50 Hz, EN54* Certified, CE	5 (2.3)
3-BBC/M	Booster/Charger Supply w/local rail module 120V 50/60Hz	5 (2.3)
3-BBC/M-230	Booster/Charger Supply w/local rail module 230V 50/60Hz	5 (2.3)
3-BBC/ M-230-E	Booster/Charger Supply w/local rail module, 230V 50Hz, EN54* Certified, CE	5 (2.3)
3-BBCMON(-E)	Booster/Charger Monitor Module with charger capability (upgrade 3-BPS/M(-230)(-E) to 3-BBC/M-(230)(-E))	5 (2.3)
3-BTSEN	Distribution Module required when battery installed in remote cabinet	.5 (.22)
3-BTSEN-E	Distribution and Temperature Sensor Module. Required in EN54* Markets when battery installed in a remote cabinet.	.5 (.22)
EFM-2	Data filter board, ships with 3-PPS/M-230-E. Provides filtering for network data. For distributed audio applications refer to model EFM-10. Additional ferrite clamp kits may be ordered separately. See European Marketplace Manual P/N 270925 for details on ferrite clamp locations, quantities and wiring.	
EFM-10	Data Filter board order separately for distributed audio. Order one EFM-10 for each node receiving audio in the network. Additional ferrite clamp kits may be ordered separately. See European Marketplace Manual P/N 270925 for details on ferrite clamp locations and quantities.	
7300172	Ferrite Kit includes 2 ferrites for EN54 applications.	
7300173	Ferrite Kit includes 15 ferrites for EN54 applications.	
7300174	Ferrite Kit includes 4 ferrites for EN54 applications.	
7300175	Ferrite Kit includes 8 ferrites for EN54 applications.	
4-FIL	Blank EST4 filler plate (order separately when no LED or LED/Switch module is installed on the inner door).	0.1 (0.05)
3-FP	EST3 application filler plate, order separately when no LED or LED/Switch module installed.	0.1 (0.05)

* **EN54-2: (1997) +A1: (2006)** *Control and Indicating Equipment;* **EN54-4: (1997) +A1: (2002) +A2: (2006)** *Power Supply Equipment;* **EN54-16:(2008)** *Voice Alarm Control and Indicating Equipment when used with EST3*

Liquid Crystal Display Module

Model: 3-LCD

Features

- **Uses simple lights and switches**
- **Displays information important to user**
- **Hands free first alarm display**
- **Last event of highest priority always displays**
- **Eight lines by 21 character graphic LCD display — 168 characters total**
- **Multlingual**
  Supports English, French, Spanish, and Russian
- **Uses queues to sort events**
  A queue is a list of messages Alarm, Supervisory, Trouble and Monitor
- **Slide in LED and switch labels**
  Makes customization for regional language easy

Description

The Main Display interface is the primary user interface in the EST3 Life Safety System. The main display interface focuses on the emergency user by putting information important to the user up front. Hands free, the first highest priority event is shown. The display always gives the last highest priority event. Arriving at the panel and without opening the door the first and last alarm is given. Simple to understand lights and switches help the emergency user execute system commands with confidence.

A menu system supports maintenance functions such as disables or reports for use by staff or service personnel.

Application

The 3-LCD module mounts to the local rail over the nodes Central Processing Unit Module (3-CPU). The 3-LCD module is optional in any network node.

Ensuring information clarity the 3-LCD uses a backlit high contrast supertwist graphical display. Eight lines of 21 characters provide the room needed to convey emergency information in a useful format.

The 3-LCD always displays the last highest priority event even when the user is viewing other message queues. Further message flexibility is provided with EST3's message routing ability. Messages from a node can display at every node on the network or messages can route to specific nodes only. Routing can be initiated at a specific time/shift change. There is no need to have messages display in areas that are not affected by an event.

The 3-LCD can display messages in English, Spanish, French, and Russian. The bilingual display lets the operator select between either of two languages. Consult your representative for available language combinations.

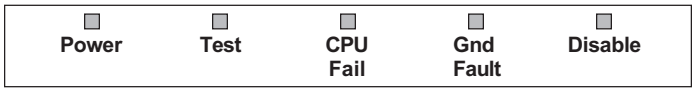
The EST3 system configures for Proprietary, Local or EN54 market operations. The mode of operation is selected through the System Definition Utility (SDU) which may adjust the following operations slightly to fit the system operation selected.

MEA

International Application Notes Available

About LEDs and Switches

Further enhancing the 3-LCD user interface are easy to read and understand lights and switches. All functions are laid out in a logical order. At the top of the 3-LCD are five system status LEDs. Here determining the general condition of the system is easy.



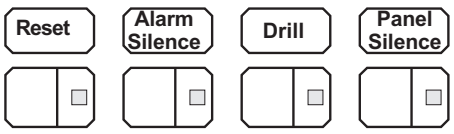
Power LED: Green, on when AC power is on.

Test LED: Yellow, on when any portion of the system (Group) is under test.

CPU Fail LED: Yellow, on when CPU stops running.

Gnd Fault LED: Yellow, on when a ground exists on the system (group)

Disable LED: Yellow, on when any point or zone is disabled by a user.



For EN-54 compliance, please see page 4.

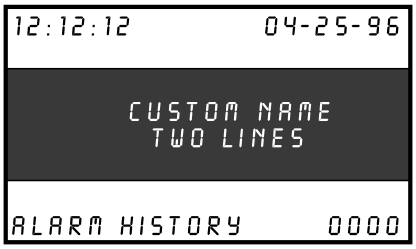
Below the general status LEDs are located four, LED / Switch common controls. The versatility of EST3 allows system designers to define the features as affecting a domain (defined group of nodes) or as global (affects all nodes) across the network. This feature is very useful when configuring systems with multiple buildings on one network. As an example, operating the reset in one building may have adverse effect in other buildings. With EST3 having operational differences between buildings on the same network is not a problem.

Pressing **Reset** starts the system's reset operation. The yellow LED has three flash rates during reset. The LED flashes fast during the smoke power down phase of reset, flashes slow during the restart phase, and turns on steady for the restoral phase. The Reset LED turns off when the system is normal.

Pressing **Alarm Silence** turns off all Notification Appliance Circuits defined as audible. The yellow LED turns on when silence is active via the Alarm Silence switch or via alarm silence software timers.

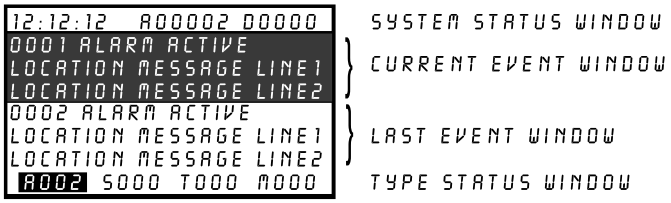
Pressing **Panel Silence** turns off the system's internal audible signal. The yellow LED turns on when panel silence is active. The EST3 panel buzzer has user programmable signal rates for alarm, supervisory, trouble and monitor conditions.

Pressing **Drill** turns on the drill LED and all signals sound evacuation. Drill does not activate city tie connections. Auxiliary relays will not activate unless programmed to do so with drill.



In the center of the 3-LCD is the Liquid Crystal Display. In the normal condition the date and time plus a definable system title display on the LCD. The last line of the display gives an alarm history. This total equals the number of times the system has entered the alarm state from the normal state.

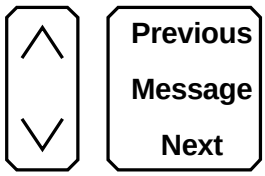
When active events are on display, the LCD formats into four logical windows.



In the system status window, the display shows the time and the status of active and disabled points.

The current event window, lines 2, 3, 4 automatically display the first active event of the highest priority if the user has not taken control of the system. Once the emergency user takes control, this window displays user message selections.

The second line of the display shows system event information. In the example above the display shows the chronological number of the event (0001 is the first alarm) followed by the event type (Alarm Active). EST3 supports over 45 event type messages from which system designers choose. The last two lines of the current event window are custom programmable location message lines with space for 42 characters.

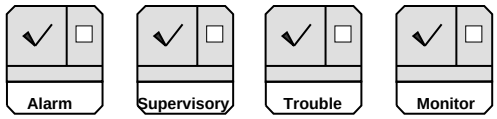


The last event window shows the last highest priority event. This window is always displayed and updated automatically by the system. Here the emergency user can monitor the progress of a fire.

When EST3 is configured for a local mode system viewing the second alarm message is easy, just press the NEXT key. The next message scrolls into the current event window. The last highest priority event always remains on view. No matter what queue the user selects for viewing, the LCD always displays the most recent alarm. A new alarm event resounds the panel audible signal and appears immediately on display without overwriting information the user selected for view.

The final window of the LCD the type status window shows the total number of active events by queue type. A is alarm, S is supervisory, T is trouble, and M is monitor. The number following each letter is the number of active events existing in each queue.

EST3 breaks down event types into queues and automatically displays the first event of the highest priority type.



For EN-54 compliance, please see page 4.

Priority order is alarm, supervisory, trouble, monitor. By using queues an emergency user does not waste time scrolling through a mixed event list looking for alarms or confusing an alarm message with other message types.

EST3 configures for **Remote proprietary** system operation where every event must be acknowledged by viewing them before the internal buzzer will silence. Or the EST3 will configure for **Local** operation. Here the internal buzzer silences by pressing panel silence. If any events exist in queues that have not been viewed the queue LED continues to flash informing the user of un-seen events.

When all events in a queue are acknowledged or 'seen', the LED associated with the queue turns on steady. If a new event is added to the queue, the EST3 internal buzzer resounds and the queue LED flashes.

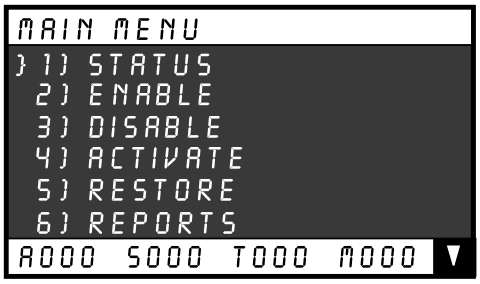
EST3 allows device grouping into logical group zones. Here two or more alarm devices (such as detectors or pull stations) make up the zone. When a device in the zone activates, the LCD displays the zone description. Each zone only displays once, regardless of the number of devices active within the zone.

To display device information the user presses the Details key. The device with the lowest address displays in the first window.

If multiple devices are active each is available for viewing by using the arrow associated with the Previous Message Next key and scrolling through the device list.

The common controls easily expand beyond the Main Display interface by adding a Control Display Module and assigning features to its switch controls.

For Maintenance users, the EST3 provides a smooth operating menu system providing powerful tools for system management, reports, and trouble shooting.



Specifications

Catalog Number	3-LCD
Agency Listings	UL, ULC, FM, CE, EN-54
LCD Display	Eight lines by 21 characters backlit LCD
Mounting	Two local rail spaces on top of 3-CPU
Common Control Switches and LEDs	Reset switch and LED Alarm Silence switch and LED Panel Silence switch and LED Drill Switch and LED
Alarm Current	53mA
Standby Current	53mA

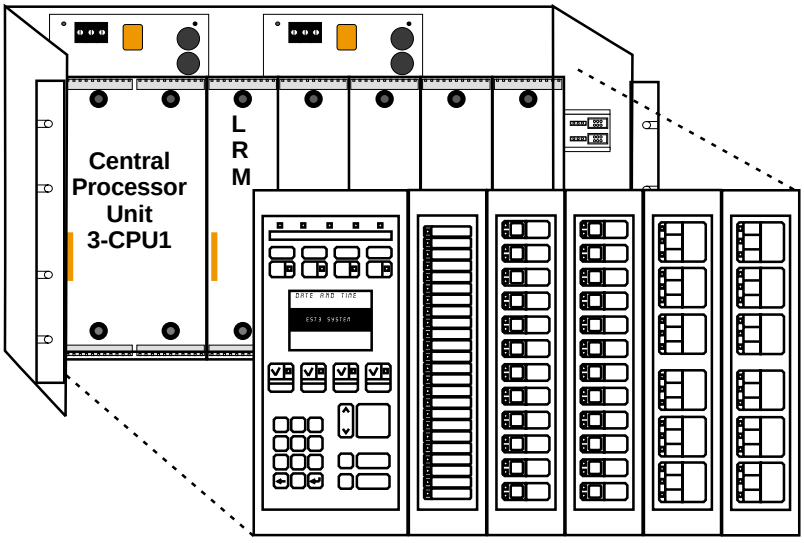
Engineers Specification

The system shall provide a user interface that displays system events in a text format, and supports basic common control LEDs and switches. The Common Control Switches and LEDs provided as minimum will be; Reset switch and LED, Alarm Silence switch and LED, Panel Silence switch and LED, Drill switch and LED. It must be possible to add additional common controls as required through the use of modular display units. The user interface must provide an LCD that will allow custom event messages of up to 42 characters. The interface must provide a minimum of eight lines by 21 characters and provide the emergency user, hands free viewing of the first and last highest priority event. The last highest priority event must always display and update automatically. Events shall be automatically placed in easy to access queues. It shall be possible to view specific event types separately. Having to scroll through a mixed list of event types is not acceptable. The total number of active events by type must be displayed. Visual indication must be provided of any event type which has not been acknowledged or viewed. It must be possible to customize the designation of all user interface LEDs and Switches for local language requirements. It shall be possible to have a custom message for each device in addition to zone messages. Custom device messages must support a minimum of 42 characters each. Instructional text messages support a maximum of 1,000 characters each. The display shall be capable of displaying English, Spanish, French, or Russian messages.

Ordering Information

Catalog Number	Description	Shipping Weight lb. (kg)
3-LCD	Liquid Crystal Display Module	.8 (.36)
3-LKE	UK English Label Kit	.25 (.11)
3-LKF	French Label Kit	.25 (.11)
3-LKR	Russian Label Kit	.25 (.11)
3-LKS	Spanish Label Kit	.25 (.11)

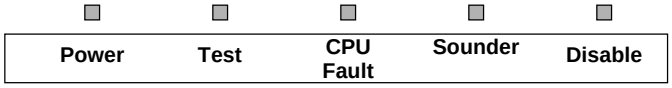
Installation and Mounting



EN-54 Compliance

In 1998 the British-based Loss Prevention Certification Board (LPCB) certified EST3 control panels and power supplies as having surpassed the requirements of the pivotal EN-54 standard, parts two and four. LPCB Certificate #257c for EST3 fire alarm control panels marks the first such certification since the stringent EN54-2 : 1997 and EN54-4 : 1997 were publish by the European Committee for Standarzation (CEN). In order to meet these standards, display and control functions have undergone slight modifications for the EN-54 marketplace. These differences are highlighted below. All other control and annunciation features remain unchanged.

System Status LEDs



Power LED (Green): on when DC power is on.

Test LED (Yellow): on when any portion of the system (Group) is under test.

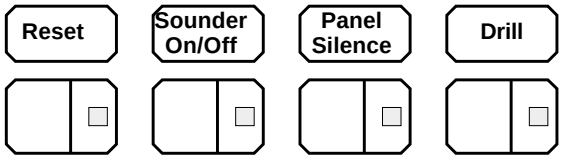
CPU Fault LED (Yellow): on when CPU stops running (processor failures must be manually reset).

Gnd Fault LED: Not available.

Sounder LED (Yellow): flashing indicates fault on sounder circuit. Steady indicates a disabled sounder circuit.

Disable LED (Yellow): on when any point or zone is disabled by a user (disabled conditions have priority over fault conditions).

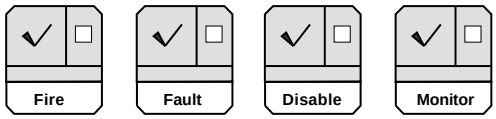
Switch Functions



Pressing **Sounder On/Off** turns off all sounder circuits defined as audible. The yellow LED turns on when silence is activated via the Sounder On/Off or via the alarm silence software timers.

See Page 2 for descriptions of Reset, Panel Silence, and Drill functions.

Event Queues



For EN-54 compliance, EST3 configures for remote proprietary system operation. This requires that every event must be acknowledged by viewing them before the internal buzzer will silence. The priority order is Fire, Fault, Disable, Monitor.

It is our intention to keep the product information current and accurate. We can not cover specific applications or anticipate all requirements.
All specifications are subject to change without notice. For more information or questions relative to this Specification Sheet, contact EST.

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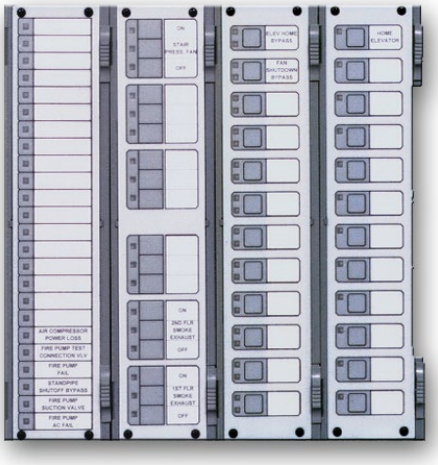
EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Control Display Modules

3-LDSM, 3-24x series, 3-12xx series, 3-6/3S1xxx series



S3000

FM APPROVED

FDNY APPROVED

CE

7165-1657: 0186/0193

EN 54-2: 1997 + A1: 2006
EN 54-4: 1997 + A1: 2002 + A2: 2006
EN 54-16: 2008

Overview

The EST3 Control Display modules provide the emergency user with the simplest of interfaces, lights and switch control. The Control Display modules install over local rail modules. The local rail modules supply the power and drivers via a ribbon cable connection to the control display modules. The displays mount over any local rail module maximizing the flexibility of design layout. When a display module is required where no local rail module exists, an LED Display Support Module 3-LDSM mounts to the local rail providing support for one Control Display Module.

Surface mount technology used to minimize space, also reduces the power requirements of display modules. Slide-in labels keep the control display modules flexible and allow labeling for local languages.

Module lamp test can be programmed to any spare control switch or a local node lamp test is initiated by simultaneously operating the Alarm Silence and Trouble Silence switches on the 3-CPU.

Standard Features

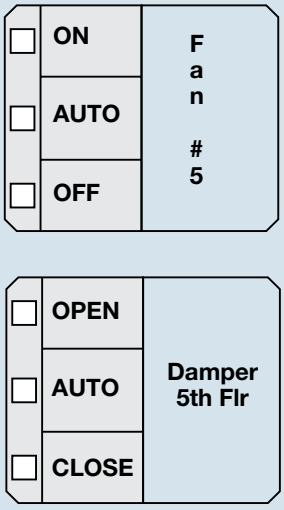
- Programmable LED flash rates
- Membrane style tactile pushbuttons
- Software supported for toggle, and latching interlock switch action
- Slide in labels
- Lamp test

Application Notes

Control Display Modules come in a variety of types providing operational flexibility. There are five types of display modules available with EST3.

Typically alarm zone annunciation appears on any of the first four module types shown. The first module supports simple zone annunciation; the second, zone annunciation with zone disable; the third, alarm and trouble zone annunciation, the fourth alarm and trouble zone annunciation with zone disable. From a simple one LED annunciation point to higher functionality, EST3 fills the requirements.

Simple Control Examples



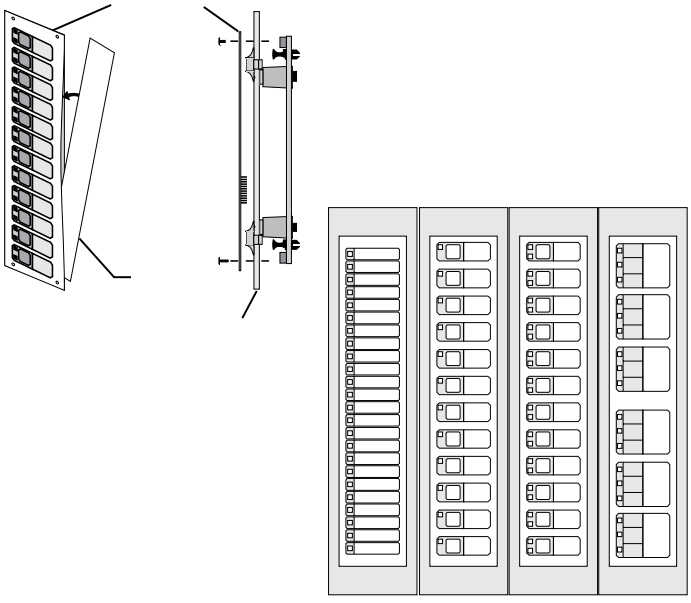
The fifth module is very adaptable to system requirements for audio or remote equipment control. Each module contains 18 LEDs and 18 switches. Each group of three switches has a latching-interlock to support operations that must be kept separated. The interlock is under software control so only one switch is active at a given time. EST3 software makes meeting the wide variety of applications needed with today's codes and building system operations easy.

For fan control the emergency user assumes control of the remote device by selecting "On" or "Off." Programming of the switches to multiple relays keeps operational design choices open. The user returns the system control of the remote device to the Life Safety system by simply pressing Auto. The Auto LED programs to its related switch and gives positive feed back to the user by turning on yellow when the system has active control of remote devices.

Individual switch LEDs are also programmable. As an example the "Open" or "On" LED (green) could program to follow its related switch or, program to follow a remote monitor input and provide positive feedback of the remote devices control status. If budget restrictions prevent "sail type" positive feedback, EDWARDS's unique command processing satisfy requirements for positive feedback of HVAC control systems. Any switch command will send a signal to the 3-CPU for processing. While in this state the LED associated with the switch will flash. Once the command has been received by a remote Signature Series Module, the module (since it is intelligent with its own microprocessor) will issue a "Processed" command back to the 3-CPU which will latch the LED associated with the switch "ON" steady. This same process is used for all audio speaker selections ensuring the circuit is connected. A variety of switch and associated LED colors are available to meet the demands of the specifiers application.

Life Safety Systems are generally passive requiring only occasional operation. Yet, in an emergency the user must be able to identify system operation and status quickly and easily. LCD displays are excellent for identifying specific information, but even a large LCD can not display overall "system" status as effectively as LEDs and Switches. The EST3 Control Display modules are designed to provide simple identification and operation of system functions for the emergency user. They provide positive feedback of control activity with unrivaled selection of display configurations and mounting location options.

Installation and Mounting

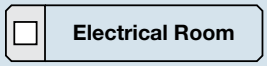


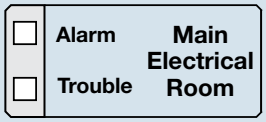
Engineering Specification

The Life Safety system shall incorporate annunciation of Alarm, Supervisory, Trouble and Monitor operations. Annunciation must be through the use of LED display strips complete with a means to custom label each LED as to its function. Where applicable control of remote smoke control devices must be made available at the control center. Switches with LEDs must provide positive feed back to the operator of remote equipment status. Where voice audio is required a means of paging individual zones must be made. The status of each paging zone must be annunciated. It must be possible to selectively page into specific zones. It shall be possible to manipulate the evacuation of the building from the main control center. It must be possible for the emergency operator to put specific zones into evacuation manually.

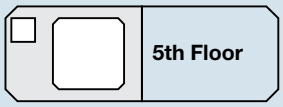
Technical Specifications

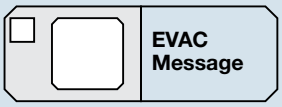
Catalog Number	Number of LEDs	LED Colors	Switches	Applications	Standby Current	Alarm Current
3-LDSM	N/A	N/A	N/A	Provides interface for one Control Display Module	5 mA	

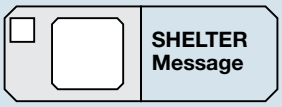




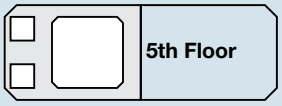
3-24R	24	red	0	Alarm Annunciation	2 mA base + 1.5 mA per active LED
3-24Y		yellow		Supervisory and Trouble Annunciation	
3-24G		green		Monitor Annunciation	
3-12RY		12 red over 12 yellow pairs		Red LEDs Alarm Annunciation Yellow LEDs Supervisory Annunciation	

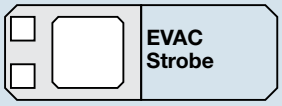


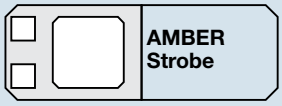




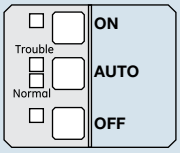
3-12SR	12	red	12	Alarm Annunciation with enable/disable operation	2 mA base + 1.5 mA per active LED
3-12SY		yellow		Supervisory Annunciation with enable/disable operation	
3-12SG		green		Monitor Annunciation, Page select	

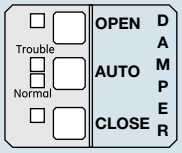




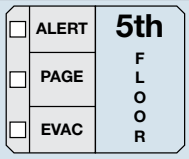


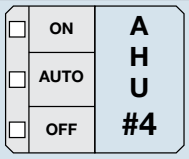
3-12/S1GY	12 groups of two w/ switch	green/ yellow	12	Zone Page select with Trouble Annunciation	2 mA base + 1.5 mA per active LED
3-12/S1RY		red/yellow		Alarm and Trouble Annunciation with enable/disable	
3-12/S2Y		yellow/ yellow		Supervisory and Trouble Annunciation with enable/disable	

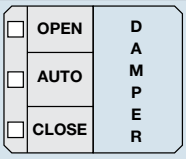




3-4/3SGYWR	4 LEDs	Green /Yellow and White/Red	1 2 3 switches	On-Auto-Off fan and Open-Auto-Close Damper Control with Trouble and Normal LED indicators	2mA base + 1.5mA per active LED







3-6/3S1G2Y	6 groups of 3 w/switch	green/yellow / yellow	Six groups of three	On-Auto-Off fan and Open-Auto-Close Damper Control	2 mA base + 1.5 mA per active LED
3-6/3S1GYR		green/yellow / red		Page and Evacuation select with zone trouble	

Notes:

1) All Control Display Modules are UL and ULC listed.

