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Project 25-020
Repair Multiple Hail Damaged Roofs

SECTION 01 10 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. The work to be performed under this project consists of providing the labor, equipment, and materials to repair building 935, 2605, and 3020 as described in the contract documents.

B. The work includes incidental related work.

1.2 LOCATION OF WORK

A. Work is located at Building 935, 2605, and 3020 Fort Sill, Oklahoma.

1.3 PRINCIPAL FEATURES

A. Building 935

1. Demolition:
   a. Remove the existing elastomeric coating from corrugated metal roof (main roof and north lower).
      1) Sand blasting in not permitted, water blasting and wet sand blasting is acceptable. Water will be collected and tested prior to introduction into sanitary sewer system. Coordinate with COR.
   b. Coordinate with COR for the removal and reinstallation of communication equipment by others.
   c. Remove complete single ply roof system down to deck at two lower roofs. (East Entrance and South lower).
   d. All material being removed shall be disposed of in accordance with State, Federal Regulations and Ft. Sill Environmental Quality Division requirements.
   e. Metal shall be disposed or recycled off post, all other debris shall be disposed of at the Fort Sill landfill.

2. New Work:
   a. Install new Elastomeric Coating system to corrugated metal roof. Elastomeric Coating system will have 20-year warranty.
   b. Coating to be white in color.
   c. Provide written work plan stating complete elastomeric coating process, from removal of existing coating to project closeout and warranty. Plan will provide information on cleaning and preparation, joint sealant process, priming and final coatings to include details, coating thicknesses, and product specifications/safety data sheets.
   d. Provide quality control system (how will you show the COR you are meeting the manufacturer installation/application requirements).
   e. Install metal crickets at all roof curbs and provide new Neoprene pipe

boots to all vents per coating manufactures requirements.

f. All pitch pans will be covered with sheet metal cap, per manufacturers requirements.
g. Resolve and/or treat any ponding water areas.
h. Replace all condensate lines, running them to drain or gutter per all applicable codes. Provide piping support per manufacturers requirements.
i. Ensure all gutter straps are tightly fastened to gutter and panels. Correct any misalignment to gutter and seal gutter along with all laps and joints per coating manufacturer requirements.
j. If any gutter is missing or damaged replace with like and kind.
k. Replace or provide all concrete splash blocks if gutter discharge to ground.
l. Ensure metal panel surface is clean and prepared for primer.
m. Treat all fasteners and panel joints and seam per coating manufacturer requirement.
n. Treat all penetrations, curb flashings and roof to gutter transitions per coating manufactures requirements.
o. Prime entire metal roof system per coating manufactures requirement.
p. Install topcoat to metal roof system per coating manufactures requirement.
q. Install protective topcoat to create walkways for maintenance traffic. Walkways will begin at North edge of roof and provide access to all sides of each vent, exhaust fan and package unit.
r. Items “r” through “bb” pertain to the two lower roof sections.
s. Provide complete 135 mil fleece back TPO single ply system, meeting the Very Severe Hail standard, to include all system requirements for 20-year warranty.
t. Roof system insulation to meet ASHRE Climate Zone 3 rating of R-25
u. Ensure all roof curbs are 8 inches above roof surface. If existing curbs do not comply with minimum 8” above roof surface, they will be replaced with new curbs in accordance with UFC 3-110-03.
v. Raise all active vent pipes a minimum of 8” above roof surface.
w. New single-ply roofing system shall be white in color.
x. Install new flashings, crickets, treated wood nailers and tapered insulation.
y. Provide new flashings at all roof penetrations to include, parapet caps, exhaust fans, pipe/duct supports, utility penetrations, pitch pans, vent pipes and roof hatch’s locations for watertight condition.
z. Re-install any lightning protection system components that were removed to facilitate roof replacement.
aa. Install textured roof walkway compatible with single-ply membrane system. Walkway to be installed from roof access point to all serviceable equipment and all high traffic areas.
bb. Ensure all duct penetrations, exhaust fans and other penetrations are properly sealed and weather tight.
cc. New roof system installation and details shall be in accordance with (NRCA) National Roofing Contractors Association manual for membrane roofs 2023.

B. Building 2605 (Option 1 - Bid Item 0002)

1. Demolition:
   a. Remove existing composition shingle roof and underlayment down to deck.
   b. Remove all loose or unbonded self-adhered underlayment.
   c. Remove drip edge and penetration flashings.
   d. Ensure all nails are removed from roof decking.
   e. All material being removed shall be disposed of in accordance with State, Federal Regulations and Ft. Sill Environmental Quality Division requirements.
   f. Metal shall be disposed or recycled off post, all other debris shall be disposed of at the Fort Sill landfill.

2. New Work:
   a. Install new 26 gauge minimum, Galvalume or Prefinished galvanized steel drip edge to match existing.
   b. Install new single layer of ASTM D1970 self-adhering polymer-modified bitumen sheet underlayment over entire deck.
   c. Replace up to 5% of roof decking with like and kind. OSB is not acceptable.
   d. Install new penetration flashings and vent jacks. All galvanized vent pipe will have a cold galvanizing coating applied; all others will be painted grey.
   e. Install Class 4 architectural shingles in accordance with manufacturer's instructions and recommendations.
   f. Upon completion of project ensure all trash is removed to include retrieving nails with magnet roller, minimum 10’ from single story buildings and 20’ on multi-story.
   g. New roof system installation and details shall be in accordance with (NRCA) National Roofing Contractors Association Manual.

C. Building 3020 (Option 2 - Bid Item 0003)

1. Demolition:
   a. Remove the existing down spouts, gutter, and associated hanger for replacement with new.
   b. Remove existing standing seam roof system for replacement with new.
   c. Remove all polyisocyanate insulation board down to steel deck.
   d. Remove existing barrel roof standing seam roof system at entrances for replacement with new.
   e. Remove for reinstallation lighting protection system.
   f. Remove light gauged framed dormers.
   g. Remove solar water heater system and reinstall.
   h. Provide minimum of one OSHA compliant scaffold stair roof access point. Provide all required fall protection systems.
   i. Provide temporary fence to protect general public from work zones.
   j. All material being removed shall be disposed of in accordance with State, Federal Regulations and Ft. Sill Environmental Quality Division requirements.

k. Metal shall be disposed or recycled off post, all other debris shall be disposed of at the Fort Sill landfill.

2. New Work:
   a. Replace polyisocyanate