2) All Control Display Modules mount over one Local Rail Module. If no local rail module exists the 3-LDSM mounts to local rail and supports one control display module.

LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

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Bradenton, FL 34202

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Ordering Information

Catalog Number	Description	Shipping Weight
3-LDSM	LED Display Support Module. Add suffix "-E" for EN54 compliant versions.	0.45lb (.2kg)
3-24R	24 Red LED Display Module. Add suffix "-E" for EN54 compliant versions.	
3-24Y	24 Yellow LED Display Module. Add suffix "-E" for EN54 compliant versions.	
3-24G	24 Green LED Display Module. Add suffix "-E" for EN54 compliant versions.	
3-12SR	12 switches with 12 Red LED Display/Control Module. Add suffix "-E" for EN54 compliant versions.	
3-12SY	12 switches with 12 Yellow LED Display/Control Module. Add suffix "-E" for EN54 compliant versions.	
3-12SG	12 switches with 12 Green LED Display/Control Module. Add suffix "-E" for EN54 compliant versions.	
3-12RY	12 Red LED and 12 Yellow LED Display Module . Add suffix "-E" for EN54 compliant versions.	
3-12/S1GY	12 switches with one Green and one Yellow LED per switch Display/ Control Module. Add suffix "-E" for EN54 compliant versions.	0.35lb (.12kg)
3-12/S1RY	12 switches with one Red and one Yellow LED per switch Display/ Control Module. Add suffix "-E" for EN54 compliant versions.	
3-12/S2Y	12 switches with two Yellow LEDs per switch Display/Control Module.	
3-6/3S1G2Y	Six groups of three switches. Each switch with one LED. LEDs provided Green, Yellow, Yellow. Add suffix "-E" for EN54 compliant versions.	
3-4/3SGYWR	12 switches in four groups of three switches, switch one with a green LED, switch two with yellow and white LEDs and switch three with a red LED.	
3-6/3S1GYR	Six groups of three switches. Each switch with one LED. LEDs provided Green, Yellow, Red. Add suffix "-E" for EN54 compliant versions.	

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Signature Driver Controller Modules

3-SSDC1, 3-SDDC1, 3-SDC1

Approvals

EST4	EST3
UL, ULC S3000	UL, ULC S3000
7165-1657: 0186/0306	7165-1657: 0186/0306
NYC FIRE DEPT. COA # 6314	FDNY APPROVED
FM APPROVED	FM APPROVED
	CE

EN 54-2: 1997 + A1: 2006
EN 54-4: 1997 + A1: 2002 + A2: 2006
EN 54-16: 2008

Overview

The 3-SSDC1 and 3-SDDC1 Signature Driver Controller modules provide an intelligent interface between the system's main CPU module and Signature Series devices. Each module contains its own microprocessor used to coordinate, process and interpret information received from and sent to Signature devices. Power and communications is received directly from the control panel rail assembly. The 3-SSDC1 Single Signature Driver Controller module supports one Signature Data circuit, while the 3-SDDC1 Signature Dual Driver Controller module supports two Signature circuits. Both modules occupy one rail space in the fire alarm control cabinet and provide removable field wiring terminals to aid installation.

Innovative design gives the 3-SSDC1/3-SDDC1 and Signature devices truly "distributed intelligence". Signature detectors and modules have their own on-board microprocessor communicating with the loop controller in a fully digital communication format. This increases the accuracy of the information coming to and from the loop controller by reducing the effects of capacitance and noise.

With decentralized intelligence much of the decision making moves from the loop controller to the devices. Advanced fire detection algorithms processed within the Signature devices effectively end unwanted alarms. Environmental compensation and multiple sensing element decision making operations are resident in the devices. Intelligent devices allow the Signature Controllers to execute communication and system functions with greater speed and low baud rates, increasing the accuracy of information transmitted between the loop controller and devices.

Standard Features

- One or two circuit versions
- Dedicated microprocessor control
- Full digital communication
- Specialized communication protocol
  – Less sensitive to cable characteristics
  – Utilize existing wiring in most applications
- Loop alarm in under 750 milliseconds
- Device location supervision
  – Unexpected additional device addresses
  – Missing device addresses
  – Switched device locations
  – Programmed device parameters
- Automatic nonvolatile as-built mapping
  – Stores "actual" and "expected" device data
  – Stores physical connection sequence including "T" taps
- Automatic day/night sensitivity
- Supports up to 250 intelligent Signature detectors and 250 Intelligent Signature Modules
- Up to five 3-SDDC1s per node
  – Total of 10 Signature circuits
- Removable field wiring terminal blocks
- Multiple survival modes — stand alone
- Fully backward compatible with 3-SSDC and 3-SDDC

Application

Up to 125 detectors and 125 modules are supported over a single pair of wires by the 3-SDC1 Signature Cards that plug into the Signature controller modules. Loop distances over 11,000 feet (3300m) are possible. Class B wiring, Class A and Class X wiring are supported.

The 3-SSDC1 and 3-SDDC1 use advanced communication formats that provide exceptional response. Using a “BROADCAST POLL” the loop controller checks the entire device circuit for any changes of state. Should one or more devices report a change the 3-SSDC1/3-SDDC1 uses “DIRECT ADDRESS SEARCH” to find reporting device(s). Devices that have entered the alarm state or become active are located nearly instantaneously.

The unique use of “BROADCAST POLLING” combined with “DIRECT ADDRESS SEARCH” ensures that only new information is transmitted allowing a reduced baud rate with fast response time. The low baud rate is ideal for retrofit applications since in most applications existing wiring can be used.

To enhance survivability of the system the 3-SSDC1/3-SDDC1 supports a standalone mode for Signature devices. Two catastrophic failure modes are supported. If the main panel CPU fails, the loop controller will continue to poll its devices. If an alarm is detected it will be sent on the local rail communication bus and received by other local rail modules. A common alarm condition throughout the panel will result. If the local rail module (3-SSDC1/3-SDDC1) fails, and a device (smoke or module) detects an alarm, specialized circuitry will make the node aware of the alarm condition. The panel’s main CPU will communicate the alarm condition to the rest of the network. Having multiple redundant modes is paramount in a life safety system.

Every time the 3-SSDC1/3-SDDC1 communicates with a detector a green LED on the detector flashes. Normal green LED activity is not disturbing to building occupants, but can be quickly spotted by a maintenance technician. A red LED on the detector turns on only in the alarm condition.

The 3-SSDC1/3-SDDC1 also supervises the device wiring, physical location of each device and the programmed device characteristics. This EDWARDS/Signature Series unique characteristic is accomplished by “MAPPING” the Signature circuit and committing the map to memory. Upon power up the loop controller will scan device serial numbers and map their physical location sequence on the loop, including “T” taps. After mapping is complete the controller automatically addresses each detector and module through downloading over the loop. There are no switches or dials to set. Each device is assigned a unique soft address generated by the site specific program.

The 3-SSDC1/3-SDDC1 then compares the “Actual” physical device data to the “Expected” site specific program data. If any correlations are different, the loop controller issues a trouble to the CPU identifying the devices which do not match and posting a map fault. A graphical map of the loop can be uploaded depicting each device’s location on the loop, including branches (T-Taps) and all of the physical attributes associated with the device. This diagnostic information is unparalleled in the fire detection industry and vital for keeping accurate records on how the system was installed.

During installation a common problem with analog/ addressable systems is locating ground faults. The 3-SSDC1 and 3-SDDC1 controllers have the ability to locate ground faults by specific module, speeding up the troubleshooting process. Another significant advantage of the 3-SSDC1/3-SDDC1 controllers during commissioning is electronic addressing and mapping. This eliminates duplicate addresses, which are also very difficult for most systems to locate.

During maintenance, should groups of detector heads be removed for service and returned into the wrong smoke detector base (location), the 3-SSDC1/3-SDDC1 will automatically detect the problem. If the attributes of the switched devices are the same, the system will automatically download the correct soft addresses and algorithms to the devices (maintaining location supervision).

If the attributes are not the same the 3-SSDC1/3-SDDC1 will send a map fault indication to to the system’s main CPU and post a trouble indicating the specific devices in fault.

The 3-SSDC1/3-SDDC1 also monitors the Signature Series devices for maintenance and trouble conditions. Each smoke detector contains intelligence to adjust with environmental changes. This expands the amount of time required between cleaning while maintaining a constant alarm threshold. As the detector begins to exhaust the environmental compensation, and reaches the 80% level, the 3-SSDC1/3-SDDC1 will indicate a maintenance alert or dirty condition to the system’s main CPU and indicate the specific device requiring cleaning. If cleaning is not performed the detector will continue to operate until all of its environmental compensation is utilized. At this point the 3-SSDC1/3-SDDC1 sends a dirty trouble indication to the panel’s main CPU and posts a trouble condition. If maintenance is still not performed the Signature detector will automatically remove itself from service once the programmed threshold window has been breached (preventing a false alarm).

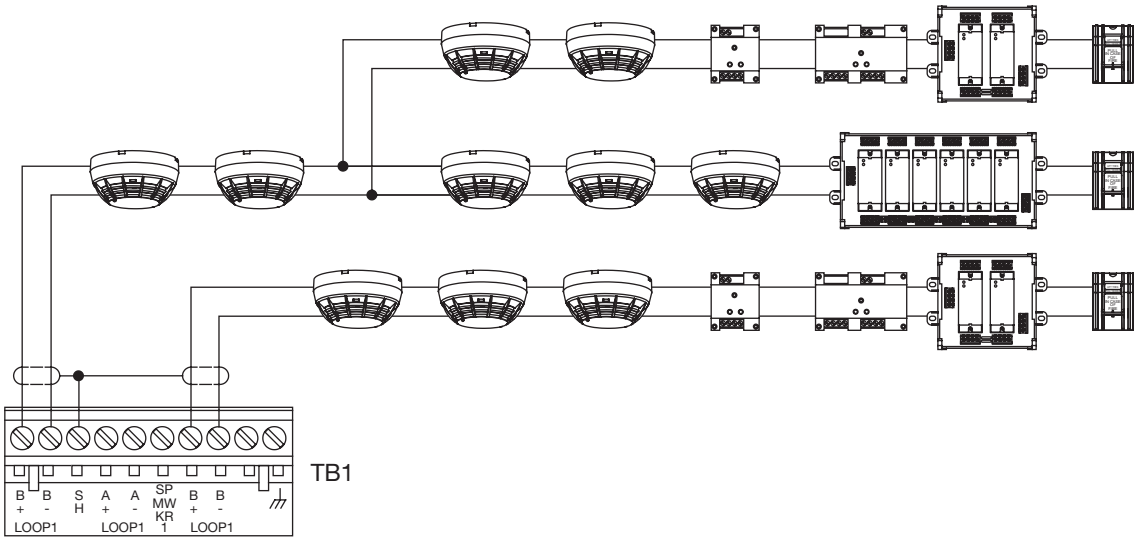
When a detector includes carbon monoxide (CO) detection, the detector monitors its CO life remaining for the CO sensor element and provides this information automatically to the panel. For maintenance of the system the CO life remaining is also available by simply running a maintenance report at the panel or through the FireWorks graphical interface. A unique CO maintenance signal is automatically generated by the panel when there is 8% (several months) of CO life remaining. Should the CO sensor not be replaced after the maintenance signal is reported, an “End of Life” trouble automatically posts on the panel when the CO sensor detection capability is exhausted.

Remote test capability permits devices to be put in alarm, pre-alarm, supervisory, monitor, or security alarm, or trouble from the panel menu or controls. This facilitates testing of smoke and heat detectors as well as monitor and security devices. Fast test is also provided for CO detectors allowing these devices to be tested quickly in the field.

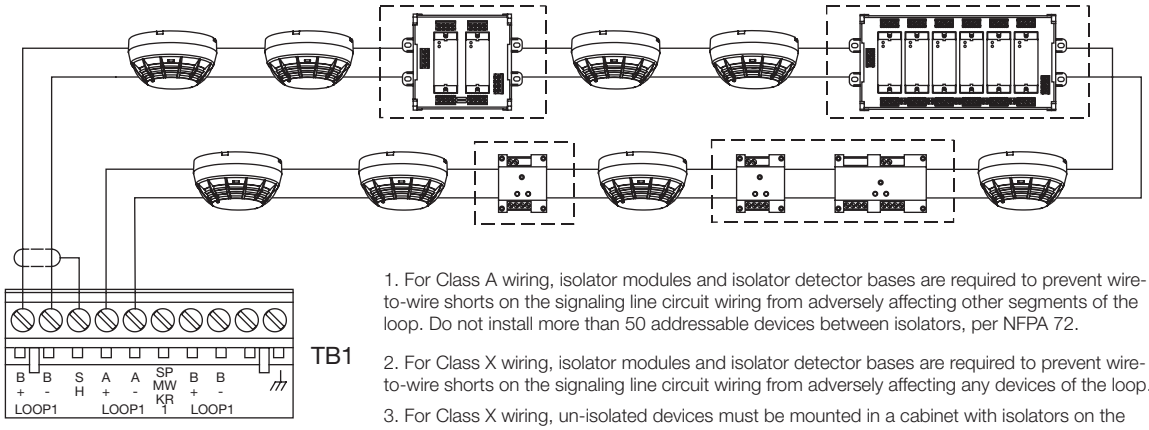
The 3-SSDC1 and 3-SDDC1 local rail modules modules are fully backwards compatible with the 3-SSDC and 3-SDDC local rail modules.

Typical Wiring

3-SSDC1, 3-DSDC1, and 3-SDDC1 Class B wiring



3-SSDC1, 3-DSDC1, and 3-SDDC1 Class A and Class X wiring



1. For Class A wiring, isolator modules and isolator detector bases are required to prevent wire-to-wire shorts on the signaling line circuit wiring from adversely affecting other segments of the loop. Do not install more than 50 addressable devices between isolators, per NFPA 72.

2. For Class X wiring, isolator modules and isolator detector bases are required to prevent wire-to-wire shorts on the signaling line circuit wiring from adversely affecting any devices of the loop.

3. For Class X wiring, un-isolated devices must be mounted in a cabinet with isolators on the incoming and outgoing wiring.

Engineering Specification

The communication format between the control panel and analog devices shall be 100% digital.

Loop alarm recognition must be within 750 milliseconds of a device going into the alarm state, with system response time no greater than 3 seconds. All devices shall support remote testing.

It must be possible to wire the circuit as Class B, Class A or Class X with non-shielded, non-twisted wire. It must be possible to wire branches (T-taps) with Class B wiring.

The driver controller must be manufactured in accordance with ISO 9001 standards.

The system must have tolerance to multiple failures. There must be a standalone mode of operation that will ensure the system is aware of alarms even if the local rail or main CPU fails.

Specifications (Signature Circuits)

Charts assume wire and devices are evenly distributed over length of circuit

Non-twisted, non shielded wire

Device type	# of Detectors	# of Module Addresses	#14 AWG (20pf/foot) (2.53 Ohm/1000ft)	#16 AWG (20pf/foot) (4.02 Ohm/1000ft)	#18 AWG (20pf/foot) (6.38 Ohm/1000ft)
Detectors only	125	0	14,752 feet (4,497 meters)	9,275 feet (2,827 meters)	5,839 feet (1,780 meters)
Modules only	0	125	12,599 feet (3,840 meters)	7,921 feet (2,414 meters)	4,986 feet (1,520 meters)
Detectors and Modules	125	125	5,738 feet (1,749 meters)	3,608 feet (1,100 meters)	2,271 feet (692 meters)
Detectors and Modules with 2-wire smokes	63	55 + 9 SIGA-UM	7,623 feet (2,324 meters)	4,793 feet (1,461 meters)	3,017 feet (920 meters)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	3,798 feet (1,158 meters)	2,388 feet (728 meters)	1,503 feet (458 meters)

Twisted pair non shielded wire

Device Type	# of Detectors	# of Module Addresses	#14 AWG (38pf/foot) (2.53 Ohm/1000ft)	1.5mm² (36pf/foot) (3.75 Ohm/1000ft)	#16 AWG (36pf/foot) (4.02 Ohm/1000ft)	1.0mm² (25pf/foot) (5.51 Ohm/1000ft)	#18 AWG (25pf/foot) (6.38 Ohm/1000ft)
Detectors only	125	0	13,157 feet (4,010 m)	9,933 feet (3,028 m)	9,275 feet (2,827 m)	6,760 feet (2,061 m)	5,839 feet (1,780 m)
Modules Only	0	125	12,599 feet (3,840 m)	8,483 feet (2,586 m)	7,921 feet (2,414 m)	5,774 feet (1,760 m)	4,986 feet (1,520 m)
Detectors & Modules	125	125	5,738 feet (1,749 m)	3,864 feet (1,178 m)	3,608 feet (1,100 m)	2,630 feet (802 m)	2,271 feet (692 m)
Detectors and modules with 2-wire smokes	63	55 + 9 SIGA-UM	7,623 feet (2,324 m)	5,133 feet (1,565 m)	4,793 feet (1,461 m)	3,494 feet (1,065 m)	3,017 feet (920 m)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	3,798 feet (1,158 m)	2,558 feet (780 m)	2,388 feet (728 m)	1,741 feet (531 m)	1,503 feet (458 m)

Twisted pair shielded wire

Device Type	# of Detectors	# of Module Addresses	#14 AWG (84pf/foot) (2.53 Ohm/1,000ft)	#16 AWG (82pf/foot) (4.02 Ohm/1,000ft)	#18 AWG (58pf/foot) (6.38 Ohm/1,000ft)
Detectors only	125	0	5,952 feet (1,814 meters)	6,098 feet (1,859 meters)	5,839 feet (1,780 meters)
Modules Only	0	125	5,952 feet (1,814 meters)	6,098 feet (1,859 meters)	4,986 feet (1,520 meters)
Detectors & Modules	125	125	5,738 feet (1,749 meters)	3,608 feet (1,100 meters)	2,271 feet (692 meters)
Detectors and modules with 2-wire smokes	63	55 + 9 SIGA-UM	5,952 feet (1,814 meters)	4,793 feet (1,461 meters)	3,017 feet (920 meters)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	2,558 feet (780 meters)	2,388 feet (728 meters)	1,503 feet (458 meters)

Specifications (controllers)

Catalog Number	3-SSDC1	3-SDDC1
Installation	1 LRM Space	1 LRM Space
Module Configuration	1 Addressable circuit (3-SDC1 Card) expandable to 2 circuits.	2 Addressable circuits (3-SDC1 Cards)
Operating Current [Note 2]	Standby 144 mA Alarm 204 mA	Standby 264 mA Alarm 336 mA
Operating Voltage	24 Vdc, Nominal	
Address Requirements	Automatic	
Detectors Supported	125 per 3-SDC1 Card	
Modules Supported	125 Module Addresses per 3-SDC1 Card	
2-Wire Smoke Power Output	100 mA per 3-SDC1 Card (not included in *Operating Current* above	
Conventional detectors supported	150 of 100 µA type per circuit.	
Signature Circuit Voltage	20 VDC +/- 5%	
Maximum Signature Circuit Resistance	100 Ohms	
Maximum Signature Circuit Capacitance	0.33 µF	
Communications Format	100% Digital	
Circuit Wiring Styles	Class B, Class A or Class X	
Termination	Removable plug-in terminal strip(s) on module	
Permissable Wire Size	18 to 12 AWG (0.75 to 2.5 mm^2)	
Agency Listings	UL, ULC (see Note 1); CE, LPCB, EN54 (see Note 3).	
Operating Environment	32 °F (0 °C) to 120 °F (49 °C) 93% RH, non-condensing	

Note 1: Other EST3 components are modularly listed under the following standards:
UL 864 categories: UOJZ, UOXX, UUKL and SYZV, UL 294 category ALVY, UL 609 category AOTX, UL 636 category ANET, UL 1076 category APOU, UL 365 category APAW, UL 1610 category AMCX, UL 1635 category AMCX
ULC-S527, ULC-S301, ULC-S302, ULC-S303, ULC-S306, ULC/ORD-C1076, ULC/ORD-C693
Please refer to EST3 Installation and Service Manual for complete system requirements. EST4 may not have all the above listings. Please refer to EST4 Installation and Service Manual for complete listing details.

Note 2: Current shown Includes full loop of devices.

Note 3: *For EN 54-2: 1997 + A1: 2006, EN 54-4: 1997 + A1: 2002 + A2: 2006, and EN 54-16: 2008 compliant product add suffix -E to model eg. 3-SSDC1-E (verify device and loop controller compatibility). EN54 approval for EST3 applications only.

Ordering Information

Catalog Number	Description	Shipping Wt. lb (kg)
3-SSDC1	Single Signature Driver Controller. Comes with one 3-SDC1 Device Card. Mounts to Local Rail. *Add suffix "-E" for EN54 compliant versions.*	0.5 (0.23)
3-SDDC1	Dual Signature Driver Controller. Comes with two 3-SDC1s. Mounts to Local Rail. *Add suffix "-E" for EN54 compliant versions.*	0.5 (0.23)
3-SDC1	Signature Device Card - upgrades a 3-SSDC1 to a 3-SDDC1. *Add suffix "-E" for EN54 compliant versions.*	0.25 (0.11)
4-FIL	Blank EST4 filler plate (order separately when no LED or LED/Switch module is installed on the inner door).	0.1 (0.05)
3-FP	Filler Plate, order separately when no LED or LED/Switch module installed.	0.1 (0.05)

Note 1: EN54 approval for EST3 applications only.

EDWARDS

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EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Mass Notification Communications

MN-NETSW1, MN-COM1S

S3000

7165-1657:
0186/0306

Overview

MN-NETSW1
Four-port Mass Notification
multimode fiber optic Ethernet switch
The MN-NETSW1 is an industrial grade, 10/100 Mbps auto-negotiating Ethernet switch used in life safety and mass notification applications to connect EST3's FireWorks workstation to the MN-FVPN VoIP module and/or the MN-COM1S RS-232 interface. The MN-NETSW1 provides four RJ-45 ports for local connections and two full-duplex multimode fiber ports for remote connections.

The MN-NETSW1 has three LED indicators

- **Power:** On indicates the MN-NETSW1 has power.
- **Link:** On indicates Ethernet link has been established. Flashing indicates link is active.
- **HS:** Indicates data transferring at 100 Mbps.

MN-COM1S
Mass Notification Serial Communications/LAN interface
The MN-COM1S is a TCP/IP to RS-232 interface with one RJ-45 port and one RS-232 port. It is used in mass notification settings to connect a FireWorks workstation to an EST3 control panel.

Both the MN-NETSW1 and the MN-COM1S mount on an MN-BRKT1 or an MN-BRKT3 bracket. These install inside the EST3 control panel or Auxiliary Power Supply for a neat and self-contained mass notification solution.

Standard Features

MN-NETSW1 Four-port Mass Notification Ethernet Switch

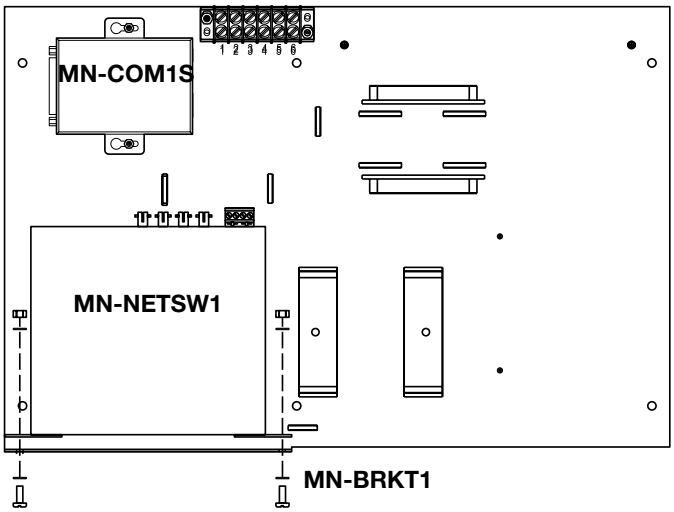
- Connect alarm panels to a remote FireWorks workstation over TCP/IP, LAN/WANs
- Supports Mass Notification and Fire Alarm applications
- Implement VoIP communications between EST3 nodes
- 10/100BASE-T Ethernet interface (RJ45)
- Supports MN-COM1S for Serial connection to 3-CPU3
- Supports MN-FVPN for VoIP communication between FireWorks workstations
- Four RJ-45 ports for local connections
- Two full-duplex multimode fiber ports for remote connections.
- Configuration and port director software included
- Flash ROM for easy software upgrade

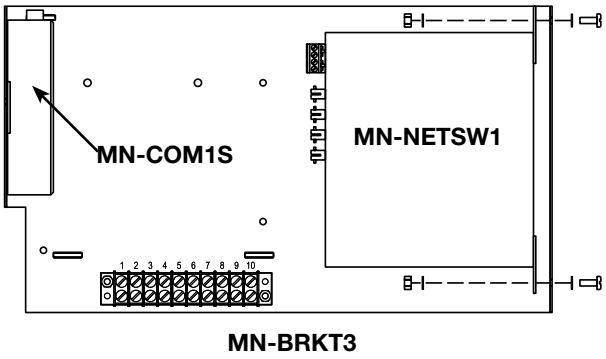
MN-COM1S Mass Notification Serial Communications/LAN interface

- Connect a FireWorks workstation to an EST3 control panel.
- RS-232 Serial port for connection to 3-CPU3
- One RJ-45 port
- One RS-232 port
- Browser-based setup and configuration

Mounting

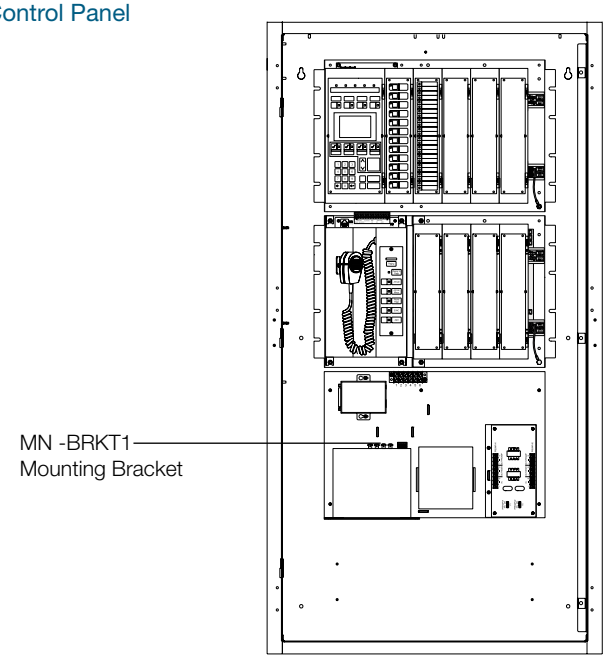
The MN-NETSW1 and the MN-COM1S mount on an MN-BRKT1 or an MN-BRKT3 bracket. These install inside the EST3 control panel or Auxiliary Power Supply for a neat and self-contained mass notification solution.



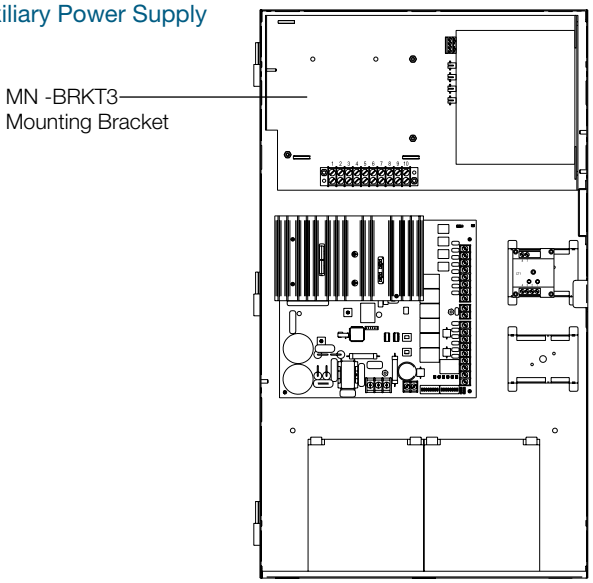


Component Layout

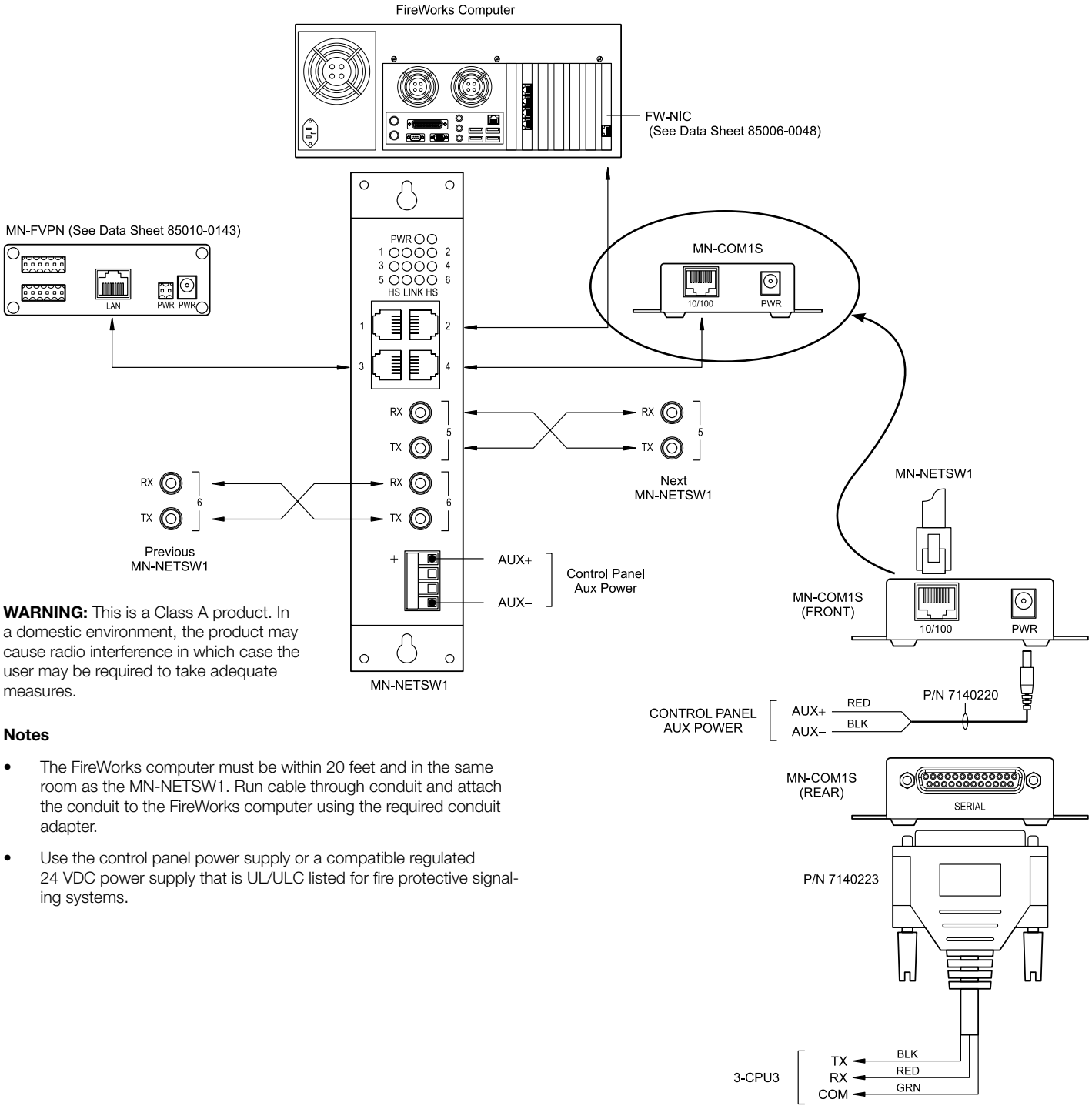
EST3 Control Panel



APS Auxiliary Power Supply



Wiring



WARNING: This is a Class A product. In a domestic environment, the product may cause radio interference in which case the user may be required to take adequate measures.

Notes

- The FireWorks computer must be within 20 feet and in the same room as the MN-NETSW1. Run cable through conduit and attach the conduit to the FireWorks computer using the required conduit adapter.
- Use the control panel power supply or a compatible regulated 24 VDC power supply that is UL/ULC listed for fire protective signaling systems.

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Bradenton, FL 34202

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Specifications, MN-COM1S

Voltage	18 to 28 VDC
Current	60 mA
Dimensions	(W × H × D) 2.5 × 0.9 × 3.5 in. (6.4 × 2.3 × 9.0 cm)
Serial interface	RS-232C
Network Interface	
Connector	RJ-45
Cable type	Category 5, min.
Other	10/100 Mbps, TCP/IP, autonegotiating
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Humidity	0 to 93% RH, noncondensing at 90°F (32°C)

Specifications, MN-NETSW1

Voltage	18 to 28 VDC
Current	350 mA, max.
Dimensions (W × H × D)	1.75 × 7.54 × 5.54 in. (44 x 191 × 138.4 mm)
Fiber optic ports	
Quantity	2
Connector type	ST
Signaling /Data Rate	100Base-FX / 100 Mbps
Attenuation	13 db, max. at a 1310 wave length
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Humidity	0 to 93% RH, noncondensing at 90°F/32°C
Segment Length	
Copper	3,28ft (100m)
Fiber Optic	~6,562 ft (2km) multi mode fiber
Fiber Optic Budget	10dB
Segment Media	
Copper	Category 6 UTP
Fiber Optic (1300 nm)	50/125 or 62/5/125 Multi Mode Fiber
Agency Listings	CE; FCC Part 15, Class A; EN50081-2; EN50082-2; UL-864
Power Requirements	24VDC at 21 mA, nominal10 –36VDC, 5 watts 8-24VAC, 47 – 63 Hz, 5 VA

Ordering Information

MN-COM1S	UL 864 Listed FireWorks Communications Ethernet Port, Command & Control. Comes with power and RS232 data cables
MN-NETSW1	Four-port multimode fiber optic Ethernet switch

Related Equipment

MN-BRKT1	MN-FVP mounting bracket for EST3 enclosures
MN-BRKT3	MN-FVP mounting bracket for APS-(6)(10)A power supplies
FW-NCCA4	Ethernet cable conduit connector assembly for UL4 computer
MN-FVPB1	Polymer mounting bracket for MN-FVPN
MN-FVPN	Fire VoIP encoder/decoder, includes power and audio cables
MN-PASM2	MN-FVPN preamp signal supervisory booster module (1 required per MN-FVPN, along with SIGA-RM1 or SIGA-MRM1)
SIGA -RM1/MRM1	Riser Supervision Module
MN-ABPM	Audio Bridge (Panel mount 3-ATPINT)

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

LISTING No.:	7165-1657:0186
CATEGORY:	7165 - FIRE ALARM CONTROL UNIT (COMMERCIAL)
LISTEE:	EDWARDS, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL, 34202 Contact: Conover, Jewell (941) 739-4358 (941) 308-8123 Email: rhonda.micochero@carrier.com
DESIGN:	Models EST3, EST3R, EST3-230, EST3R-230, EST200, EST200R, EST200-2, and EST200R-2 fire alarm control units. Power limited. Automatic, manual, coded, noncoded, local, auxiliary, remote station, (DACT), (reverse polarity), proprietary (multiplex), central station, waterflow, sprinkler supervisory service and releasing device. Model EST3 is also suitable for mass notification system and smoke control. Refer to listee's data sheet for additional detailed product description and operational considerations. System components: 3-BPS/M, 3-BPS/M/230: Booster Power Supply 3-PPS/M, 3-PPS/M-230: Primary Power Supply 3-BBC, /230, /M, /M-230: Battery Booster Charger Power Supply 3-RS232: CPU RS232 Comm 3-XMEM: CPU Memory Option 3-IDC8/4: Zone Card 3-CPU, 3-CPU1, 3-CPU2, 3-CPU3: Central Processing Unit 3-LCD, 3-LCDXL, 3-LCDXL1: CPU LCD Display 3-OPS: Off Premises Signaling Module 3-LDSM: LED Display Module 3-LRMF: Blank LRM Filler 3-CHAS4, -CHAS-5, -CHAS-7, -CHASS: Module Chassis 3-CAB-5(R), -7(R), -14(R), -21(R): Module Cabinet (red) 3-TAMP, 3-TAMP5: Tamper Switch 3-TAMPRCC: Tamper Switch 3-RCC7(R), -RCC14(R), -RCC21(R): Closet Cabinet (red)

3-PSMON: Power Supply Drive Monitor

3-BPMON: Power Supply Booster Monitor

3-BBCMON: Battery Booster Charger Monitor

3-24G, -24R, -24Y, -12RY, -12SY, -12SR, -12SG: LED Display

3-12/RY, -12/2Y, -12/2S2Y, -12/S1GY, -12/S2R: LED Display

3-12/S1RY, -18S1G2Y, -6/3S1G2Y: LED Display

3-6/3S1GYR, -18S1GYR, -6/3S3L, -6/3S2RY: LED Display

3-4/3SGYWR: LED Display

4X-12/S1GY, 4X-12/S1RY, 4X-12SR, 4X-24R: LED Display

4X-6/3S1G2Y, 4X-6/3S1GYR, 4X-4/3SGYWR: LED Display

4X24Y, 4X-12RY: LED Display

4X-LRMF: Blank Plate

3X-NET, 3X-NET8, 3X-FIB8: LED Display

3X-FIB: Fiber Network Option Module

3-CAB5BR: Enclosure

*3-SSDC, 3-SSDC1, 3-SDDC1, VM-SLCXB: Single Loop Controller Module

3-SDC, 3-SDC1, 3-SDC1-HC, VM-SLC-HC: Signature Data Card

3-ASU, 3-ASU/4, 3-ASUMX/100, /MM: Audio Source Module

3-FTCU: Firefighter Phone Module

3-ASU/FT: Audio/Firefighter Module

3-ZA15, 20, 30, 40, 95: Amplifier

3-RS485(130316/130410-01): Network Communication Card

3-RS485A, 3-RS485B, 3-RS485R: Network Communication Card

3-DSDC, 3-DSDC1: Dual Loop Controller Module

3-FIB, 3-FIBA: Fiber/Copper Data Com Module

3-FIBMB: Fiber Optic Interface Card

3-CCI: City Interface

CDR-3: Coded Output Module

URSM: Universal Riser Supervisor Module

RM1: Supervisory Module

3-AADC, 3-AADC1: Analog Addressable Communication Module

3-ATPINT, MN-ABPM: ATPC Interface Module

3-REMICA, 3-REMICP: Remote Microphone

PT1-S: System Printer

PT1-P: System Printer Parallel

3-ZA90, 3-ZA20A, 3-ZA20B: Zone Amplifiers

3-ZA40A, 3-ZA40B, 3-ZA95: Zone Amplifiers

ATCK: Attack Kit Cover for 3-RCC7R cabinet

3-MODCOM, 3-MODCOMP: Modem communicator/pager interface

3-NSHM1, 3-NSHM2: Modem Communication Cards

3-SAC: Security Access Control Module

3-ASUXM/100: Audio and Telephone Masters

MN-COM1S: Interface Module

MN-NETSW1, MN-NETSW2: Network Switching Hub

MN-FNS8C2F3, MN-FNS4C2F3, MN-FNS8C18F2, MN-FNS8C18F3: Network Switching Hub

MN-FNS8C18FAC: AC Power Supply

MN-FNS8C18FDC: DC Power Supply

MN-FNSGBDSM70K, MN-FNSFEDSM10K, MN-FNSFEMM2K: Fiber Optic Modules

MN-FNSGBDSMDR-XX, MN-FNSGBDSM10K, MN-FNSGBSSM10KD, MN-FNSGBSSM10KU: Fiber Optic Modules

MN-FNS4HDK1, MN-FNS8HDK1: Mounting Bracket

MN-PASM,MN-PASM2: Audio Preamp Module

MN-FVPN: VoIP Encoding/Decoding Unit

MN-BRK1, MN-BRKT8C18F, MN-BRKT4F: Mounting Bracket

MN-NRBK1, MN-BRKT1, 1F, 2, 3, 3F: Mounting Bracket

RC-BRKT: Mounting Bracket

	3-RCCEQ50, 3-RCCEQ65, 3-FTEQ, 3-CABEQ: Seismic Kits SMXL02, SMXHI2: Fiber Tranceivers 3-FIBMB2, MN-ABPM: Interface Module MN-NETRLY4: Network Relay Module NETCOM-BRKT, MN-NRBRT: Mounting Bracket SMXLO, SMXH, MMXVR: Fiber Tansceiver 3-CPUDR: CPU Door 3-BTSEN: Battery backup distribution bus 3-SSDC2: Single Signature Loop Controller Module *3-SDDC2, VM-SLCXB2: Dual Signature Loop Controller Module
RATING:	EST3, EST3R, EST200, EST200-2, EST200R, EST200R-2:120 VAC EST3-230, EST3R-230: 220 VAC
INSTALLATION:	In accordance with listee's printed installation instructions, applicable codes and ordinances, and in a manner acceptable to the authority having jurisdiction.
MARKING:	Listee's name, model number, electrical rating, and UL label.
APPROVAL:	Listed as fire alarm control units for use with separately listed electrically and functionally compatible initiating and indicating devices. Also suitable for high-rise application. Refer to listee's Installation Instructions Manual for details. These control units can generate a distinctive three-pulse Temporal Pattern Fire Alarm Evacuation Signal (for total evacuation) in accordance with NFPA 72. This control unit meets the requirements of UL 864, 9th Edition.
NOTES:	1. For Fire Alarm Verification Feature (delay of fire alarm signal), the maximum Retard/Reset/Restart period shall not exceed 30 seconds. 2. Formerly 7165-1591:0186 and 7165-1388:0211 3. Combined with 7170-1657:0187

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

08-05-24 MH

*Revised

This listing is based upon technical data submitted by the applicant. OSFM Fire Engineering staff has reviewed the test results and/or other data but does not make an independent verification of any claims. This listing is not an endorsement or recommendation of the item listed. This listing should not be used to verify correct operational requirements or installation criteria. Refer to listee's data sheet, installation instructions and/or other suitable information sources.

Date Issued: 08/07/2024

Listing Expires: 06/30/2025

Authorized By: **Michael Huang**, Program Coordinator
Fire Engineering & Investigations Division

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Sealed Lead-Acid Batteries

Overview

Rechargeable sealed lead-acid batteries are ideal for use as a secondary (standby) power source as defined by NFPA 72. Their low maintenance and high energy density make them ideal for fire alarm signaling applications.

Standard Features

- Rechargeable
- Non-spillable
- Non-hazardous
- Low maintenance
- High energy density

Application

When multiple power supplies are provided, each power supply's battery requirements should be calculated individually. Consult the specific system manual to determine battery capacity requirements.

Safety Information

Due to a battery's low internal resistance and high power density, high levels of short circuit current can develop across battery terminals. Put on protective eye covering and remove all jewelry before working on batteries. Do not rest tools or cables on the battery, and only use insulated tools. Follow all manufacturers installation instructions and diagrams when installing or maintaining batteries.

DATA SHEET E85010-0127
Not to be used for installation purposes. Issue 1.3

LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

8985 Town Center Pkwy
Bradenton, FL 34202

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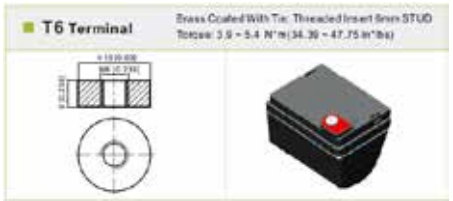
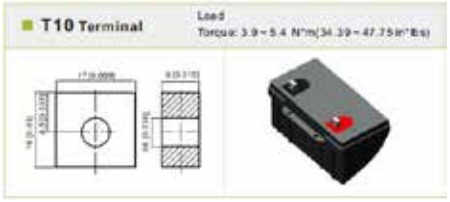
Specifications

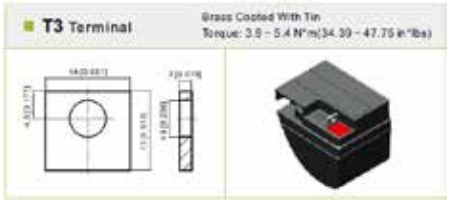
Case Material	ABS Thermoplastic
Regulatory Information	DOT Class 60, Batteries, non-hazardous, non-spillable
Operating Environment	32° F to 120° F (0° C to 49° C) 0 to 93% RH, Non-condensing

Ordering Information

Catalog #	Description	Shipping Weight, lb (kg)	Terminal
12V4A	4.5 Ah Sealed Lead Acid Battery - 12 Vdc	5 (2.27)	T1/T2
12V6A5	7.6 Ah Sealed Lead Acid Battery - 12 Vdc	6 (2.72)	T1/T2
12V10A	10.5 Ah Sealed Lead Acid Battery - 12 Vdc	10 (4.45)	T2
12V17A	18 Ah Sealed Lead Acid Battery - 12 Vdc	13 (5.90)	T3
12V24A	26 Ah Sealed Lead Acid Battery - 12 Vdc	20 (9.07)	T10/M5
12V40A	40 Ah Sealed Lead Acid Battery - 12 Vdc	32 (14.51)	T6/M6
12V50A	50 Ah Sealed Lead Acid Battery - 12 Vdc	40 (18.14)	T6/M6
12V65A	65 Ah Sealed Lead Acid Battery - 12 Vdc	49 (22.23)	T6/M6







EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Remote Booster Power Supplies

BPS6A, BPS10A

FM APPROVED
MEA 476-91-E Vol.13

UL UL S3424

7300-1657: 0229

Overview

The Booster Power Supply (BPS) is a UL 864, 10th Edition listed power supply. It is a 24 Vdc filtered-regulated, and supervised unit that can easily be configured to provide additional notification appliance circuits (NACs) or auxiliary power for Mass Notification/ Emergency Communication (MNEC), as well as life safety applications.

The BPS contains the circuitry to monitor and charge internal or external batteries. Its steel enclosure has room for up to two 10 ampere-hour batteries. The BPS has four Class B (convertible to two Class A) NACs. These can be activated in one or two groups from the BPS's unique dual input circuits.

The BPS is available in 6.5 or 10 ampere models. Each output circuit has a capacity of three amperes; total current draw cannot exceed the unit's rating.

The BPS meets current UL requirements and is listed under the following standards:

Standard (CCN)	Description
UL864 10th edition (UOXX)	Fire Alarm Systems
UL636 (ANET, UEHX7)	Holdup Alarm Units and Systems
UL609 (AOTX, AOTX7)	Local Burglar Alarm Units and Systems
UL365 (APAW, APAW7)	Police Station Connected Burglar Alarm Units and Systems
UL1076 (APOU, APOU7)	Proprietary Burglar Alarm System Units
UL1610 (AMCX)	Central Station Alarm Unit
ULC-S527 (UOXXC)	Control Units, Fire Alarm (Canada)
ULC-S303 (AOTX7)	Local Burglar Alarm Units and Systems (Canada)
C22.2 No. 205	Signaling Equipment (Canada)

Standard Features

- Allows for reliable filtered and regulated power to be installed where needed
- Cost effective system expansion
- Provides for Genesis and Enhanced Integrity notification appliance synchronization
- Supports coded output operation
- Self-restoring overcurrent protection
- Multiple signal rates
- Can be cascaded or controlled independently
- Easy field configuration
- On-board diagnostic LEDs identify wiring or internal faults
- Standard EDWARDS keyed lockable steel cabinet with removable door
- 110 and 230 Vac models available
- Accommodates 18 to 12 AWG wire sizes
- Optional tamper switch
- Dual battery charging rates
- Optional earthquake hardening: OSHPD seismic pre-approval for component Importance Factor 1.5

Application

The BPS provides additional power and circuits for notification appliances and other 24 Vdc loads. It is listed for indoor dry locations and can easily be installed where needed.

Fault conditions are indicated on the on-board diagnostic LEDs, opening the BPS input sense circuit and the trouble relay (if programmed). While this provides indication to the host system, the BPS can still be activated upon command. A separate AC Fail contact is available on the BPS circuit board, which can be programmed for trouble or AC Fail. There are seven on-board diagnostic LEDs: one for each NAC fault, one for battery fault, one for ground fault, and one for AC power.

The unique dual-input activation circuits of the BPS can be activated by any voltage from 6 to 45 VDC (filtered-regulated) or 11 to 33 Vdc (full-wave rectified, unfiltered). The first input circuit can be configured to activate 1-4 of the four possible outputs. The second input circuit can be configured to control circuits 3 and 4. When outputs are configured for auxiliary operation, these circuits can be configured to stay on or automatically deactivate 30 seconds after AC power is lost. This feature makes these circuits ideal for door holder applications. The BPS also has a separate 200 mA 24 Vdc output that can be used to power internal activation modules.

BPS NACs can be configured for a 3-3-3 temporal or continuous output. This makes the BPS ideal for applications requiring signaling rates that are not available from the main system.

In addition to the internally generated signal rates, the BPS can also be configured to follow the coded signal rate of the main system NACs. This allows for the seamless expansion of existing NACs.

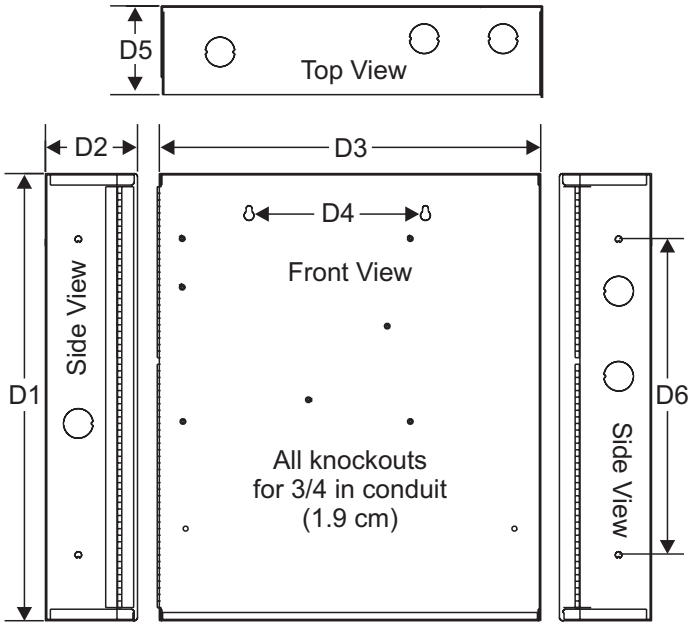
The BPS enclosure has mounting brackets for up to three Signature modules to the right of the circuit board.

Engineering Specification

Supply, where needed, EDWARDS BPS Series Booster Power Supplies (BPS) that are interconnected to and supervised by the main system. The BPS shall function as a stand-alone auxiliary power supply with its own fully-supervised battery compliment. The BPS battery compliment shall be sized to match the requirements of the main system. The BPS shall be capable of supervising and charging batteries having the capacity of 24 ampere-hours for Mass Notification/Emergency Communication (MNEC), life safety applications.

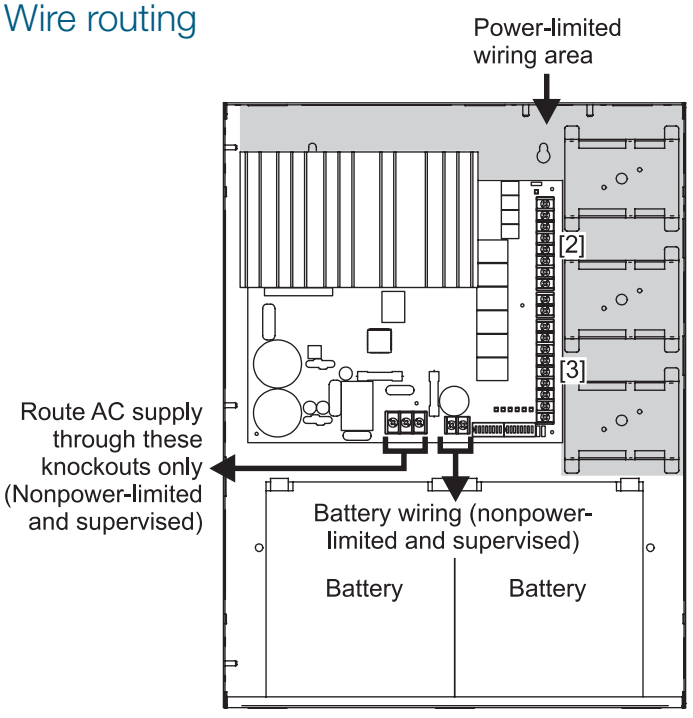
<<The BPS shall be capable of installation for a seismic component Importance Factor of 1.5.>> The BPS shall provide a minimum of four independent, fully supervised Class B circuits that can be field configurable for notification appliance circuits or auxiliary 24 Vdc power circuits. BPS NACs shall be convertible to a minimum of two Class A NACs. Each BPS output circuit shall be rated at 3 amperes at 24 Vdc. Each output circuit shall be provided with automatically restoring overcurrent protection. The BPS shall be operable from the main system NAC and/or EDWARDS Signature Series control modules. BPS NACs shall be configurable for continuous or 3-3-3 temporal rate. Fault conditions on the BPS shall not impede operation of main system NAC. The BPS shall be provided with ground fault detection circuitry and a separate AC fail relay.

Dimensions



D1	D2	D3	D4	D5	D6
17.0 in (43.2 cm)	3.5 in (8.9 cm)	13.0 in (33.0 cm)	6.5 in (16.5 cm)	3.375 in (8.6 cm)	12.0 in (30.4 cm)

Wire routing



Notes

1. Maintain 1/4-inch (6 mm) spacing between power-limited and nonpower-limited wiring or use type FPL, FPLR, or FPLP cable per NEC.

[2] Power-limited and supervised when not configured as auxiliary power. Non-supervised when configured as auxiliary power.

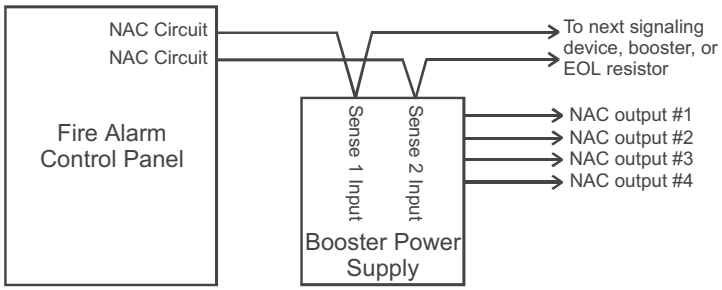
[3] Source must be power-limited. Source determines supervision.

4. When using larger batteries, make sure to position the battery terminals towards the door.

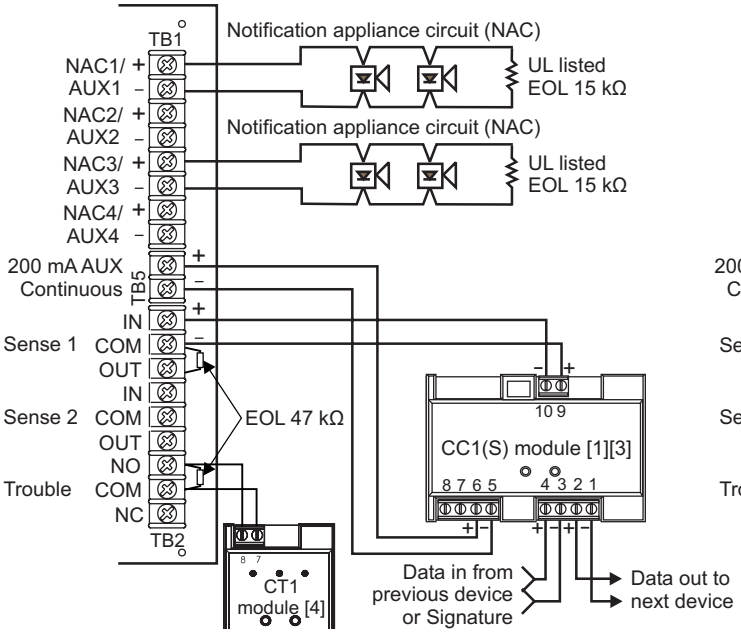
Typical Wiring

Single or cascaded booster anywhere on a notification appliance circuit

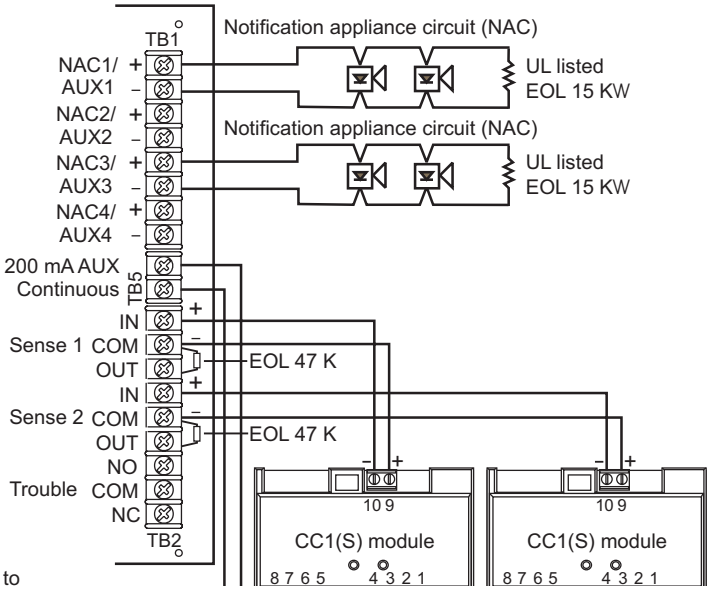
Existing NAC end-of-line resistors are not required to be installed at the booster's terminals. This allows multiple boosters to be driven from a single NAC circuit without the need for special configurations.



Configuring the Booster for AC Power Fail delay operation*



Multiple CC1(S) modules using the BPS's sense inputs



*The Booster supports AC Power fail delay of three hours via its trouble contact when dip switch SW2-6 is on. All other troubles are reported to supervising module or panel without delay via Sense inputs.

LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
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Bradenton, FL 34202

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Specifications

Model	6.5 amp Booster	10 amp Booster
AC Line Voltage	120VAC or 220-240VAC 50/60Hz 390 watts	120VAC or 220-240VAC 50/60Hz 580 watts
Notification Appliance Circuit Ratings	3.0A max. per circuit @ 24Vdc nominal 6.5A max total all NACs	3.0A max. per circuit @ 24Vdc nominal 10A max total all NACs
Trouble Relay	2 Amps @ 30Vdc	
Auxiliary Outputs	Four configurable outputs replace NACs 1, 2, 3 or 4. as auxiliary outputs and 200 mA dedicated auxiliary. (See note 1.)	
Input Current (from an existing NAC)	3mA @ 12Vdc, 6mA @ 24Vdc	
Booster Internal Supervisory Current	70mA + 35 mA for each circuit set to AUX	
Booster Internal Alarm Current	270mA	
Signature Mounting Space	Accomodates three two-gang modules.	
Maximum Battery Size	10 Amp Hours (2 of 12V10A) in cabinet up to 24 Amp hours with external battery cabinet for fire applications.	
Terminal Wire Gauge	18-12 AWG	
Relative Humidity	0 to 93% non condensing @ 32°C	
Temperature Rating	32° to 120°F (0° to 49°C)	
NAC Wiring Styles	Class A or Class B	
Output Signal Rates	Continuous, 3-3-3 temporal, or follow installed panel's NAC.	
Ground Fault Detection	Enable or Disable via jumper	
Agency Listings	UL, ULC, CSFM	

1. Maximum of 8 Amps can be used for auxiliary output.

Ordering Information

Catalog Number	Description	Shipping Wt. lb (kg)
BPS6A	6.5 Amp Booster Power Supply	13 (5.9)
BPS6AC	6.5 Amp Booster Power Supply (ULC)	13 (5.9)
BPS6A/230	6.5 Amp Booster Power Supply (220V)	13 (5.9)
BPS10A	10 Amp Booster Power Supply	13 (5.9)
BPS10AC	10 Amp Booster Power Supply (ULC)	13 (5.9)
BPS10A/230	10 Amp Booster Power Supply (220V)	13 (5.9)

Related Equipment		
12V6A5	7.2 Amp Hour Battery, two required	3.4 (1.6)
12V10A	10 Amp Hour Battery, two required	9.5 (4.3)
3-TAMP	Tamper switch	
BPS-CVR	Electronics Protective Cover	
BC-1EQ	Seismic Kit for BC-1. Order BC-1 separately. See note 2	
BPSEQ	Seismic kit for BPS6A or BPS10 Booster Power Supplies. See note 2	
BC-1	Battery Cabinet (up to 2 - 40 Amp Hour Batteries)	58 (26.4)
BC-2	Battery Cabinet (up to 2 - 17 Amp Hour Batteries)	19 (8.6)
12V17A	18 Amp Hour Battery, two required (see note 1)	13 (5.9)
12V24A	24 Amp Hour Battery, two required (see note 1)	20 (9.07)

1. Requires installation of separate battery cabinet.
2. For earthquake anchorage, including detailed mounting weights and center of gravity detail, refer to Seismic Application Guide 3101676. Approval of panel anchorage to site structure may require local AHJ, structural or civil engineer review.

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

LISTING No.:	7300-1657:0229
CATEGORY:	7300 - FIRE ALARM CONTROL UNIT ACCESSORIES/MISC. DEVICES
LISTEE:	EDWARDS, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL, 34202 Contact: Conover, Jewell (941) 739-4358 (941) 308-8123 Email: rhonda.micochero@carrier.com
DESIGN:	Models BPS6A, BPS10A, BPS6A/230, BPS10A/230, BPS6CAA, and BPS10CAA remote booster power supplies. Models APS6A, APS6A/230, APS6CAA, APS10A, and APS10A/230 Auxiliary Power Supply. *Models BPSEQ and APSEQ Seismic Kits. Refer to listee's data sheet for detailed product description and operational considerations.
RATING:	120 V/240 V, 60 Hz, 50 Hz
INSTALLATION:	In accordance with listee's printed installation instruction, applicable codes and ordinances and in a manner acceptable to the authority having jurisdiction.
MARKING:	Listee's name, model number, rating, and UL label.
APPROVAL:	Listed as remote booster power supplies for use with listee's separately listed compatible fire alarm control units to extend the notification appliance circuit. Refer to listee's Installation Instruction Manual for details.
NOTES:	Formerly 7300-1591:229

*Rev 07-23-19 gt

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

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Date Issued: 05/03/2024

Listing Expires: 06/30/2025

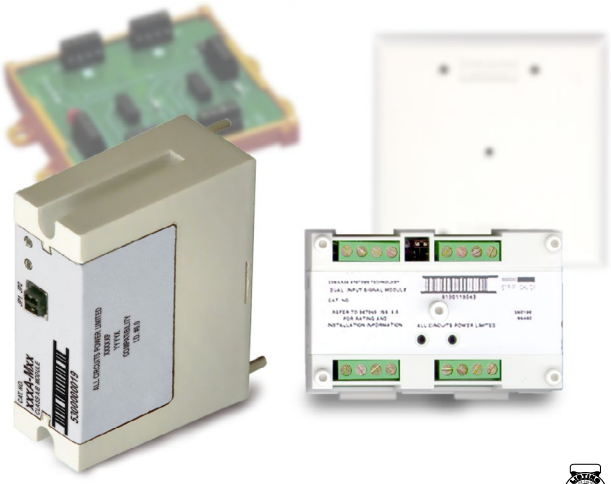
Authorized By: **Michael Huang**, Program Coordinator
Fire Engineering & Investigations Division

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Synchronization Output Module

SIGA-CC1S, MCC1S



Patented

FM APPROVED MEA 7300-1657: 0121 S3424

Overview

SIGA-CC1S and MCC1S Synchronization Output Modules are intelligent analog addressable devices that form part of EDWARDS's Signature line of products. The actual operation of the SIGA-CC1S and MCC1S is determined by the "personality code" selected by the installer, which is downloaded to the module from the Signature loop controller during system configuration.

Depending on their assigned personality, Synchronization Output Modules may be used as a signal power riser selector to provide synchronization of fire alarm signals across multiple zones, or for connecting, upon command from the loop controller, supervised Class B signal or telephone circuits to their respective power inputs. The power inputs may be polarized 24 Vdc to operate audible and visible signal appliances or 25 and 70 VRMS to operate audio evacuation speakers and firefighter's telephones.

Standard Features

- **Provides UL 1971-compliant auto-sync output for visual signals**
  Use for connecting a supervised output circuit to a supervised 24 Vdc riser input and synchronizing multiple notification appliance circuits.
- **Functions as an audible signal riser selector**
  Use as a synch module or for connecting supervised 24 Vdc Audible/Visible signal circuits, or 25 and 70 VRMS Audio Evacuation and Telephone circuits to their power inputs.
- **Built-in ring-tone generator**
  When configured for telephone circuits, the SIGA-CC1S generates its own ring-tone signal, eliminating the need for a separate ring-tone circuit.
- **Automatic device mapping**
  Signature modules transmit information to the loop controller regarding their circuit locations with respect to other Signature devices on the wire loop.
- **Electronic addressing**
  Programmable addresses are downloaded from the loop controller, a PC, or the SIGA-PRO Signature Program/Service Tool; there are no switches or dials to set.
- **Intelligent device with microprocessor**
  All decisions are made at the module to allow lower communication speed with substantially improved control panel response time and less sensitivity to line noise and loop wiring properties; twisted or shielded wire is not required.

Application

The SIGA-CC1S mounts to a standard North American two-gang electrical box, making it ideal for locations where only one module is required. Separate I/O and data loop connections are made to each module.

The SIGA-MCC1S is part of the UIO family of plug-in Signature Series modules. It functions identically to the SIGA-CC1S, but takes advantage of the modular flexibility and easy installation that characterize all UIO modules. Two- and six-module UIO motherboards are available. These can accommodate individual risers for each on-board module, or risers that are shared by any combination of its UIO modules. All wiring connections are made to terminal blocks on the motherboard. UIO assemblies may be mounted in EDWARDS enclosures.

Personality Codes

The operation of the SIGA-CC1S is determined by their sub-type code or "Personality Code". The code is selected by the installer depending upon the desired application and is downloaded from the loop controller.

Personality Code 5: Signal Power or Audio Evacuation (single riser). Configures the module for use as a Class B Audible/Visible Signal power (24 Vdc polarized) or Audio Evacuation (25 or 70 VRMS) power selector. The ring-tone generator is disabled. The output circuit is monitored for open or shorted wiring. If a short exists, the control panel inhibits the activation of the audible/visible signal circuit to prevent connection to the power circuit.

Personality Code 6: Telephone with ring-tone (single riser). Configures the module for use as a Telephone power selector. When a telephone handset is plugged into its jack or lifted from its hook, the module generates its own Ring-Tone signal. A separate ring-tone circuit is not needed. The module sends this signal to the control panel to indicate that an off-hook condition is present. When the system operator responds to the call, the ring-tone signal is disabled.

Personality Code 25: Visual Signal Synchronization. This personality code configures the module to provide synchronization of fire alarm signals across multiple zones. It functions as a signal power (24 Vdc) riser selector. The output wiring is monitored for open circuits and short circuits. A short circuit will cause the fire alarm control panel to inhibit the activation of the audible/visual signal circuit so the riser is not connected to the wiring fault.

Warnings & Cautions

This module will not operate without electrical power. As fires frequently cause power interruption, we suggest you discuss further safeguards with your fire protection specialist.

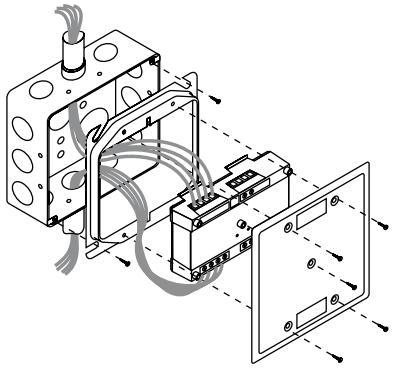
EDWARDS recommends that these modules be installed according to latest recognized edition of national and local fire alarm codes.

Compatibility

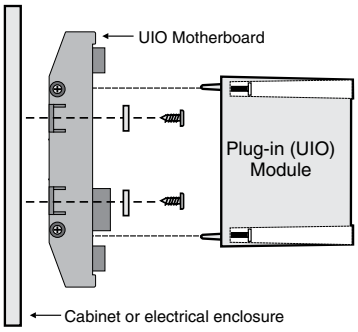
These modules are part of EDWARDS's Signature Series intelligent processing and control platform. They are compatible with EST3, EST3X and iO Series control panels.

Installation

The SIGA-CC1S: mounts to North American 2-1/2 inch (64 mm) deep 2-gang boxes and 1-1/2 inch (38 mm) deep 4 inch square boxes with 2-gang covers and SIGA-MP mounting plates. The terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



SIGA-MCC1S: mount the UIOxR motherboard inside a suitable EDWARDS enclosure with screws and washers provided. Plug the module into any available position on the motherboard and secure the module to the motherboard with the captive screws. Wiring connections are made to the terminals on the motherboard (see wiring diagram). UIOxR motherboard terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



Electronic Addressing

The loop controller electronically addresses each module saving valuable time during system commissioning. Setting complicated switches or dials is not required. Each module has its own unique serial number stored in its "on-board memory". The loop controller identifies each device on the loop and assigns a "soft" address to each serial number. If desired, the modules can be addressed using the SIGA-PRO Signature Program/Service Tool.

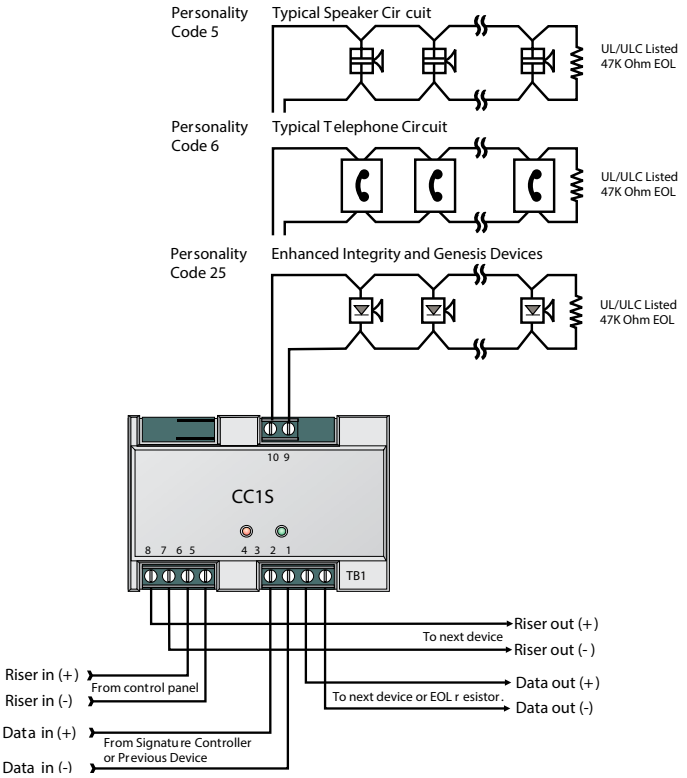
Testing & Maintenance

The module's automatic self-diagnosis identifies when it is defective and causes a trouble message. The user-friendly maintenance program shows the current state of each module and other pertinent messages. Single modules may be turned off (de-activated) temporarily, from the control panel.

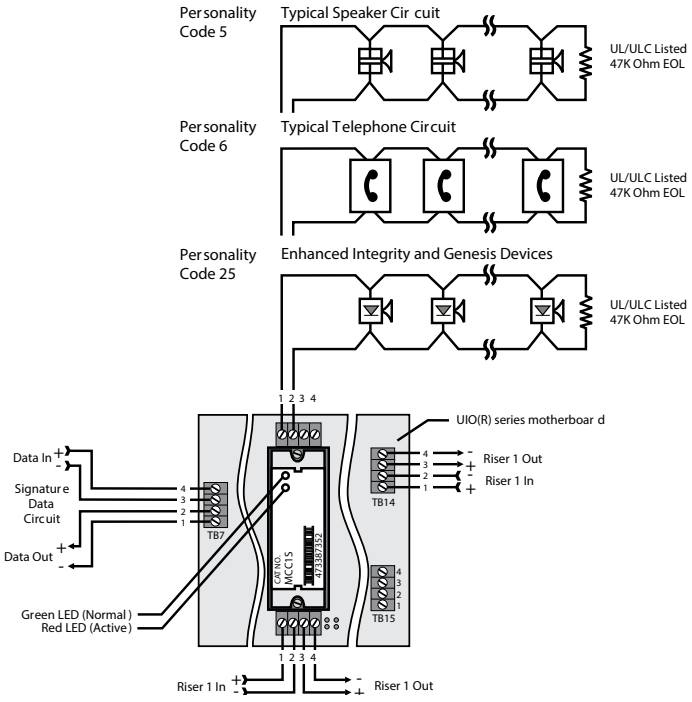
Scheduled maintenance (Regular or Selected) for proper system operation should be planned to meet the requirements of the Authority Having Jurisdiction (AHJ). Refer to current NFPA 72 and ULC CAN/ULC 536 standards.

Typical Wiring

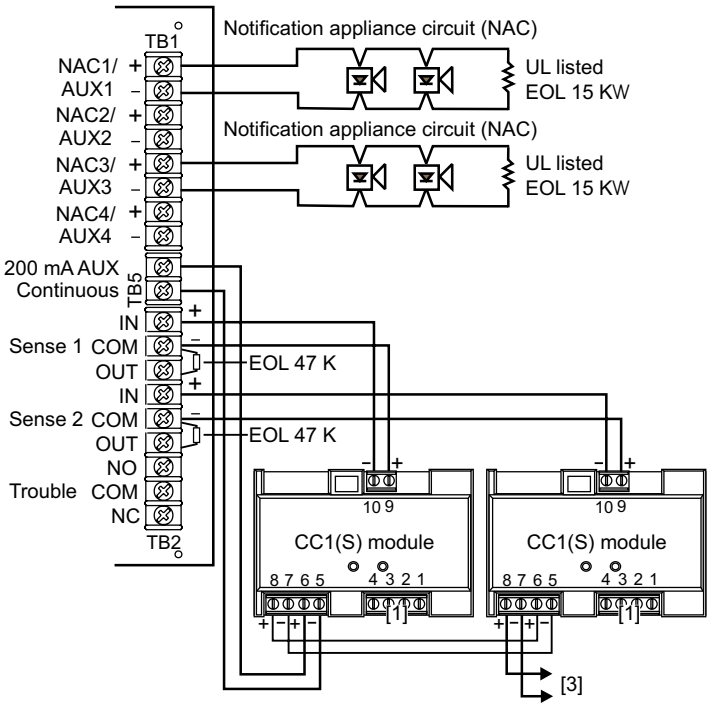
SIGA-CC1S (Standard Mount)



SIGA-MCC1S (UIO Mount)



Multiple CC1(S) modules using the BPS's sense inputs



LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

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Bradenton, FL 34202

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Specifications

Catalog Number	SIGA-CC1S	SIGA-MCC1S
Mounting	North American 2½ inch (64 mm) deep two-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with 2-gang covers and SIGA-MP mounting plates	Plugs into UIO2R, UIO6R or UIO6 Motherboards
Description	Synchronization Output Module	
Type Code	50 (factory set)	
Address Requirements	Uses one module address	
Wiring Terminations	Suitable for #12 to #18 AWG (2.5 mm^2 to 0.75mm^2)	
Operating Current	Standby = 223µA Activated = 100µA	
Operating Voltage	15.2 to 19.95 Vdc (19 Vdc nominal)	
Output Rating	24 Vdc = 2 amps 25 V Audio = 50 watts 70 V Audio = 35 watts	
Construction	High Impact Engineering Polymer	
Storage and Operating Environment	Operating: 32°F to 120°F (0°C to 49°C) Storage: -4°F to 140°F (-20°C to 60°C) Humidity: 0 to 93% RH	
LED Operation	Green LED - Flashes when polled Red LED - Flashes when in alarm/ active	
Compatibility	Use with: Signature Loop Controller under EST3 version 2.0 or higher	
Agency Listings	UL, ULC, CSFM, MEA	

Ordering Information

Catalog Number	Description	Shipping Wt. lbs (kg)
SIGA-CC1S	Synchronization Output Module (Standard Mount) - UL/ULC Listed	0.5 (0.23)
SIGA-MCC1S	Synchronization Output Module (UIO Mount) - UL/ULC Listed	0.18 (0.08)

Related Equipment		
27193-21	Surface Mount Box - Red, 2-gang	2 (1.2)
27193-26	Surface Mount Box - White, 2-gang	2 (1.2)
SIGA-UIO2R	Universal Input-Output Module Board w/Riser Inputs - Two Module Positions	0.32 (0.15)
SIGA-UIO6R	Universal Input-Output Module Board w/Riser Inputs - Six Module Positions	0.62 (0.28)
SIGA-UIO6	Universal Input-Output Module Board - Six Module Positions	0.56 (0.25)
235196P	Bi-polar Transient Protector	0.01 (0.05)
MFC-A	Multifunction Fire Cabinet - Red, supports Signature Module Mounting Plates	7.0 (3.1)
SIGA-MP1	Signature Module Mounting Plate, 1 footprint	1.5 (0.70)
SIGA-MP2	Signature Module Mounting Plate, 1/2 footprint	0.5 (0.23)
SIGA-MP2L	Signature Module Mounting Plate, 1/2 extended footprint	1.02 (0.46)

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

LISTING No.:	7300-1657:0121
CATEGORY:	7300 - FIRE ALARM CONTROL UNIT ACCESSORIES/MISC. DEVICES
LISTEE:	EDWARDS, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL, 34202 Contact: Conover, Jewell (941) 739-4358 (941) 308-8123 Email: rhonda.micochero@carrier.com
DESIGN:	Models SIGA-CC1, SIGA-CC2, SIGA-CT1, SIGA-CT1HT, SIGA-CT2, SIGA-CR, SIGA-CRR, SIGA-UM, SIGA-MM1, SIGA-WTM, SIGA-IM, *SIGA-IM2, SIGA-MDM, SIGA-MAB, SIGA-MCT2, SIGA-MCC1, SIGA-MCC2, SIGA-MCR, and SIGA-MCRR Remote Transponders. Models SIGA-AA30 and SIGA-AA50 audio amplifiers. Models SIGA-APS and SIGA-APS-220 power supplies. Models SIGA-MB4, SIGA-MP1, SIGA-MP2 and SIGA-MP2L mounting plates. Models SIGA-UIO2R, SIGA-UIO6 and SIGA-UIO6R motherboards. Model CS-SIGA-CC1P releasing module. Models SIGA-CC1S and SIGA-MCC1S Auto-Sync Output Modules. Models MFC-A and MFC-AD Enclosures. Model SIGA-CR2 Control Relay Module. Model SIGA-CT1HT Signature Series High Temperature Single Input Module. SIGA-CRH High Power Control Relay Module. Refer to listee's data sheet for additional detailed product description and operational consideration.
RATING:	15.2 - 19.95 VDC
INSTALLATION:	In accordance with listee's printed installation instructions, applicable codes and ordinances, and in a manner acceptable to the authority having jurisdiction.
MARKING:	Listee's name, model number, electrical rating, and UL label.
APPROVAL:	Listed as control unit accessories for use with separately listed compatible fire alarm control units. Refer to listee’s Installation Instruction Manual for details.
NOTES:	Formerly 7300-1591:121 and 7300-1388:178

*Revision 10-30-20 VWW

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

This listing is based upon technical data submitted by the applicant. OSFM Fire Engineering staff has reviewed the test results and/or other data but does not make an independent verification of any claims. This listing is not an endorsement or recommendation of the item listed. This listing should not be used to verify correct operational requirements or installation criteria. Refer to listee's data sheet, installation instructions and/or other suitable information sources.

Date Issued: 05/03/2024

Listing Expires: 06/30/2025

Authorized By: **Michael Huang**, Program Coordinator
Fire Engineering & Investigations Division

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Sealed Lead-Acid Batteries

Overview

Rechargeable sealed lead-acid batteries are ideal for use as a secondary (standby) power source as defined by NFPA 72. Their low maintenance and high energy density make them ideal for fire alarm signaling applications.

Standard Features

- Rechargeable
- Non-spillable
- Non-hazardous
- Low maintenance
- High energy density

Application

When multiple power supplies are provided, each power supply's battery requirements should be calculated individually. Consult the specific system manual to determine battery capacity requirements.

Safety Information

Due to a battery's low internal resistance and high power density, high levels of short circuit current can develop across battery terminals. Put on protective eye covering and remove all jewelry before working on batteries. Do not rest tools or cables on the battery, and only use insulated tools. Follow all manufacturers installation instructions and diagrams when installing or maintaining batteries.

DATA SHEET E85010-0127
Not to be used for installation purposes. Issue 1.3

LIFE SAFETY & INCIDENT MANAGEMENT

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Email: edwards.fire@carrier.com
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Bradenton, FL 34202

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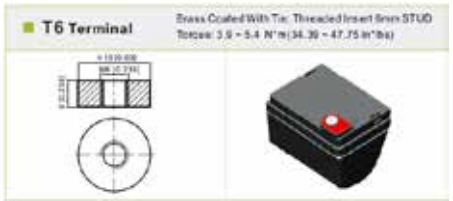
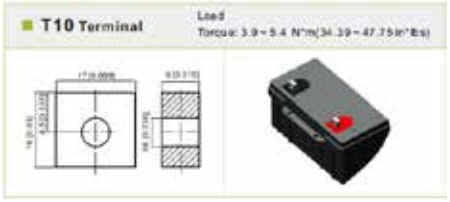
Specifications

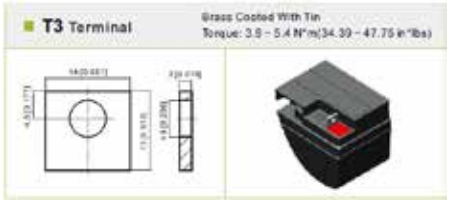
Case Material	ABS Thermoplastic
Regulatory Information	DOT Class 60, Batteries, non-hazardous, non-spillable
Operating Environment	32° F to 120° F (0° C to 49° C) 0 to 93% RH, Non-condensing

Ordering Information

Catalog #	Description	Shipping Weight, lb (kg)	Terminal
12V4A	4.5 Ah Sealed Lead Acid Battery - 12 Vdc	5 (2.27)	T1/T2
12V6A5	7.6 Ah Sealed Lead Acid Battery - 12 Vdc	6 (2.72)	T1/T2
12V10A	10.5 Ah Sealed Lead Acid Battery - 12 Vdc	10 (4.45)	T2
12V17A	18 Ah Sealed Lead Acid Battery - 12 Vdc	13 (5.90)	T3
12V24A	26 Ah Sealed Lead Acid Battery - 12 Vdc	20 (9.07)	T10/M5
12V40A	40 Ah Sealed Lead Acid Battery - 12 Vdc	32 (14.51)	T6/M6
12V50A	50 Ah Sealed Lead Acid Battery - 12 Vdc	40 (18.14)	T6/M6
12V65A	65 Ah Sealed Lead Acid Battery - 12 Vdc	49 (22.23)	T6/M6







LIFE SAFETY & INCIDENT MANAGEMENT

Intelligent Multisensor Smoke and CO Detector

SIGA-OSCD

Helps Reduce Cooking Nuisance Alarms
UL 268 7th Ed.

7275-1657:
0513

Overview

The Signature Optica Series SIGA-OSCD smoke detector brings advanced optical (photoelectric) sensing technology to a practical
design that increases efficiency, saves installation time, cuts costs, and extends life safety and property protection capabilities. Continuous self-diagnostics ensure reliability over the long-haul, while environmental compensation helps reduce maintenance costs.

The SIGA-OSCD provides a combination of optical detection for the early detection of smoke, with the added element of carbon monoxide sensing. The result is a detector that pulls double duty: continually monitoring the environment for signs of fire, as well as its invisible yet deadly companion, carbon monoxide.

Like all Signature Optica Series detectors, the SIGA-OSCD is an intelligent device that gathers analog information from multiple optical sensors, converting this data into digital signals. Utilizing dual optical wavelengths combined with multiple detection angles, the SIGA-OSCD differentiates particles that are not representative of actual smoke. Particle data is input into digital filters which feed a series of ratios removing signal patterns that are typical of nuisance sources, thus reducing unwanted alarms. To make an alarm decision, the detector's on-board microprocessor measures and analyzes all optical sensor readings and compares this information to preprogrammed settings. The detector also analyzes the smoke sensor independently from the CO sensor to determine whether to initiate a fire alarm, a life safety CO alarm, or both.

Standard Features

- Multi-criteria optical smoke sensing technology
- Integrates advanced optical smoke with life safety carbon monoxide detection
- Wide 0.5 to 4.36 %/ft. (1.6 to 13.6 %/m) smoke obscuration
- Integrated nuisance rejection reducing unwanted alarms from general cooking particulates
- Sensor Markings Provide Easy Testing Identification
- Listed to UL 268 7th edition
- Uses existing wiring
- Automatic device mapping
- Ground fault detection by module
- Up To 250 Total Signature Addresses Per Loop
- Two levels of environmental compensation
- Two levels of dirty detector warning
- Twenty pre-alarm settings
- Five sensitivity settings
- Non-volatile memory
- Electronic addressing
- Automatic day/night sensitivity adjustment
- Bicolor (green/red) status LED
- Standard, relay, fault isolator, and audible mounting bases

Note: Some features described here may not be supported by all control systems. Check your control panel's Installation and Operation Guide for details.

Application

Smoke detection

The SIGA-OSCD detects particles from a wide range of combustion sources and will trigger an alarm when smoke density in the chamber reaches a preprogrammed level. Thanks to its high-performance reflective response technology, the smoke sensor responds quickly and reliably to a wide range of fire types, including both fast and slow burning fires fueled by combustibles typically found in modern multi-use buildings.

CO Detection

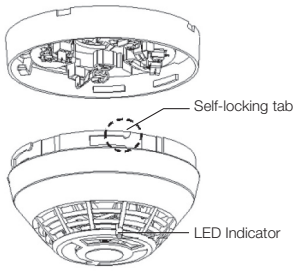
Monitored CO detection, such as that provided by the SIGA-OSCD, is becoming mandated with increasing frequency in all types of commercial applications, but particularly in occupancies such as hotels, rooming houses, dormitories, day care facilities, schools, hospitals, assisted living facilities, and nursing homes. Known as the "Silent Killer," CO is odorless, tasteless, and colorless. It claims nearly 500 lives, and results in more than 15,000 hospital visits annually.

Compatibility

The Siga-OSCD detector is compatible only with control panels using a Signature Loop controller.

Installation

Signature Series detectors mount to North American 1-gang boxes, 3-1/2 inch or 4 inch octagon boxes, and to 4 inch square electrical boxes 1-1/2 inches (38 mm) deep. They mount to European BESA and 1-gang boxes with 60.3 mm fixing centers. See mounting base installation and wiring for more information.



Testing & Maintenance

Scheduled maintenance (regular or selected) for proper detector operation should be planned to meet the requirements of the Authority Having Jurisdiction (AHJ). Refer to current NFPA 72, NFPA 720, and ULC CAN/ULC 536 standards.

Smoke Sensor Sensitivity

The SIGA-OSCD determines when its optical sensor is dirty or defective and can transmit sensitivity data to the loop controller. A sensitivity report can also be printed to satisfy NFPA sensitivity measurements which must be conducted at the end of the first year and every two years thereafter. The availability of maintenance features depends on the fire alarm system used.

CO Sensor Life

The CO sensor has a 10-year life from the date of manufacture or when the control panel indicates a sensor end-of-life condition, whichever comes first. When the sensor reaches its end of life, the detector signals a "COMMON TRBL ACT" condition on the control panel. Pressing the ***Details*** button on the control panel displays "END OF LIFE ACT" providing verification that it is an end-of-life trouble of the CO sensor. This trouble remains active until the detector is replaced, even if the panel is reset.

Sensing and reporting technology

The microprocessor in each detector provides additional benefits – Self-diagnostics and History Log, Automatic Device Mapping, and Fast, Stable Communication.

Self-diagnostics and History Log - Each Signature Series detector constantly runs self-checks to provide important maintenance information. The results of the self-check are automatically updated and permanently stored in the detector's non-volatile memory.

Automatic Device Mapping - The loop controller learns where each device's serial number address is installed relative to other devices on the circuit. The mapping feature provides supervision of each device's installed location to prevent a detector from being reinstalled (after cleaning, etc.) in a different location from where it was originally.

Fast Stable Communication - On-board intelligence means less information needs to be sent between the detector and the loop controller. Other than regular supervisory polling response, the detector only needs to communicate with the loop controller when it has something new to report.

Accessories

Detector mounting bases have wiring terminals that are accessible from the "room-side" after mounting the base to the electrical box. The bases mount to North American 1-gang boxes and to 3½ inch or 4 inch octagon boxes, 1½ inches (38 mm) deep. They also mount to European BESA and 1-gang boxes with 60.3 mm fixing centers. The SIGA-SB4, SIGA-RB4, and SIGA-IB4 mount to North American 4 inch sq. electrical boxes in addition to the above boxes. They include the SIGA-TS4 Trim Skirt, which is used to cover the "mounting ears" on the base. Sounder bases mount to a 4 inch square boxes only.

SIGA-AB4G/T/LF
Audible Base

SIGA-SB
Standard Base

SIGA-IB
Isolator Base

SIGA-RB
Relay Base

SIGA-LED
Remote LED

Remote LED SIGA-LED - The remote LED connects to the SIGA-SB or SIGA-SB4 Standard Base only. It features a North American size 1-gang plastic faceplate with a white finish and red alarm LED.

SIGA-TS4 Trim Skirt - Supplied with 4 inch bases, it can also be ordered separately to use with the other bases to help hide surface imperfections not covered by the smaller bases.

Sounder Bases - Signature Series sounder bases are designed for use where localized or group alarm signaling is required.

- **SIGA-AB4GT** bases provide sounder capability to the SIGA-PCD when used with a SIGA-TCDR Temporal Pattern Generator to separate CO (TC4) and Fire (TC3) tone patterns.
- **SIGA-AB4G-LF** bases provide 520 Hz low frequency sounder capability to the SIGA-OSCD when used with a SIGA-TCDR Temporal Pattern Generator to separate CO (TC4) and Fire (TC3) tone patterns. The SIGA-AB4G-LF is suitable for applications requiring low frequency audible tones.

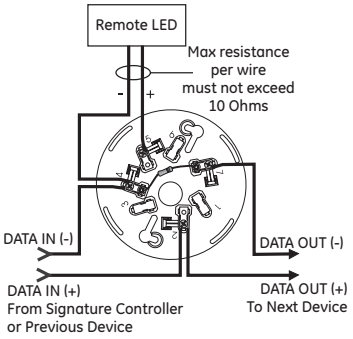
Typical Wiring

The detector mounting bases accept #18 AWG (0.75mm^2), #16 (1.0mm^2), #14 AWG (1.5mm^2), and #12 AWG (2.5mm^2) wire sizes. Sizes #16 AWG (1.0mm^2) and #18 AWG (0.75mm^2) are preferred for ease of installation.

Standard Detector Base, SIGA-SB, SIGA-SB4

This is the basic mounting base for EDWARDS Signature Series detectors. The SIGA-LED Remote LED is supported by this Base.

Term	Description
1	Not Used
2	DATA IN/OUT (+)
3	Not Used
4	DATA IN (-)
4	Remote LED (-)
5	Remote LED (+)
6	Not Used
7	DATA OUT (-)



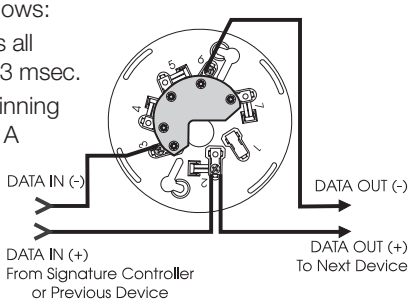
Isolator Detector Base, SIGA-IB, SIGA-IB4

This base includes a built-in line fault isolator for use on Class A circuits. A detector must be installed for it to operate. The isolator base does not support the SIGA-LED Remote LED.

The isolator operates as follows:

- a short on the line causes all isolators to open within 23 msec.
- at 10 msec intervals,beginning on one side of the Class A circuit nearest the loop controller, the isolators close to provide the next isolator down the line with power.
- when the isolator next to the short closes, it reopens within 10 msec.

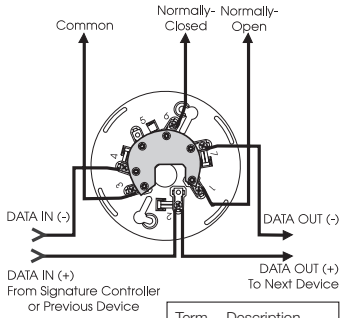
The process repeats beginning on the other side of the loop controller.



Term	Description
1	Not Used
2	DATA IN/OUT (+)
3	DATA IN (-)
4	Not Used
5	Not Used
6	DATA OUT (-)
7	Not Used

Relay Detector Base, SIGA-RB, SIGA-RB4

This base includes a relay. Normally Open or Normally Closed operation is selected during installation. The dry contact is rated for 1 amp (pilot duty) @ 30 Vdc. The relay's position is supervised to avoid accidentally jarring it out of position. The SIGA-RB can be operated as a control relay if programmed to do so at the control panel. The relay base does not support the SIGA-LED Remote LED.

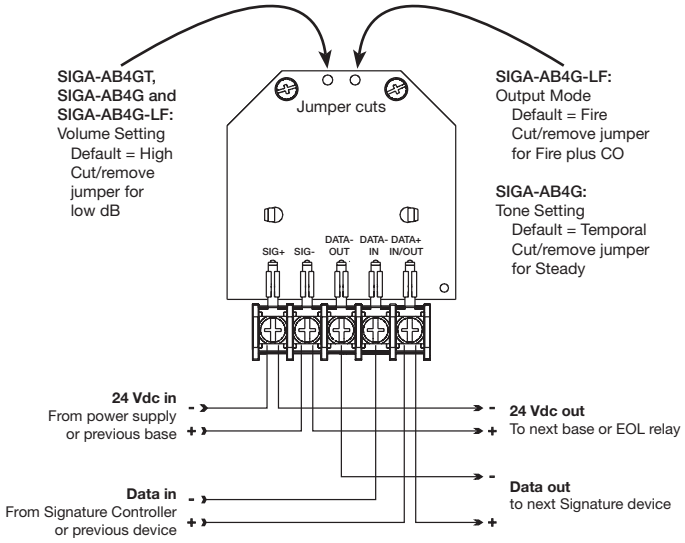


CONTACT RATING
1.0 Amp @ 30 VDC
(Pilot Duty)

Term	Description
1	Normally Open
2	DATA IN/OUT (+)
3	Common
4	DATA IN (-)
5	Not Used
6	Normally-Closed
7	DATA OUT (-)

Audible Sounder Bases, Fire Mode

AB4G, AB4GT and AB4G-LF sounder bases

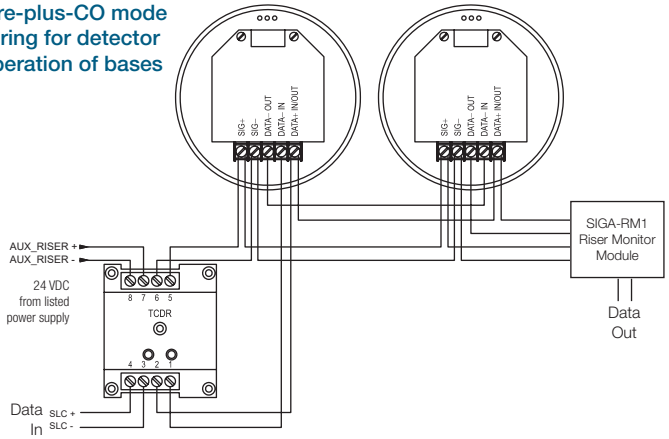


Audible Sounder Bases, Fire-plus-CO Mode

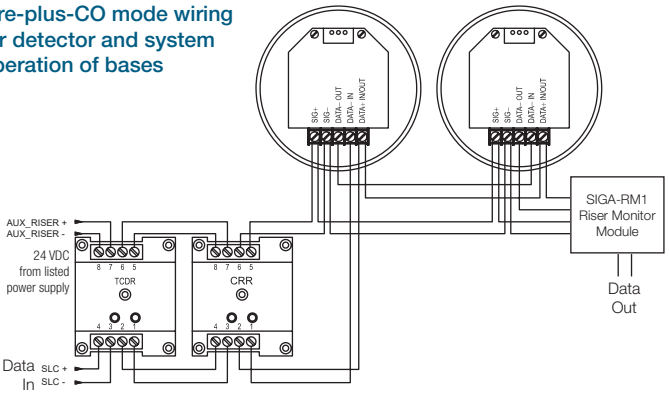
AB4GT and AB4G-LF sounder bases only.

These configurations require a SIGA-TCDR Temporal Pattern Generator to separate CO (TC4) and Fire (TC3) tone patterns.

Fire-plus-CO mode wiring for detector operation of bases



Fire-plus-CO mode wiring for detector and system operation of bases



LIFE SAFETY & INCIDENT MANAGEMENT

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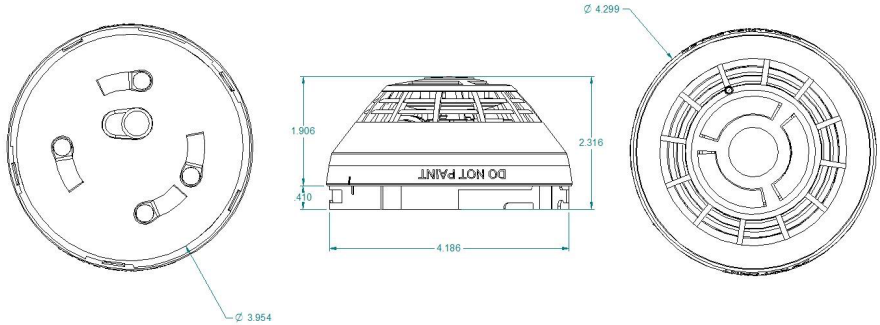
Dimensions



Specifications

Operating voltage	15.20 to 19.95 VDC
Normal operating current	32 µA
Alarm current	45 µA
Smoke Sensitivity Range	UL/ULC: 0.5 to 4.36 %/ft. (1.6 to 13.6 %/m) obscuration
Vibration level	10 to 35 Hz, with an amplitude of 0.01 in.
Wall mounting	12 in. (305 mm) max. from ceiling
Compatible bases	See Ordering Information
Compatible detector testers	Testifire 1000, Testifire 2000
Operating environment	32 to 120°F (0 to 49°C), 0 to 90% RH, noncondensing
Construction	High Impact Engineering Polymer, White
Storage temperature	-4 to 140°F (-20 to 60°C)
Environmental compensation	Automatic
UL CO alarm level per UL 2034, CAN/CSA 6.19	70 ppm 60 to 240 minutes 150 ppm 10 to 50 minutes; 400 ppm 4 to 15 minutes
UL CO false alarm level per UL 2034, CAN/CSA 6.19	30 ppm 30 days 70 ppm 60 minutes
Agency Listings, SIGA-OSCD	UL 268-7, UL 2075, CSFM. Evaluated to the CO alarm sensitivity limits of UL 2034. ULC Listed to CAN/ULC-S529 and CAN/CSA 6.19.

Warnings & Cautions

- This detector does not sense fires in areas where smoke cannot reach the detector. Smoke from fires in walls, roofs, or on the opposite side of closed doors may not reach the detector.
- Install per NFPA 72 National Fire Alarm and Signaling Code, NFPA 720 Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment, and UL 2075 Standard for Gas and Vapor Detectors and Sensors.

Ordering Information

Catalog Number	Description	Ship Wt. lbs (kg)
SIGA-OSCD	Multisensor Smoke and CO Detector	0.4 (0.16)
Compatible Bases		
SIGA-SB	Detector Mounting Base - Standard	0.2 (.09)
SIGA-SB4	4-inch Detector Mounting Base c/w Trim Skirt	
SIGA-RB	Detector Mounting Base w/Relay	
SIGA-RB4	4-inch Detector Mounting Base w/Relay, c/w Trim Skirt	
SIGA-IB	Detector Mounting Base w/Fault Isolator	
SIGA-IB4	4-inch Detector Mounting Base w/ Fault Isolator, c/w Trim Skirt	
SIGA-LED	Remote Alarm LED (not for EN54 applications)	
SIGA-AB4G-LF	Low Frequency Audible (Sounder) Base for CO and Fire Detectors	0.3 (0.15)
SIGA-AB4GT	Audible (Sounder) Base for CO and Fire Detectors	0.3 (0.15)
SIGA-TCDR	Tone Generator for Detector Sounder Bases with CO mode	0.2 (0.1)
SIGA-TS4	Trim Skirt (supplied with 4-inch bases)	0.1 (.04)
SIGA-RTA	Detector Removal Tool	
SIGA-VA	Detector Cleaning Tool	

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Sounder Bases

SIGA-AB4G, SIGA-AB4G-LF, SIGA-AB4GT, SIGA-TCDR

SIGA-AB4G-LF

SIGA-AB4GT

SIGA-AB4G

S853

7300-1657: 0222
7300-1657:0322
7300-1657:0308

Overview

The Signature Series AB4G sounder bases add audible output functions to any Signature Series detector. Bases can operate as independent local alarms, or as part of a zone or system alarm with synchronized audible output.

Three models provide a full range of features that meet application needs and mandated code-compliant requirements:

SIGA-AB4G bases provide sounder capability to Signature Series single-function smoke detectors. They are not intended for use with combination smoke/CO devices in Fire-plus-CO mode.

SIGA-AB4GT bases provide sounder capability to Signature Series single-function smoke detectors, as well as combination smoke/CO detectors when used with a SIGA-TCDR Temporal Pattern Generator.

SIGA-AB4G-LF bases provide 520 Hz low frequency sounder capability to Signature Series single-function smoke detectors, as well as combination smoke/CO detectors in Fire-plus-CO mode when used with a SIGA-TCDR Temporal Pattern Generator. The SIGA-AB4G-LF is suitable for applications requiring low frequency audible tones.

All bases are compatible with first and second generation Signature Series intelligent detectors when properly configured.

SIGA-AB4G sounder bases match the finish of Signature Series devices, and the sound output slots complement the air entry openings of the detector. The result is a compact unit with an attractive appearance.

Standard Features

- **Low frequency model available**
  Code-compliant 520 Hz output.
- **Temporal or steady tone**
  Jumper selects steady or synchronized temporal output.
- **High or low dB output**
  Jumper selects low or high dBA output.
- **Single or group operation**
  Optional polarity reversing module configures base for group alarm output.
- **UL268 and UL464 listed**
  UL listing under smoke detector and audible signal standards allows application as smoke alarm and/or audible signal.
- **Attractive installation**
  Flush mount to a wide selection of North American boxes or surface mount to optional custom-matched box.

Application

Signature Series AB4G sounder bases are for use with Signature Series detectors in applications where localized or group alarm signaling is required. They are listed by Underwriters Laboratories under the UL268 and UL464 standards, allowing their application where both life safety alarms and/or notification appliances are required.

Programming and Field Configuration

Each AB4G base uses the same address and programming label as the detector it supports.

AB4G sounder bases can be set to simply operate according to the state of its detector, or configured through system programming to operate in conjunction with all sounder bases on the same circuit. They can also be controlled by program rules. Available operating modes are determined by the system that supports the Signature data loop.

Bases may be configured in the field for either high or low dB output. When used for fire alarm-only applications (i.e.: not with CO detectors), AB4G bases may be configured for steady or temporal output. The default setting is high dB with temporal output.

Group Activation and Sychronization

AB4G sounder bases on the same circuit may be activated as a group or zone with the use of a SIGA-CRR polarity reversal module, and the group or zone may be synchronized audible output with the use of a G1M-RM signal master.

Combination Smoke/CO Applications

SIGA-AB4GT and SIGA-AB4G-LF audible bases may be used with combination smoke/CO detectors when a SIGA-TCDR is installed on the same Signature data loop.

The output of these bases is field-configurable for Fire Alarm mode, or Fire Alarm plus CO Alarm mode. The SIGA-AB4G-LF has two operating modes: fire output only, where the unit produces a T3 tone; and, a Fire-plus-CO mode. In the Fire-plus-CO mode, the NAC circuit requires a SIGA-TCDR module to generate and synchronize the TC3 and TC4 tones. These two distinctive tones are necessary to differentiate fire alarm signals from CO alarm signals.

Depending on the system supporting the Signature loop, the base can follow the state of the device it supports, or be controlled by program rules.

Low Frequency Applications

The low frequency model (SIGA-AB4G-LF), features a distinctive 520 Hz signal and is ideal for hotels, dormitories, and other commercial sleeping occupancies. This base can be set for low dB output with a jumper cut that reduces audible output by about 4 dB. For commerical sleeping rooms, most codes and standards require 75 dBA-fast at the pillow.

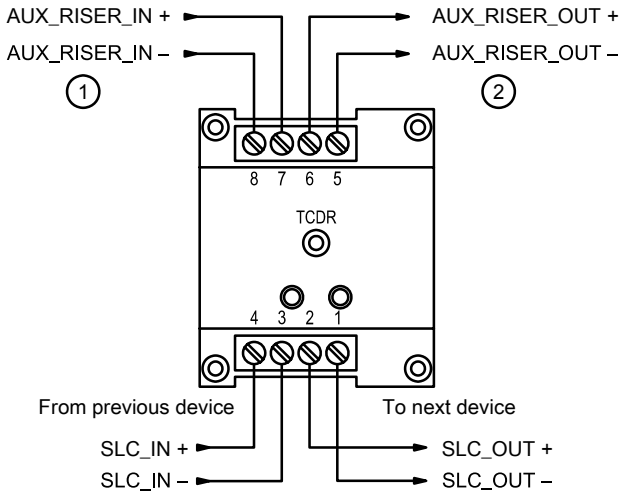
SIGA-TCDR Temporal Pattern Generator

The SIGA-TCDR Temporal Pattern Generator is an addressable device that generates CO and fire signal sound patterns for AB4GT and AB4G-LF sounder bases. The control panel sends synchronization and channel commands to the SIGA-TCDR; the channel selection determines the pattern. In the U.S. Channel 1 is TC3 and Channel 2 is TC4. In Europe, Channel 1 is TC4 and Channel 2 is TC3 (in case both channels are activated Channel 1 has priority). Other markets depend on local requirements.

Temporal patterns

Name	Code	Used for
TC4	NFPA 720	CO
TC3	NFPA 72	Fire

The SIGA-TCDR module uses two addresses on the signaling line circuit (SLC). Address 1 is tied to Channel 1; Address 2 is tied to Channel 2.



1. Use a power-limited and regulated 24 VDC primary or auxiliary power supply that is UL/ULC listed for fire protective signaling systems.
2. Power out to AB4GT sounder base or listed EOL relay and supervising module

Depending on the type of alarm, the panel can select the corresponding pattern and send the activation command to the SIGA-TCDR.

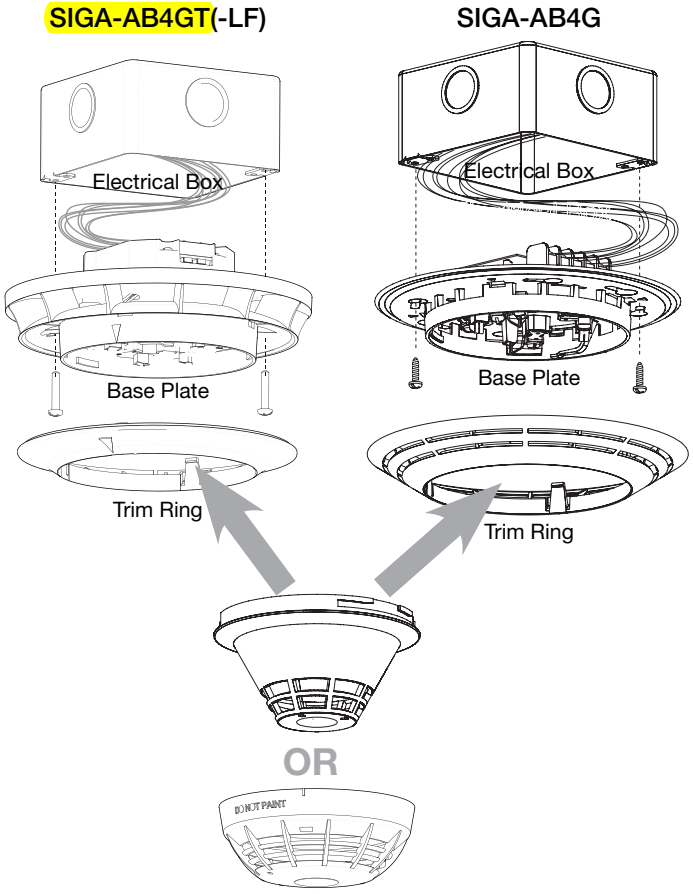
To control all sounder bases in the loop, use a SIGA-CRR module. The panel sends a signal to the SIGA-CRR causing it to reverse polarity. With the polarity on the riser reversed, all the sounder bases on this loop activate. The SIGA-TCDR maintains synchronization by processing the SYNC commands from the loop controller.

EDWARDS recommends that fire alarm systems and their devices always be installed in accordance with the latest recognized edition of national and local fire alarm codes.

Installation and Mounting

Flush Mounting

The sounder base flush mounts into 2-1/8 inch (54 mm) deep standard North American 4 inch square electric box, North American 4 x 4 inch octagonal concrete ring (mud box), and standard European 100 mm square electric boxes. The terminal block makes field wire connections fast and efficient . After wiring, a simple push and twist motion locks the Signature detector into the base.

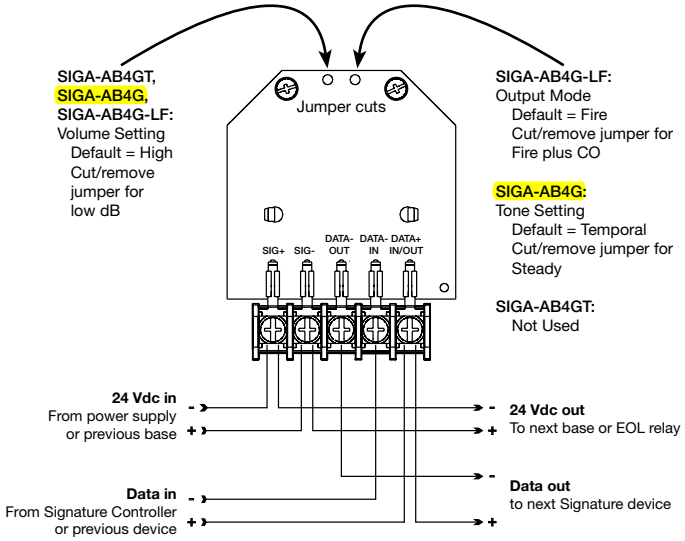


Surface Mounting

AB4G-SB
Optional Surface Box
(6.8” diameter x 1.8” deep)

AB4G-SB: When using the AB4G-SB surface mount box, install a reinforcing plate at every knockout. (Reinforcing plates are included with the box.) Remove the knockout first, and then slide the reinforcing plate into the plastic housing. After the plate is in place, install a conduit connector and nut (not supplied).

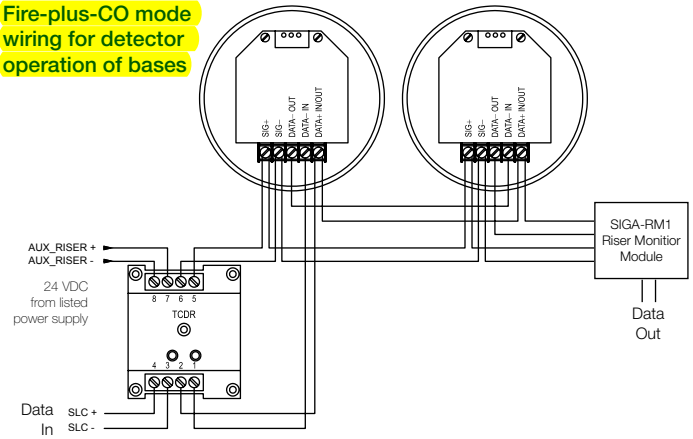
Configuration and Wiring



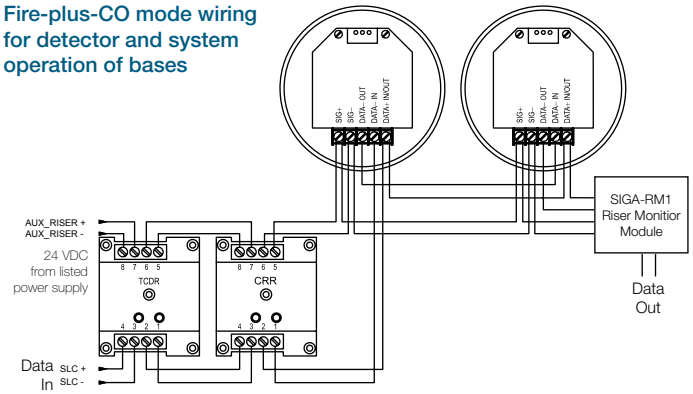
Typical Wiring, Fire-plus-CO mode

AB4GT, AB4G-LF sounder bases

Fire-plus-CO mode wiring for detector operation of bases



Fire-plus-CO mode wiring for detector and system operation of bases

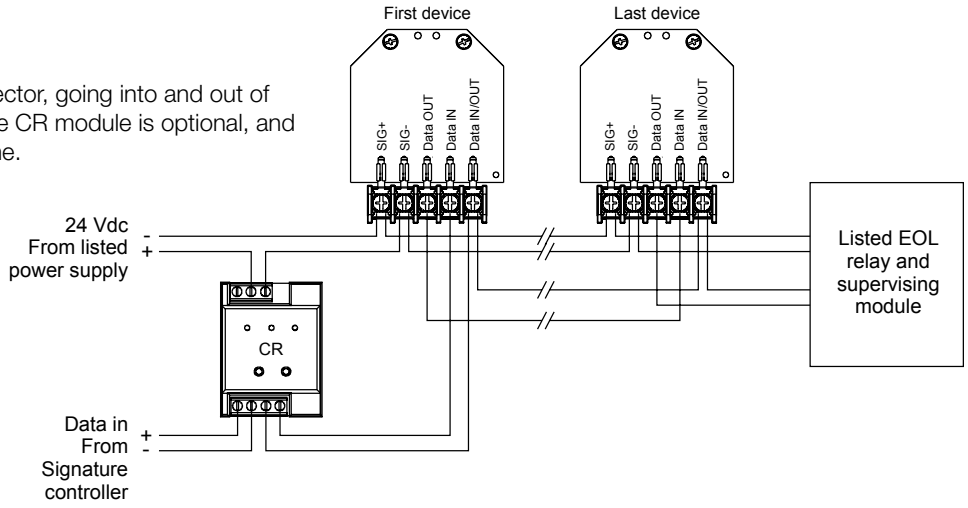


Typical Wiring, Fire mode

AB4G, AB4G-LF sounder bases

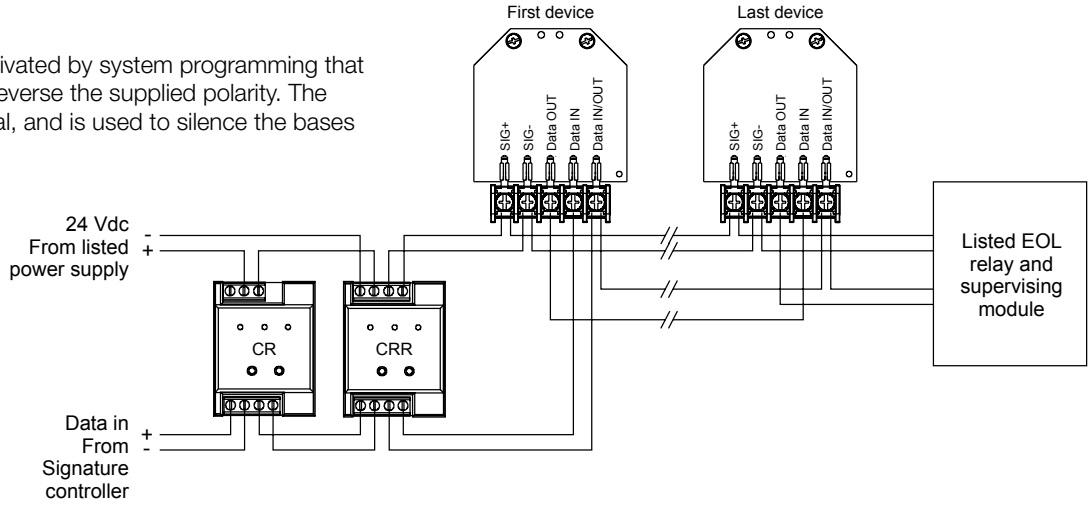
Detector operates the base

The base follows the state of the detector, going into and out of alarm with the detector. The Signature CR module is optional, and is used to silence the bases on the line.



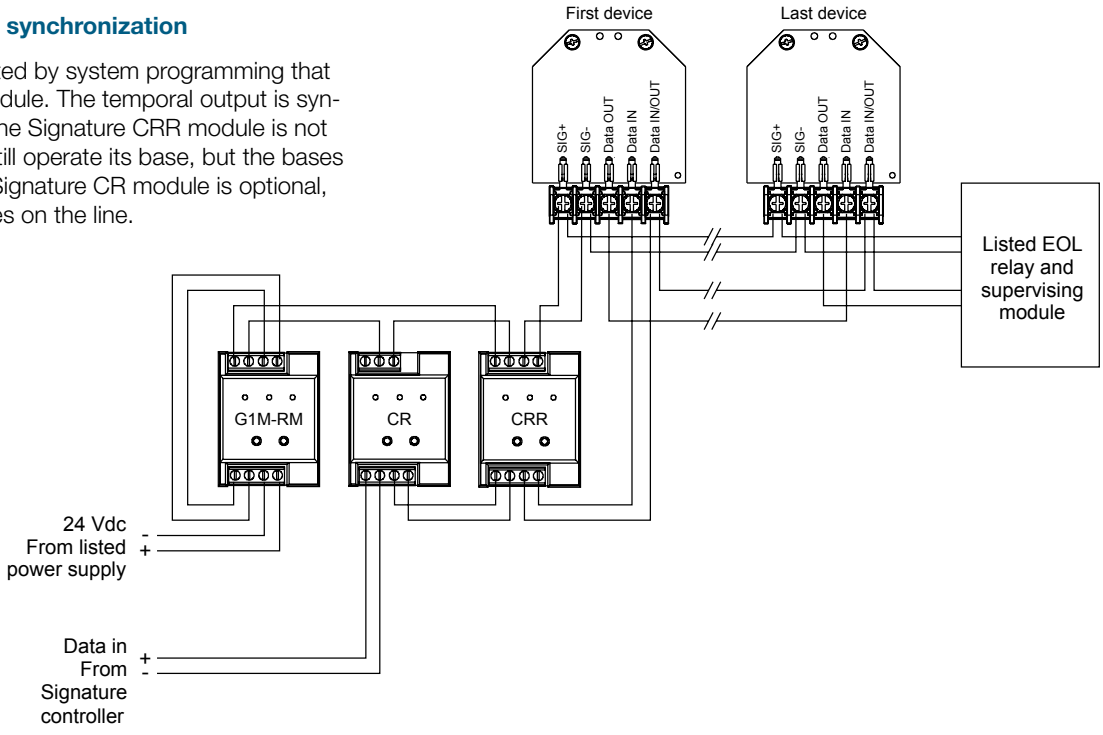
System turns on all bases

All bases on the line can be activated by system programming that triggers the Signature CRR to reverse the supplied polarity. The Signature CR module is optional, and is used to silence the bases on the line.



System turns on bases with synchronization

All bases on the line are activated by system programming that triggers the Signature CRR module. The temporal output is synchronized by the G1M-RM. If the Signature CRR module is not activated, each detector can still operate its base, but the bases will not be synchronized. The Signature CR module is optional, and is used to silence the bases on the line.



Sound Level Output, AB4G-LF

Signal	Low dBA	High dBA [1]
Nominal Sound Level [2]		
Steady/T3/T4	83	87
Per UL 268, UL 521, UL 2075 (reverberant) [3]		
TC3 (fire pattern)	76.3	80.8
TC4 (CO pattern)	73.0	77.4
Steady	80.9	85.3
Per UL 464 (reverberant) [3]		
TC3 (fire pattern)	70.3	74.8
TC4 (CO pattern)	67.0	71.4
Steady	74.9	79.3

[1] For NFPA 72 and NFPA 720 applications, the high dBA settings can be used for public mode evacuation.

[2] Anechoic chamber @ 10ft

[3] As measured in a UL reverberant room at 10 ft.

Operating Current, AB4G-LF

mA RMS UL/ULC ratings

	Low dBA			High dBA		
Signal	16 VDC	24 VDC	33 VDC	16 VDC	24 VDC	33 VDC
TC3	76.0	76.4	85.6	92.0	76.0	93.6
TC4	112.8	148.0	125.6	107.2	150.0	150.8
Steady	75.2	76.0	92.4	143.0	92.0	97.0

Sound Level Output, AB4G

Signal	Voltage	Low dBA	High dBA
Reverberant room per UL 464*			
Temporal	16 Vdc	71.5	78.1
	24 Vdc	75.5	80.7
	33 Vdc	78.5	83.1
Steady	16 Vdc	75.5	81.7
	24 Vdc	79.5	84.5
	33 Vdc	81.8	86.5
Reverberant room per UL 268			
Temporal	16 Vdc	77.5	84.1
	24 Vdc	81.5	86.7
	33 Vdc	84.5	89.1
Steady	16 Vdc	81.5	87.7
	24 Vdc	85.5	90.5
	33 Vdc	87.8	92.5

dBA = Decibels, A-weighted

*For UL 464 applications low dBA settings are for private mode only.

Operating Current (RMS), AB4G

Voltage	Low dBA	High dBA	Notes
16 VDC	17	28	VDC = Volts direct current, regulated and filtered
24 VDC	24	41	
33 VDC	31	52	
16 VFWR	41	48	VFWR = Volts full wave rectified
24 VFWR	51	60	
33 VFWR	60	66	

Sound Level Output, AB4GT

Signal	Voltage	Low dBA	High dBA
Reverberant room per UL 464 [1]			
TC3 (fire pattern)	16 VDC	80.5	85.2
TC4 (CO pattern)	16 VDC	73.9	77.5
Reverberant room per UL 268 and FM [2]			
TC3 (fire pattern)	16 VDC	86.5	90.8
TC4 (CO pattern)	16 VDC	77.5	84.1
Sound pressure level per CAN/ULC-S525 [3]			
Temporal	24 VDC	95	91
Steady	24 VDC	93	89

[1] For UL 464 applications, low dBA settings are for private mode only.
[2] For UL 268 applications, the high setting must be used for evacuation.
[3] Voltage is regulated and filtered.

Operating current (RMS), AB4GT

Low dBA	High dBA
31 mA	52 mA

LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

8985 Town Center Pkwy
Bradenton, FL 34202

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Specifications

	SIGA-AB4G	SIGA-AB4GT	SIGA-AB4G-LF
Riser operating voltage	16 to 33 VDC		
Operating Current	See tables on previous page		
Supervisory Current	DC = 1.46 mA, FWR = 2.15 mA	DC = 1.46 mA	DC = 6.0 mA
Default Output Volume	High dBA		
Default Tone	Temporal	Fire: Steady or TC3; Fire-plus-CO: TC3 or TC4	
Resonant frequency	3.2 kHz		520 Hz +/- 10%
Temporal pattern	0.5 s on, 0.5 s off, 0.5 s on, 0.5 s off, 0.5 s on, 1.5 s off, repeat cycle	As determined by the SIGA-TCDR... Fire: Steady or TC3; Fire-plus-CO: TC3 or TC4	
Compatible detectors	All Signature Series detectors		
Compatible electrical boxes	AB4G-SB surface box for audible base; 4 in. square by 2-1/8 in. (54 mm) deep box; 3-1/2 in. octagonal by 2-1/8 in. (54 mm) deep box; Standard European 100 mm² box		
Wire size	12 to 18 AWG (0.75 to 2.50 mm²)		
Base diameter	6.8 in. (173 mm)		
Base height from box	0.8 in. (21 mm)		1.4 in. (35 mm)
Maximum distance from ceiling	Wall mount — 12 in. (305 mm)		
Environment type	Indoor only		
Operating environment Temperature Relative humidity	 32 to 120°F (0 to 49°C) 0 to 93% noncondensing		
Storage temperature	–4 to 140°F (–20 to 60°C)		
Listings	UL, ULC, CSFM		UL, CSFM

Ordering Information

Catalog Number	Description	Ship Wt., lb. (kg)
SIGA-AB4G-LF	Low Frequency Sounder Base for CO and Fire Detectors	0.3 (0.15)
SIGA-AB4GT	Sounder Base for CO and Fire Detectors	0.3 (0.15)
SIGA-AB4G	Sounder Base for Fire Detectors	0.3 (0.15)

Related Equipment		
SIGA-TCDR	Temporal Pattern Generator	0.2 (0.1)
SIGA-MCRR	Polarity Reversal Relay (Plug-in UIO module)	0.18 (0.08)
SIGA-CRR	Polarity Reversal Relay (Standard mount module)	0.2 (0.1)
SIGA-MCR	Control Relay Module (Plug-in UIO module)	0.18 (0.08)
SIGA-CR	Control Relay Module (Standard mount module)	0.2 (0.1)
SIGA-RM1	Riser Monitor Module	0.2 (0.1)
G1M-RM	Signal Master (1-gang remote mount)	0.2 (0.1)
AB4G-SB	Surface Box for Audible Base	1.0 (0.45)

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OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

LISTING No.:	7275-1657:0513
CATEGORY:	7275 - COMBINATION SMOKE/CO DETECTOR-PHOTOELECTRIC TYPE
LISTEE:	EDWARDS, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL, 34202 Contact: Conover, Jewell (941) 739-4358 (941) 308-8123 Email: rhonda.micochero@carrier.com
DESIGN:	Models SIGA-OSCD, *SIGA-OSCD-NL, SIGI-OSCD, KI-OSCD, and KIR-OSCD: Intelligent Optical Smoke Detectors with CO Sensor. Analog addressable photoelectric smoke detector with CO detector. Refer to listee's data sheet for detailed product description and operational considerations.
RATING:	15.2-19.95 VDC
INSTALLATION:	In accordance with listee's printed installation instructions, NFPA 72, NFPA 720, applicable codes and ordinances, and in a manner acceptable to the authority having jurisdiction.
MARKING:	Listee's name, model number, electrical rating, and UL label. Models beginning with SIGA and SIGI are marked Edwards. Models beginning with KI and KIR are marked Kidde.
APPROVAL:	Listed as analog addressable photoelectric combination smoke and CO detectors for use with listee's separately listed compatible fire alarm control units. Model KI-OSCD is for use with listee's models VS1, VS2, and VS4 (7165-1657:0244); VM-1 (7165-1657:0309) fire alarm control units. Models SIGA-OSCD, and *SIGA-OSCD-NL is for use with listee's models EST4 (7165-1657:0508); EST3 (7165-1657:0186); iO64, iO1000 (7165-1657:0244); EST3X (7165-1657:0306) fire alarm control units. Refer to listee's installation, operation, and maintenance manual for details.

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NOTES:	The photoelectric type detectors are generally more effective at detecting slow, smoldering fires, which smolder for hours before bursting into flames. Sources of these fires may include cigarettes burning in couches or bedding. The ionization type detectors are generally more effective at detecting fast, flaming fires, which consume combustible materials rapidly and spread quickly. Sources of these fires may include paper burning in a waste container or a grease fire in the kitchen.

02-05-24 MH

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Date Issued: 05/03/2024

Listing Expires: 06/30/2025

Authorized By: **Michael Huang**, Program Coordinator
Fire Engineering & Investigations Division

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LISTING SERVICE

LISTING No.:	7300-1657:0307
CATEGORY:	7300 - FIRE ALARM CONTROL UNIT ACCESSORIES/MISC. DEVICES
LISTEE:	EDWARDS, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL, 34202 Contact: Conover, Jewell (941) 739-4358 (941) 308-8123 Email: rhonda.micochero@carrier.com
DESIGN:	Models SIGA-AB4GT, SIGI-AB4GT, KI-ABDT and GSA-SBT detector base and audible signal appliance. When the SIGA-AB4GT and SIGI-AB4GT are wired to listed model SIGA-TCDR module, units will be capable of sounding a four-tone temporal emergency evacuation signal. When the GSA-SBT and KI-ABDT are wired to listed model GSA-T3T4 or *FX-T3T4 module, units will be capable of sounding a four-tone temporal emergency evacuation signal. Model SIGI-AB4GT is similar to the SIGA-AB4GT with the exception that the addressing resistor has been removed. Model KI-ABDT is identical to the SIGA-AB4GT except for the model number. Refer to listee's data sheet for detailed product description and operational considerations.
RATING:	24 VDC *Regulated
INSTALLATION:	In accordance with listee’s printed installation instructions, applicable codes and ordinances and in a manner acceptable to the authority having jurisdiction.
MARKING:	Listee’s name, model number, and UL label. *Models SIGA-AB4GT and SIGI-AB4GT are under the Edwards brand. *Models KI-ABDT and GSA-SBT are under the Kidde brand.
APPROVAL:	Listed as a detector base for use with listee’s separately listed detector heads. Units are capable of sounding a three-tone temporal fire evacuation signal or a four-tone temporal emergency evacuation signal. Models SIGA-AB4GT and SIGI-AB4GT must be wired to listed Model SIGA-TCDR module (CSFM# 7300-1657:0308) in order to sound a four-tone temporal emergency evacuation signal. Models GSA-SBT and KI-ABDT must be wired to listed Model GSA-T3T4 module (CSFM# 7300-1657:0308) or FX-T3T4 (CSFM# 7300-1657:0507) in order to sound a four-tone temporal emergency evacuation signal. Model KI-ABDT is for use with separately listed KI and KIR series detector heads. Refer to listee’s Installation Instruction Manual for details.

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NOTES:	

*Rev 09-13-18 gt

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Date Issued: 05/03/2024

Listing Expires: 06/30/2025

Authorized By: **Michael Huang**, Program Coordinator
Fire Engineering & Investigations Division

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BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

LISTING No.:	7300-1657:0308
CATEGORY:	7300 - FIRE ALARM CONTROL UNIT ACCESSORIES/MISC. DEVICES
LISTEE:	EDWARDS, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL, 34202 Contact: Conover, Jewell (941) 739-4358 (941) 308-8123 Email: rhonda.micochero@carrier.com
DESIGN:	Models SIGA-TCDR and GSA-T3T4 Temporal Pattern Generator Module. Model SIGA-TCDR is intended to be used with the SIGA-AB4GT *or SIGA-AB4G-LF sounder bases. Model GSA-T3T4 is intended to be used with the GSA-SBT, SIGA-AB4G-LF* or SB4U-LF* sounder base. They regulate power on and off to the audible signal causing the audible signal to emit a tone pattern in compliance with the temporal evacuation signal for fire alarm and carbon monoxide alarm.
RATING:	24 VDC Regulated
INSTALLATION:	In accordance with listee's printed installation instructions, applicable codes and ordinances and in a manner acceptable to the authority having jurisdiction.
MARKING:	Listee's name, model number, and UL label.
APPROVAL:	Listed as a temporal pattern generator modules for use with listee's separately listed SIGA-AB4GT or GSA-SBTsounder bases (CSFM No. 7300-1657:0307) as described above. *The SIGA-TCDR or *GSA-T3T4 is also listed for use with the SIGA-AB4G-LF or SB4U-LF* sounder base (CSFM No. 7300-1657:0322) as described above. Refer to listee's Installation Instruction Manual for details.
NOTES:	

*Rev 06-23-15 gt

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Date Issued: 05/03/2024

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BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

Authorized By: **Michael Huang**, Program Coordinator
Fire Engineering & Investigations Division

Overview

The Genesis line of signals are among the smallest, most compact audible-visible emergency signaling devices in the world. About the size of a deck of playing cards, these devices are designed to blend with any decor.

Thanks to patented breakthrough technology, GE Security Genesis strobes do not require bulky specular reflectors and lenses. Instead, an exclusive cavity design conditions light to produce a highly controlled distribution pattern. Significant development efforts employing this new technology have given rise to a new benchmark in strobe performance – FullLight technology.

FullLight strobe technology produces a smooth light distribution pattern without the spikes and voids characteristic of specular reflectors. This ensures the entire coverage area receives consistent illumination from the strobe flash. As a result, Genesis strobes with FullLight technology go well beyond the minimum UL-required "T" pattern, significantly exceeding UL-1971 and ULC-S526 light distribution requirements.

Genesis strobes and horn-strobes offer 15 to 110 candela output, which is selectable with a conveniently-located switch on the side of the device. Models are also available that offer fixed 15/75 cd output. The candela output setting remains clearly visible even after final installation, yet it stays locked in place to prevent unauthorized tampering.

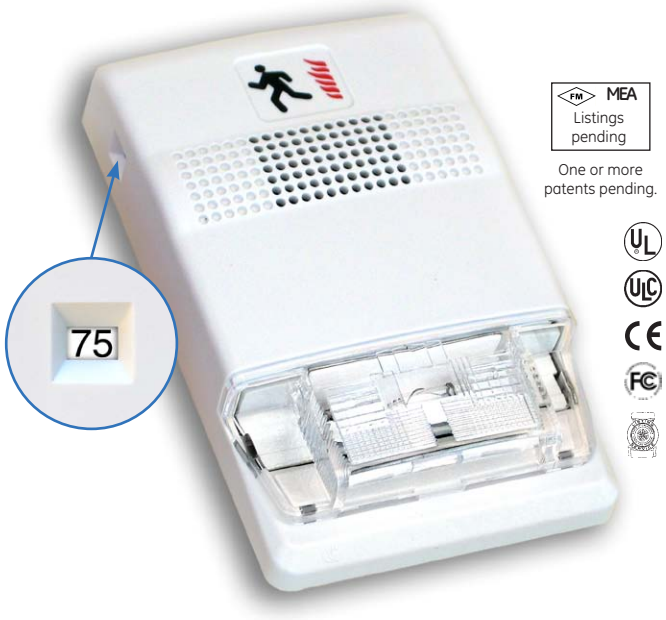
Genesis signals feature textured housings in architecturally neutral white or traditional fire red. An ingenious iconographic symbol indicates the purpose of the device. This universal symbol is code-compliant and is easily recognized by all building occupants regardless of what language they speak. Models with "FIRE" markings are also available.

Standard Features

- **Unique low-profile design**
  - The most compact UL-1971/ULC-S526 listed strobe available
  - Ultra-slim – protrudes less than one inch from the wall
  - Attractive appearance
  - No visible mounting screws
- **Four field-configurable options in one device**
  - Select 15, 30, 75, or 110 cd strobe output
  - Select high (default) or low dB horn output
  - Select temporal (default) or steady horn output
  - Select public mode flash rate (default) or private mode temporal flash
- **Fixed 15/75 cd model available**
- **Easy to install**
  - Fits standard 1-gang electrical boxes – no trim plate needed
  - Optional trim plate accommodates oversized openings
  - Pre-assembled with captive hardware
  - #12 AWG terminals – ideal for long runs or existing wiring
- **Unparalleled performance**
  - Industry's most even light distribution
  - Meets tough synchronizing standards for strobes
  - Single microprocessor controls both horn and strobe
  - Low current draw minimizes system overhead
  - Independent horn control over a single pair of wires
  - Highly regulated in-rush current
  - Multiple frequency tone improves wall penetration
  - Industry's first temporal strobe output

Field Configurable Horns and Strobes

Genesis Series



FM MEA Listings pending

One or more patents pending.

Application

Genesis strobes are UL 1971-listed for use indoors as wall-mounted public-mode notification appliances for the hearing impaired. Prevailing codes require strobes to be used where ambient noise conditions exceed 105 dBA (87dBA in Canada), where occupants use hearing protection, and in areas of public accommodation as defined in the *Americans with Disabilities Act (see application notes – USA)*.

Combination horn-strobe signals must be installed in accordance with guidelines established for strobe devices.

Strobes

Although all Genesis strobes are self-synchronizing, when installed with an optional synchronization module, strobe flashes from devices on the same circuit synchronize to within 10 milliseconds of each other *indefinitely*. This exceeds the two-hour minimum specified in the UL standards. Only one synchronization module is required per circuit.

The following guidelines are based on ANSI/NFPA 72 *National Fire Alarm Code* (1999). When applied and installed in accordance with that code, GE Security strobes meet or exceed the illumination produced by the ADA-specified 75 candela (cd) strobe at 50 feet.*

Non-Sleeping Rooms and Corridors: GE Security strobes rated at less than 110 cd per UL 1971 are intended for use in non-sleeping areas only. Install with the bottom of the device at least 80 inches (2.0 m) and no more than 96 inches (2.4 m) above the finished floor. No point in any space (including corridors) required to have strobes should be more than 50 feet (15.2 m) from the signal (in the horizontal plane).

Non-Sleeping Rooms	Use One Wall Mounted Model:
Up to 20' x 20' (6.1 x 6.1m)	One 15 cd strobe
Up to 30' x 30' (9.1 x 9.1m)	One 30 cd or two 15 cd strobes
Up to 40' x 40' (12.2 m x 12.2 m)	One 75 cd or two 30 cd strobes
Up to 50' x 50' (15.2 x 15.2m)	One 110 cd or two 75 cd strobes

Corridors	Wall Mounted - Model:
Any Length x Max. 20' (6.1m) Wide	15 cd strobes spaced at 100' (30.5 m) max. Strobes must be placed within 15' (4.5m) of each end of the corridor.

** ADA suggests using 75 cd strobes throughout an area, with spacing that never exceeds 50 ft from the strobe to any point in the protected space.*

Sleeping rooms: GE Security 110 cd strobes are intended for use in sleeping rooms and should be installed along with a smoke detector. It must be wall mounted at least 80" (2.03 m) above floor level, but no closer than 24" (610 mm) to the ceiling. The distance from the strobe to the pillow must not exceed 16' (4.8 m).

Sleeping Rooms	Use One Wall Mounted Model:
Any Size	110 cd within 16 feet of pillow

For 177 cd ceiling horn-strobes, please refer to data sheet 85001-0559.

Horns

Genesis horn output reaches as high as 99 dB and features a unique multiple frequency tone that results in excellent wall penetration and an unmistakable warning of danger. Horns may be configured for either coded or non-coded signal circuits. They can also be set for low dB output with a jumper cut that reduces horn output by about 5 dB.

The suggested sound pressure level for each signaling zone used with alert or alarm signals is at least 15 dB above the average ambient sound level, or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 feet (1.5 m) above the floor. The average ambient sound level is, A-weighted sound pressure measured over a 24-hour period.

Doubling the distance from the signal to the ear will theoretically result in a 6 dB reduction of the received sound pressure level. The actual effect depends on the acoustic properties of materials in the space. A 3 dBA difference represents a barely noticeable change in volume.

Application Notes - USA

Audible signals in the public mode should never have a sound level less than 75 dBA at 10' (3 m) per NFPA 72. Signals cannot exceed 120 dBA per ADA and NFPA 72 at the minimum hearing distance to audible appliance.

Strobe and combination horn/strobe devices should be installed with the bottom of the device at least 80 inches (2.0 m) and no more than 96 inches (2.4 m) above the finished floor. Horns should be installed with their tops not less than 6 inches (152 mm) below the ceiling and not less than 90 inches (2.3 m) above the finished floor.

Strobes must be used to supplement audible signals wherever the average ambient sound level exceeds 105 dBA. Combination audible/visual signals must be installed in accordance with NFPA guidelines established for strobes.

ADA requires visible signals in the following areas:

- rest rooms, meeting rooms, and other common use areas.
- sleeping rooms intended for use by persons with hearing impairment (in accordance with Title 1 of ADA).
- work areas used by a person with a hearing impairment (per Title 1 of ADA).

Application Notes - Canada

(Based in part on 1995 Canada National Building Code)

The fire alarm signal sound pressure level shall not exceed 110 dBA in any normally occupied area. The sound pressure level from an audible signal in a floor area used for occupancies other than residential occupancies shall not be less than 10 dBA above ambient levels, and never less than 65 dBA. In sleeping rooms the sound pressure level from an audible signal shall not be less than 75 dBA when any intervening doors between the device and the sleeping room are closed. Audible signal devices shall be installed not less than 1.8 m to the center of the device above the floor (per CAN/ULC S524).

The fire alarm audible signal shall be supplemented by fire alarm strobes in any floor area where the ambient noise level exceeds 87 dBA, or where the occupants of the floor area use ear protective devices, are located within an audiometric booth, or are located within sound insulating enclosures. This also applies to assembly occupancies in which music and other sounds associated with performances could exceed 100 dBA

Strobes shall be installed in a building so that the flash from one device is visible throughout the floor area or portion thereof in which they are installed. For maximum safety, GE Security recommends that strobes be installed as per the guidelines shown here under Strobe Spacing.

Installation

Genesis horns and strobes mount to any standard one-gang surface or flush electrical box. Matching optional trim plates are used to cover oversized openings and can accommodate one-gang, two-gang, four-inch square, or octagonal boxes, and European 100 mm square.

Genesis Horn/Strobe with optional trim plate

All Genesis signals come pre-assembled with captive mounting screws for easy installation. Two tabs at the top of the signal unlock the cover to reveal the mounting hardware. The shallow depth of Genesis devices leaves ample room behind the signal for extra wiring. Once installed with the cover in place, no mounting screws are visible.

Field Configuration

Temporal horn and horn-strobe models are factory set to sound in a **three-pulse temporal pattern**. Units may be configured for use with coded systems by cutting a jumper on the circuit board. This results in a **steady output** that can be turned on and off (coded) as the system applies and removes power to the signal circuit. A Genesis Signal Master is required when horn-strobe models are configured for coded systems. Non-temporal, horn-only models sound a steady tone.

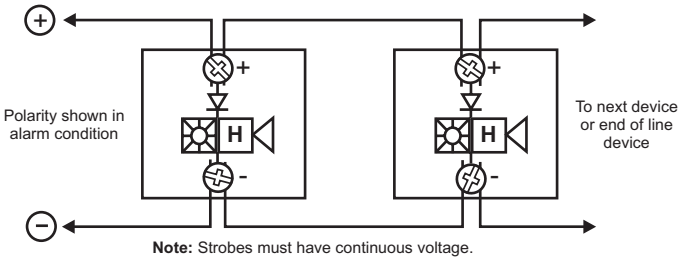
Genesis strobes and horn-strobes are shipped from the factory ready for use as **UL 1971 compliant** signals for public mode operation. These signals may be configured for **temporal flash** by cutting a jumper on the circuit board. This battery-saving feature is intended for private mode signaling only.

Genesis strobes and horn-strobes may be set for **15, 30, 75, or 110 candela output**. The output setting is changed by simply opening the device and sliding the switch to the desired setting. The device does not have to be removed to change the output setting. The setting remains visible through a small window on the side of the device after the cover is closed.

Horns and horn-strobes are factory set for **high dB output**. **Low dB output** may be selected by cutting a jumper on the circuit board. This reduces the output by about 5 dB.

Wiring

Field wiring terminals accommodate #18 to #12 AWG (0.75 mm² to 2.5 mm²) wiring. Horns, strobes, and combination horn-strobes are interconnected with a single pair of wires as shown below.



Note: Strobes must have continuous voltage.

WARNING: These devices will not operate without electrical power. As fires frequently cause power interruptions, we suggest you discuss further safeguards with your local fire protection specialist.

These visual signal appliances' flash intensity may not be adequate to alert or waken occupants in the protected area. Research indicates that the intensity of strobe needed to awaken 90% of sleeping persons is approximately 100 cd. GE Security recommends that strobes in sleeping rooms be 110 cd minimum.

Current Draw

Strobes, Horn-Strobes

Multi-cd Wall Strobes (G1-VM)

UL Rating	15 cd*	30 cd*	15/75 cd**	75 cd*	110 cd*
	RMS	RMS	RMS	RMS	RMS
16 Vdc	103	141	106	255	311
16 Vfwr	125	179	170	346	392

*G1-VM multi-cd; **G1F-V1575 fixed 15/75 cd

Typical Current	15 cd		30 cd		15/75		75 cd		110 cd	
	RMS	Mean	RMS	Mean	RMS	Mean	RMS	Mean	RMS	Mean
16 Vdc	85	79	127	124	150	140	245	243	285	283
20 Vdc	71	66	98	96	123	114	188	186	240	238
24 Vdc	59	55	82	80	104	97	152	150	191	190
33 Vdc	46	44	64	63	84	77	112	111	137	136
16 Vfwr	119	64	169	97	223	126	332	203	376	240
20 Vfwr	103	51	143	76	189	100	253	150	331	198
24 Vfwr	94	44	129	65	169	85	218	121	262	152
33 Vfwr	87	37	112	52	148	68	179	89	205	106

Wall Temporal Horn-strobes – High dB Setting

UL Rating	15 cd*	30 cd*	75 cd*	110 cd*	15/75 cd**
	RMS	RMS	RMS	RMS	RMS
16 Vdc	129	167	281	337	172
16 Vfwr	176	230	397	443	269

*G1-HDVM multi-cd
**G1F-HDV1575 fixed 15/75 cd

Typical Current	15 cd		30 cd		15/75		75 cd		110 cd	
	RMS	Mean	RMS	Mean	RMS	Mean	RMS	Mean	RMS	Mean
16 Vdc	102	89	135	129	160	152	246	242	309	305
20 Vdc	88	77	109	104	137	129	193	190	248	243
24 Vdc	81	71	94	90	122	114	161	158	203	200
33 Vdc	74	64	72	74	106	98	124	121	154	151
16 Vfwr	144	77	182	106	247	143	352	212	393	249
20 Vfwr	141	68	162	87	220	120	274	158	362	210
24 Vfwr	136	65	152	76	203	106	235	133	282	165
33 Vfwr	125	54	144	65	196	94	201	101	232	123

Wall Temporal Horn-strobes – Low dB Setting

UL Rating	15 cd*	30 cd*	75 cd*	110 cd*	15/75 cd**
	RMS	RMS	RMS	RMS	RMS
16 Vdc	122	160	274	330	146
16 Vfwr	162	216	383	429	231

*G1-HDVM multi-cd
**G1F-HDV1575 fixed 15/75 cd

Typical Current	15 cd		30 cd		15/75		75 cd		110 cd	
	RMS	Mean	RMS	Mean	RMS	Mean	RMS	Mean	RMS	Mean
16 Vdc	96	84	130	124	158	149	243	240	302	297
20 Vdc	79	70	104	99	133	124	189	186	241	237
24 Vdc	68	61	88	84	119	110	156	154	197	193
33 Vdc	56	52	71	68	100	93	118	116	146	143
16 Vfwr	128	69	180	104	241	139	344	204	389	244
20 Vfwr	118	60	157	84	213	115	266	156	343	200
24 Vfwr	113	54	144	74	195	101	230	128	279	161
33 Vfwr	112	48	137	64	182	87	197	99	226	117

Horns

Wall Temporal Horns (G1-HD)

UL Rating	High dB (RMS)	Low dB (RMS)
16 Vdc	26	19
24 Vdc	36	27
33 Vdc	41	33
16 Vfwr	51	37
24 Vfwr	69	52
33 Vfwr	76	70

Typical Current	High dB		Low dB	
	RMS	Mean	RMS	Mean
16 Vdc	22	17	17	14
20 Vdc	24	19	19	16
24 Vdc	27	21	22	18
33 Vdc	32	25	26	22
16 Vfwr	34	15	30	14
20 Vfwr	40	19	34	16
24 Vfwr	45	21	38	18
33 Vfwr	52	24	47	22

Wall Horns (G1-P)

UL Designation	Voltage Range	Max. Current, RMS
Regulated 24 Vdc	16 - 33 Vdc	13 mA
24 fwr	16 - 33 Vfwr	11 mA

Typical Current	RMS	Mean
24 Vdc	10	10
24 Vdc	11	11
31 Vdc	12	12
20 Vfwr	9	8
24 Vfwr	10	9

Notes and Comments

1. Current values are shown in mA.
2. UL Nameplate Rating can vary from Typical Current due to measurement methods and instruments used.
3. GE Security recommends using the Typical Current for system design including NAC and Power Supply loading and voltage drop calculations.
4. Use the Vdc RMS current ratings for filtered power supply and battery AH calculations. Use the Vfwr RMS current ratings for unfiltered power supply calculations.
5. Fuses, circuit breakers and other overcurrent protection devices are typically rated for current in RMS values. Most of these devices operate based upon the heating affect of the current flowing through the device. The RMS current (not the mean current) determines the heating affect and therefore, the trip and hold threshold for those devices.
6. Our industry has used 'mean' currents over the years. However, UL will direct the industry to use the 2004 RMS values in the future.

dBA output

Temporal Horns, Horn-strobes (G1-HD, G1-HDVM series)

High dB Setting	UL464		Average	Peak
	Temporal	Steady	Temporal/ Steady	Temporal/ Steady
16 Vdc	81.4	85.5	91.4	94.2
24 Vdc	84.4	88.6	94.5	97.6
33 Vdc	86.3	90.4	96.9	99.5

Low dB Setting	UL464		Average	Peak
	Temporal	Steady	Temporal/ Steady	Temporal/ Steady
16 Vdc	76.0	80.1	86.3	89.2
24 Vdc	79.4	83.5	89.8	92.5
33 Vdc	82.1	86.5	92.5	95.3

Steady Tone Horns (G1-P series)

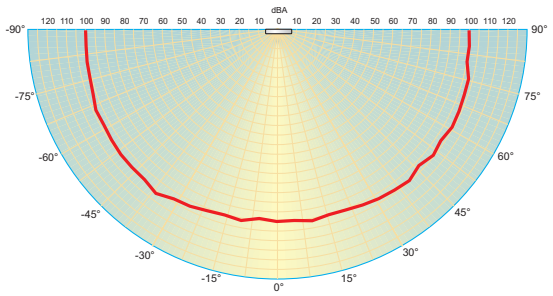
	UL464	Average	Peak
16 Vdc	77 dBA, min	85 dBA	91 dBA
16 Vfwr	77 dBA, min	85 dBA	91 dBA

Notes

1. All values shown are dBA measured at 10 feet (3.01m).
2. UL464 values measured in reverberation room.
3. Average and Peak values are measured in anechoic chamber.

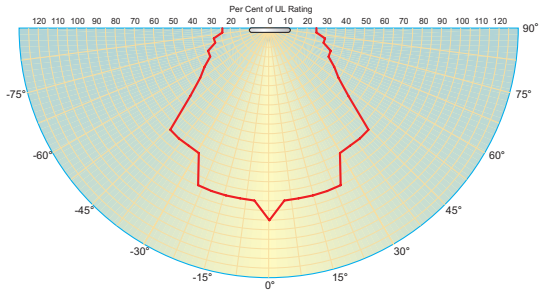
Average Sound Output (dBA)

(High dB setting, anechoic, 24V, measured at 10ft)



Light output - (effective cd)

Percent of UL rating versus angle



Specifications

Housing	Red or white textured UV stabilized, color impregnated engineered plastic. Exceeds 94V-0 UL flammability rating.
Lens	Optical grade polycarbonate (clear)
Mounting (indoor wall mount only)	Flush mount: 2½ inch (64 mm) deep one-gang box Surface mount: Model 27193 surface mount box, wiremold box, or equivalent surface-mount box With optional trim plate: One-gang, two-gang, four-inch square, octagonal, or European single-gang box
Wire connections	Screw terminals: single input for both horn and strobe. #18 to #12 AWG (0.75 mm² to 2.5 mm²) wire size
Operating environment	Indoor only: 32-120°F (0-49°C) ambient temperature. 93% relative humidity
Agency listings/approvals	UL 1971, UL 1638, UL 464, ULC S525, ULC S526, CSFM, CE, FCC, (MEA, FM pending). (All models comply with ADA Code of Federal Regulation Chapter 28 Part 36 Final Rule.)
Dimensions (HxWxD)	Signal: 4-1/2" x 2-3/4" x 13/16" (113 mm x 68 mm x 21 mm) Trimplate: 5" (127 mm); Height – 5-7/8" (149 mm); Depth – ½" (13 mm)
Operating voltage	G1-HD series temporal-tone horns: non-coded, filtered 16-33 Vdc or unfiltered 16-33 Vdc FWR (or coded when horn set to steady tone) G1-HDVM series temporal-tone horn-strobes: non-coded, filtered 16-33 Vdc or unfiltered 16-33 Vdc FWR (or coded (audible NAC only) when used with optional G1M Genesis Signal Master) G1-VM series strobes: non-coded, filtered 16 - 33 Vdc or unfiltered 16-33 Vdc FWR G1-P series steady-tone horns: coded or non-coded, filtered 20-31 Vdc or unfiltered 20-27 Vfwr
Strobe output rating	UL 1971, UL 1638, ULC S526: selectable 15 cd, 30 cd, 75 cd, or 110 cd output UL 1971: 15 cd (fixed 15/75 cd models) UL 1638, ULCS526: 75 cd (fixed 15/75 cd models)
Strobe flash rate	G1-VM strobes and G1-HDVM series temporal-tone horn-strobes: one flash per second synchronized with optional G1M Genesis Signal Master indefinitely within 10 milliseconds (or self-synchronized within 200 milliseconds over thirty minutes on a common circuit without G1M Genesis Signal Master) Temporal setting (private mode only): synchronized to temporal output of horns on same circuit
Compatible synchronization modules*	G1M, G1M-RM, SIGA-CC1S, SIGA-MCC1S
Horn pulse rate	G1-HD temporal-tone horns and G1-HDVM series temporal-tone horn-strobes: temporal rate synchronized with optional G1M Genesis Signal Master indefinitely within 10 milliseconds (or self-synchronized within 200 milliseconds over thirty minutes on a common circuit without G1M Genesis Signal Master) G1-P steady-tone horns: continuous, steady tone only
Temporal audible pattern	½ sec ON, ½ sec OFF, ½ sec ON, ½ sec OFF, ½ sec ON, 1½ sec OFF, then repeat cycle

* Not compatible with G1-P Series horns.

GE
Security

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F 866-503-3996

Canada
T 519 376 2430
F 519 376 7258

Asia
T 852 2907 8108
F 852 2142 5063

Australia
T 61 3 9259 4700
F 61 3 9259 4799

Europe
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F 32 2 721 86 13

Latin America
T 305 593 4301
F 305 593 4300

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Ordering Information

Catalog Number		Description	Ship Wt. lbs (kg)
White Finish	Red Finish		
G1-HDVM	G1R-HDVM	Genesis Horn-Strobe (selectable 15, 30, 75, or 110 cd output, selectable high/low dB output)	0.25 (0.11)
G1-VM	G1R-VM	Genesis Strobe (selectable 15, 30, 75, or 110 cd output)	
G1-HD	G1R-HD	Genesis Temporal Horn (selectable high/low dB output)	
G1-P	G1R-P	Genesis Steady Horn (not compatible with Genesis Signal Master)	
G1F-HDVM	G1RF-HDVM	Genesis Horn-Strobe (selectable 15, 30, 75, or 110 cd output, selectable high/low dB output) – with "FIRE" marking	
G1F-VM	G1RF-VM	Genesis Strobe (selectable 15, 30, 75, or 110 cd output) – with "FIRE" marking	
G1F-HD	G1RF-HD	Genesis Temporal Horn (selectable high/low dB output) – with "FIRE" marking	
G1F-P	G1RF-P	Genesis Steady Horn with "FIRE" marking (not compatible with Genesis Signal Master)	
G1F-HDV1575	G1RF-HDV1575	15/75 cd temporal horn-strobe, hi/lo dB-24V – with "FIRE" marking (see note 1)	
G1F-V1575	G1RF-V1575	15/75 cd strobe – with "FIRE" marking (see note 1)	
Mounting Accessories			
G1T	G1RT	Genesis Trim Plate (for two-gang or 4" square boxes)	0.15 (0.7)
G1T-FIRE	G1RT-FIRE	Genesis Trim Plate (for two-gang or 4" square boxes) with "FIRE" markings	0.15 (0.7)
27193-16	27193-11	One-gang surface mount box	1 (0.4)
Synchronization Modules			
G1M		Genesis Signal Master – Snap-on Mount	0.2 (0.1)
G1M-RM		Genesis Signal Master – Remote Mount (1-gang)	
SIGA-CC1S		Intelligent Synchronization Output Module (2-gang)	0.5 (0.23)
SIGA-MCC1S		Intelligent Synchronization Output Module (Plug-in UIO)	0.18 (0.08)

Note 1: These 15/75 cd models provide fixed output and are not multi-candela devices. The 15 cd output component complies with UL1971, while the 75 cd output component complies with UL 1638.

Genesis Horn-Strobes may be ordered in red or white, with or without 'FIRE' marking. Order matching trim plates separately.

imagination at work

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

LISTING No.:	7125-1657:0202
CATEGORY:	7125 - FIRE ALARM DEVICES FOR THE HEARING IMPAIRED
LISTEE:	EDWARDS, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL, 34202 Contact: Conover, Jewell (941) 739-4358 (941) 308-8123 Email: rhonda.micochero@carrier.com
DESIGN:	Models "EST" G1-HV15, -HV30, -HV60, -HV-75, G1-HOV15, -HOV30, -HOV60, -HOV75, -HOV110, GIF-HOV15, -HOV30, -HOV60, -HOV75, -HOV110, GIRF-HOV15, -HOV30, -HOV60, -HOV75, -HOV110, G1-HDVM, G1R-HDVM, G1F-HDVM, G1RF-HDVM, GC-HDVM, GC-HDVMH, GCF-HDVM, GCFR-HDVM, GCF-HDVMH, G1-HDV1575, G1R-HDV1575, G1F-HDV1575, and G1RF-HDV1575 horn/strobes with or without suffixes -R and -F. Models with HO as part of the model number are a high audible output version of the standard output model. Refer to listee's data sheet for additional detailed product description and operational considerations.
RATING:	Electrical: 24-30 Vdc 16-33 Vdc/Vfwr - Models G1-HDVM, G1R-HDVM, G1F-HDVM, G1RF-HDVM, GC-HDVM, GC-HDVMH, GCF-HDVM, GCFR-HDVM, GCF-HDVMH, G1-HDV1575, G1R-HDV1575, G1F-HDV1575, G1RF-HDV1575 Candela: 15cd, 30cd, 60cd, 75cd, 110cd 15 - 95 multi-cd - Models GC-HDVM, GCF-HDVM, GCFR-HVDM 95-177 multi-cd - Models GC-HDVMH, GCF-HDVMH 15/75cd - Models G1-HDV1575, G1R-HDV1575, G1F-HDV1575, G1RF-HDV1575
INSTALLATION:	In accordance with listee's printed installation instructions, applicable codes & ordinances and in a manner acceptable to the authority having jurisdiction.
MARKING:	Listee's name, model number, electrical/candela rating, and UL label.

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING & INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

APPROVAL:	Listed as horns and horn/strobe lights for use with separately listed compatible fire alarm control units. Suitable for use with Audible Signal Appliances (CSFM Listing No. 7135-1657:230). For indoor use and wall mount only. Models GC-HDVM, *GC-HDVMH, GCFR-HDVM, GCF-HDVM and *GCF-HDVMH for ceiling or wall mount. Refer to listee's Installation Instruction Manual for details. These units can generate a distinctive three-pulse Temporal Pattern Fire Alarm Evacuation Signal (for total evacuation) in accordance with NFPA 72, 2002 Edition.
NOTES:	Formerly 7125-1591:202

*REV 08-20-13 gt

This listing is based upon technical data submitted by the applicant. OSFM Fire Engineering staff has reviewed the test results and/or other data but does not make an independent verification of any claims. This listing is not an endorsement or recommendation of the item listed. This listing should not be used to verify correct operational requirements or installation criteria. Refer to listee's data sheet, installation instructions and/or other suitable information sources.

Date Issued: 05/03/2024

Listing Expires: 06/30/2025

Authorized By: **Michael Huang**, Program Coordinator
Fire Engineering & Investigations Division

POWER LIMITED CABLES

Paige fire alarm cables are designed for a wide range of applications in low voltage fire alarm systems. They carry the following listings in common:

NFPA® MEMBER 2006-2007

- 75°C Temperature rated
- 300 volt
- UL Listed and Canadian UL Listed
- Most are dual listed to also meet NEC Articles 760 permitting cross application in sound and security systems
- Meet NEC Articles 800 and 725

Dual NEC / UL Listings for cables in this section:

Gauge Sizes	Non-plenum	Non-plenum Riser	Plenum
24 AWG – 16 AWG	FPL/CM	FPLR/CMR	FPLP/CMP
14 AWG – 12 AWG	FPL/CL3	FPLR/CL3R	FPLP/CL3P

For additional information on NEC / UL see p. 88 - 91 in the technical section.

Additional features of cables in this section:

- Twisted conductors for reduced cross-talk
- ASTM bare copper conductors
- Premium grade PVC for improved strength and flexibility
- When shielded, corrosion resistant tinned copper drain wires are used
- Color-coded conductors

CABLES INSTALLED IN RACEWAY

For maximum installation flexibility, Paige offers a series of TFN and THHN, 600 volt cables, permitted for use in power limited fire alarm circuits under NEC Article 760.52 "Wiring Methods and Materials on Load Side of the PLFA Power Source" and sub-section 760.52(A) "NPLFA Wiring Methods and Materials". When installed in accordance with NEC Chapter 3, these cables deliver a number of speedy installation advantages:

- Rated TFN (18 and 16 AWG) or THHN (14 and 12 AWG)
- 90°C dry / 75°C wet
- Rated 600 volts
- Available in singles or Easy-pull pre-twisted, color-coded pairs
- Available in flexible metal armor

CONDUCTOR COLOR CHART

Color Code 2	
1	Black
2	Red
3	Brown
4	Blue
5	Orange
6	Yellow
7	Purple
8	Green
9	Red / Black
10	Red / White
11	Red / Green
12	Red / Blue

Color Code 7		
Cond #	18-16 AWG	14-12 AWG
1	Black	Black
2	Red	White
3	Blue	Red
4	Orange	Blue

Conductor Colors					
BE	Beige	GR	Gray	RE	Red
BK	Black	OR	Orange	VI	Violet
BL	Blue	PK	Pink	WH	White
BR	Brown	PR	Purple	YW	Yellow
GN	Green				

FIRE ALARM SYSTEMS

TFN or THHN

NON-PLENUM

ASTM Solid Bare Copper
PVC & Nylon Insulation
Twisted/Cabled Conductors
Unjacketed

PAIRED, UNJACKETED, UNSHIELDED
600V
Low Capacitance

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	CONDUCTOR COLORS
454318BR	18 SOLID	2	.165″	BK / RE
454316BR	16 SOLID	2	.190″	BK / RE
454314BR	14 SOLID	2	.224″	BK / RE

THHN

ASTM Bare Copper
PVC Insulation
Nylon Jacket

SINGLE CONDUCTOR, UNSHIELDED
600V

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	POSSIBLE USE & APPLICATIONS
700151	14 19 x 26	1	.112″	BK, BL, BR, GN, PK, RE, VI, WH, YW
741223	12 SOLID	1	.121″	GN

FIRE ALARM SYSTEMS

FPLR

NON-PLENUM

ASTM Bare Copper
High Grade PVC Insulation
Twisted/Cabled Conductors
Riser Rated Red PVC Jacket

MULTI-CONDUCTOR, UNSHIELDED

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	POSSIBLE USE & APPLICATIONS
454606Axx	22 SOLID	2	.123″	I/O SLC Loop Addressable Devices Power Horns/Strobes Panel Interconnects Speaker
454703Axx	18 SOLID	2	.161″	
454704Axx	18 SOLID	4	.175″	
454705ARE	18 SOLID	6	.220″	
454706ARE	18 SOLID	8	.240″	
454707ARE	18 SOLID	10	.280″	
454731Axx	16 SOLID	2	.186″	
454762ARE	16 7 x 22	2	.198″	
454724ARE	16 SOLID	4	.216″	
454718Axx	14 SOLID	2	.220″	
4547182RE	14 7 x 22	2	.230″	
454732ARE	14 SOLID	4	.262″	
454720ARE	12 SOLID	2	.264″	
454733ARE	12 SOLID	4	.303″	

For non-twisted zip fire alarm cables, see page 37.
Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

FIRE ALARM SYSTEMS

FPL

NON-PLENUM

ASTM Bare Copper
Low Density PE Insulation
Twisted/Cabled Conductors
Red PVC Jacket

DATA ADDRESSABLE CABLE
Multi-Conductor, Unshielded
Low Capacitance

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	CAPACITANCE
4547032RE	18 SOLID	2	.174″	16.0 pF / FT
4547311RE	16 SOLID	2	.222″	18.6 pF / FT

FPLR

ASTM Bare Copper
High Grade PVC Insulation
Aluminum Polyester Foil Shield with drain
Twisted/Cabled Conductors
Riser Rated Red PVC Jacket

MULTI-CONDUCTOR, OVERALL SHIELDED

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	POSSIBLE USE & APPLICATIONS
454722ARE	18 SOLID	2	.161″	I/O SLC Loop Addressable Devices Power Horns/Strobes Panel Interconnects Speaker
454734ARE	18 SOLID	4	.189″	
454735ARE	18 SOLID	6	.231″	
454736ARE	16 SOLID	2	.161″	
454737ARE	16 SOLID	4	.218″	
454726ARE	14 SOLID	2	.218″	
454738ARE	14 SOLID	4	.264″	
454739ARE	12 SOLID	2	.262″	

Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

DON'T SEE IT? Call Paige.
See our contact guide on the inside cover.

FIRE ALARM SYSTEMS

FPL

NON-PLENUM

ASTM Bare Copper
Low Density Polyethylene Insulation
Aluminum Polyester Foil Shield with drain
Twisted/Cabled Conductors
Red PVC Jacket

DATA ADDRESSABLE CABLE
Multi-Conductor, Overall Shielded
Mid Capacitance

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	CAPACITANCE
454722AREM	18 SOLID	2	.169″	29.7 pF / FT
454736AREM	16 SOLID	2	.190″	30.0 pF / FT
454726AREM	14 SOLID	2	.238″	34.4 pF / FT

Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

DON'T SEE IT? Call Paige.
See our contact guide on the inside cover.

FIRE ALARM SYSTEMS

FPLP

PLENUM

ASTM Bare Copper
Premium LS PVC Insulation
Twisted/Cabled Conductors
Plenum Rated Red Poly-flex Jacket

MULTI-CONDUCTOR, UNSHIELDED

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	POSSIBLE USE & APPLICATIONS
454709ARE	18 SOLID	2	.145″	I/O SLC Loop Addressable Devices Power Horns/Strobes Panel Interconnects Speaker
454711ARE	18 SOLID	4	.170″	
454713ARE	18 SOLID	6	.200″	
454714ARE	18 SOLID	8	.210″	
454740ARE	16 SOLID	2	.170″	
454741ARE	16 SOLID	4	.204″	
454719Axx	14 SOLID	2	.206″	
454743ARE	14 SOLID	4	.235″	
454725ARE	12 SOLID	2	.244″	
454744ARE	12 SOLID	4	.303″	

Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

FIRE ALARM SYSTEMS

FPLP

PLENUM

ASTM Bare Copper
Premium LS PVC Insulation
Aluminum Polyester Foil Shield with drain
Twisted/Cabled Conductors
Plenum Rated Red Poly-flex Jacket

MULTI-CONDUCTOR, OVERALL SHIELDED

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	POSSIBLE USE & APPLICATIONS
454717ARE	18 SOLID	2	.145″	I/O SLC Loop Addressable Devices Power Horns/Strobes Panel Interconnects Speaker
454745ARE	18 SOLID	4	.156″	
454746ARE	18 SOLID	6	.215″	
454747ARE	16 SOLID	2	.170″	
454748ARE	16 SOLID	4	.206″	
454727ARE	14 SOLID	2	.208″	
454749ARE	14 SOLID	4	.244″	
454750ARE	12 SOLID	2	.248″	

Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

FPLP

PLENUM

ASTM Bare Copper
Mid Cap FPR Insulation
Aluminum Polyester Foil Shield with drain
Twisted/Cabled Conductors
Plenum Rated Red Poly-flex Jacket

DATA ADDRESSABLE CABLE
Multi-Conductor, Overall Shielded
Mid Capacitance

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	CAPACITANCE
454717AREM	18 SOLID	2	.149″	30.1 pF / FT
454747AREM	16 SOLID	2	.178″	29.0 pF / FT
454727AREM	14 SOLID	2	.220″	29.9 pF / FT

Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

WIRE DISTINGUISHER Circuit Tracer System

Distinguisher approved Fire Alarm Cables with Color-Striped Jackets

A color code stripe is embedded in the red cable jacket – not an imprint!
All cables are dual marked per the latest articles of the NEC Code.

Examples:

Horns & Strobes

Speakers

Data Communication (SLC)

Annunciator Communication

24 VDC Power

Annunciator Power

alternative color stripes available.
Simplifies system servicing and expansion.

FIRE ALARM SYSTEMS

FPLR

NON-PLENUM

ASTM Bare Copper
Mid Cap PVC Insulation
Twisted/Cabled Conductors
Riser Rated Red Poly-flex Jacket
with imbedded Stripe

DISTINGUISHER
Multi-Conductor, Unshielded
Mid-Capacitance

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	STRIPE COLORS
75182MRN	18 SOLID	2	.144″	BL, BR, GR, PR, YL
75162MRN	16 SOLID	2	.170″	BL, BR, GR, PR, YL
75142MRN	14 SOLID	2	.210″	BL, GY, OR, PR
75122MRN	12 SOLID	2	.238″	GY, OR

FPLR

ASTM Bare Copper
Mid Cap PVC Insulation
Aluminum Polyester Foil Shield with drain
Twisted/Cabled Conductors
Riser Rated Red Poly-flex Jacket
with imbedded Stripe

DISTINGUISHER
Multi-Conductor, Overall Shielded

75182SRN	18 SOLID	2	.147″	BL, BR, YL
75162SRN	16 SOLID	2	.168″	BL, BR, YL

Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

FIRE ALARM SYSTEMS

FPLP

PLENUM

ASTM Bare Copper
FPR Insulation
Twisted/Cabled Conductors
Plenum Rated Red Poly-flex Jacket
with imbedded stripe

DISTINGUISHER
Multi-Conductor, Unshielded
Mid-Capacitance

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	STRIPE COLORS
75182MPN	18 SOLID	2	.150″	GR
75162MPN	16 SOLID	2	.171″	BL, GR, WH, YL
75142MPN	14 SOLID	2	.206″	BL, GY, PR, YL
75122MPN	12 SOLID	2	.240″	GY

FPLP

ASTM Bare Copper
FPR Insulation
Aluminum Polyester Foil Shield with drain
Twisted/Cabled Conductors
Plenum Rated Red Poly-flex Jacket
with imbedded stripe

75182SPN	18 SOLID	2	.150″	BL, BR, YL
75162SPN	16 SOLID	2	.169″	BL, BR, GR, OR, PR, YL

Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

FPLP / CL3P

PLENUM

ASTM Bare Copper
Premium LS PVC Insulation
Twisted/Cabled Conductors
Overall Red LS Plenum Rated PVC Jacket

SOUNDER BASE
Multi-Pair, Unshielded Composite Cable

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	CAPACITANCE
751418MP	14 SOLID	2	.379″	14 AWG 33.30 pF/ FT
	18 SOLID	2		18 AWG 30.60 pF / FT

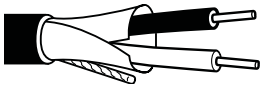
Ideal for hotels, apartments and multi-unit dwellings where there is a need for individual unit alarms combined with group, zone or general alarms.

This cable simplifies the installation of multiple sounder base units by combining the individual unit signal cable with a group signal cable. The cable is designed with individually twisted pairs combined in an overall twisted pattern providing optimum electrical properties for Sounder Base installation.

Conductor color code 2. Chart on page 24.

FPLR-CI

NON-PLENUM



ASTM Bare Copper
UL2196
Twisted/Cabled Conductors
Copper Shield with drain
Flame Retardant, LS Zero Halogen
Polyolefin Jacket

CIRCUIT INTEGRITY (CI)
Multi-Conductor, Overall Shielded

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	CAPACITANCE
451602SCI	16 SOLID	2	.320″	30.0 pF / FT
451402SCI	14 SOLID	2	.340″	36.0 pF / FT
451202SCI	12 SOLID	2	.380″	40.0 pF / FT

TYPE CI: Among the many features of this 2 hour fire rated cable is the fact that it does not need to be installed in conduit. This product passed the UL2196 fire test and fire hose test without being installed in conduit and therefore was given the designation of CI (Fire Alarm Circuit Integrity Cable) as defined in Article 760 of the National Electrical Code. Whether installing in conduit or not, this feature can provide considerable cost savings over other 2 hour rated installations that typically require fire-rated walls and strict conduit support spacing standards. Meets survivability requirements and NFAC.

Both conductors are black with words 1. Black & 2. Red.

FPL

NON-PLENUM

ASTM Bare Copper
High Grade PVC Insulation
Red, Parallel Conductors
Unjacketed

PARALLEL ZIP WIRE, UNSHIELDED

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	CONDUCTOR COLORS
454700ARE	18 SOLID	2	.110" x .213"	RE
454701ARE	16 SOLID	2	.115" x .230"	RE
454702ARE	14 SOLID	2	.126" x .252"	RE

FPLP

PLENUM

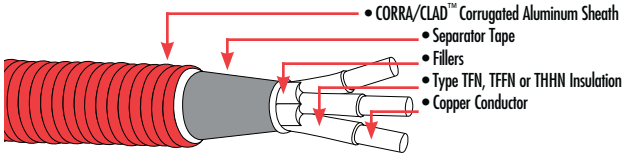
ASTM Bare Copper
Premium LS PVC Insulation
Non-Twisted Conductors
Plenum Rated Red Poly-flex Jacket

MULTI-CONDUCTOR, UNSHIELDED
Non-Twisted Color Coded Conductors
Overall Jacket

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	ALTERNATE JACKET COLORS
454758ARE	16 SOLID	2	.173"	
454755ARE	14 SOLID	2	.206"	WH

With tracer and stripe.
Conductor color code 2. Chart on page 24.
Non-Stock, Call for Availability.

CORRA/CLAD™ MC CABLE



UL LISTED MC CABLE

Corra/Clad™ is constructed in accordance with Underwriters Laboratories, Inc., standard for Metal-Clad Cable (UL 1569). Corra/Clad™ meets or exceeds interlocked MC cable. Corra/Clad™ can be used everywhere interlocked MC cable can be used plus additional places MC cable can't be used.

HEALTH CARE FACILITIES

- Corra/Clad™'s outer jacket is an approved grounding means of a listed cable assembly and employs a continuous, gas/vapor tight metal sheath.
- Corra/Clad™ is permitted for use in hospitals and health care facilities, including all patient care areas per Article 517-13(a) and (b). A properly sized ground must also be a part of the listed assembly.
- When Corra/Clad™ is ordered with a separate ground the green ground wire is marked "ISOLATED GROUND COND."
- For Health Care Facility wiring Corra/Clad™ has quickly become the preferred method of wiring for these facilities. (Consult local authorities for special inclusions or restrictions.)

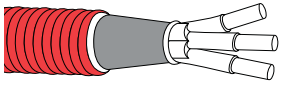
FIRE RESISTANT

- Due to its solid fill construction, smoke can not chimney through the continuous sheath. This lack of oxygen makes Corra/Clad™ and Metal Clad squared fire resistant. Corra/Clad™ may be used in a plenum area per Article 300-22(b) of the NEC.

FIRE/CLAD® MC CABLE

- Our Fire/Clad® MC Cable is Corra/Clad™ cable with a red ink coloring on the aluminum sheath to designate the cable as part of a fire alarm system. Fire/Clad® and Corra/Clad™ is dual rated as MC Cable and as FPL Cable.

SUITABLE FOR PLENUM



ASTM Bare Copper
Type TFN/TFFN & THHN
PVC and Nylon Insulation
Cabled Conductors
Aluminum Sheath
Water and Fire Resistant

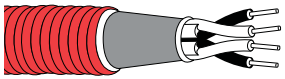
CORRA/CLAD™ MC CABLE
Multi-Conductor, Unshielded

PAIGE PART NO.	AWG & STRANDING	NO. OF COND.	NOM O.D.	CONDUCTOR COLORS
451802MC	18 SOLID	2	.335"	BK, RE
451804MC	18 SOLID	4	.370"	BK, RE, BL, OR
451602MC	16 SOLID	2	.355"	BK, RE
451604MC	16 SOLID	4	.395"	BK, RE, BL, OR
451402MC	14 SOLID	2	.380"	BK, WH
451404MC	14 SOLID	4	.425"	BK, WH, RE, BL
451202MC	12 SOLID	2	.405"	BK, WH
451204MC	12 SOLID	4	.460"	BK, WH, RE, BL

Operating Temperature 90°c / Max Voltage 600v
Suitable for plenum per NEC Article 300-22(b)
Protective metal sheath marked with red color stripe
(other colors available upon request)

Conductor color code 7. Chart on page 24.
Non-Stock, Call for Availability.

SUITABLE FOR PLENUM



ASTM Solid Bare Copper
Type TFN/TFFN & THHN
PVC and Nylon Insulation
Aluminum Sheath
Water and Fire Resistant

CORRA/CLAD™ MC CABLE
Multi-Paired Unshielded
Composite Cables

PAIGE PART NO.	PAIR NO.	AWG & STRANDING	USE	CONDUCTOR COLORS
45MC201	1	14 SOLID	SPEAKER	RE / BK
	2	12 SOLID	STROBE	YW / BL
45MC202	1	18 SOLID SHIELDED	EIA-485	RE / BK
	2	14 SOLID	24v DC	OR / BL
45MC203S	1	16 SOLID	SLC MIDCAP	RE / GR
	1	14 SOLID	24v DC	PK / VI
45MC301	1	16 SOLID	SLC MIDCAP	RE / GR
	2	12 SOLID	STROBE	YW / BL
	3	14 SOLID	24v DC	PK / VI
45MC401	1	16 SOLID	SLC MIDCAP	RE / GR
	2	12 SOLID	STROBE	YW / BL
	3	14 SOLID	SPEAKER	RE / BK
	4	14 SOLID	24v DC	PK / VI

Operating Temperature 90°c / Max Voltage 600v
Suitable for plenum per NEC Article 300-22(b), 334 & 760
Protective metal sheath marked with red color stripe (other colors available upon request)

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL
FIRE ENGINEERING - BUILDING MATERIALS LISTING PROGRAM

LISTING SERVICE

LISTING No. 7161-2075:0100

CATEGORY: 7161 -- CABLES-FIRE PROTECTIVE SIGNALING

LISTEE: Paige Electric Company200 Sheffield Street Ste. 302, Mountainside, NJ 07092
Contact: Cindy Regner (908) 687-7810 Fax (908) 687-8860
Email: cregner@paigeelectric.com

DESIGN: Types FPL, FPLP and FPLR power limited fire protective signaling cables.

Insulation - PVC compound AlphaGary Smokeguard 4010, Synergistics 1349-1028 FRD, 1360-1021-PID, PP, HDPE or LDPE.

Shields - (Optional) All metal or Aluminum Polyester tape.

Braid - (Optional) All metal.

Jacket - PVC compound AlphaGary Smokeguard II 6920, Gitto Global GA-8705-03, AlphaGary GW2038, Synergistics 1690-1060, 1604-1007 FR, 1100-1092 FRD, JAP61A or 1410-1011 FRD, Solef 31008-0003.

Refer to listee's data sheet for additional detailed product description and operational considerations.

INSTALLATION: In accordance with listee's printed installation instructions, NEC Article 760, applicable codes and ordinances, and in a manner acceptable to the authority having jurisdiction.

MARKING: Listee's name, Type FPL, FPLP or FPLR, rating and UL label.

APPROVAL: Listed as power-limited fire protective signaling cables.

NOTE: Formally 7161-1677:100

XLF: 7161-1509:0100

mt 09-09-11 mt

This listing is based upon technical data submitted by the applicant. CSFM Fire Engineering staff has reviewed the test results and/or other data but does not make an independent verification of any claims. This listing is not an endorsement or recommendation of the item listed. This listing should not be used to verify correct operational requirements or installation criteria. Refer to listee's data sheet, installation instructions and/or other

Date Issued: **July 01, 2022** *Listing Expires* **June 30, 2023**

Authorized By: ***VICTOR WONG**, Program Coordinator*

Fire Engineering Division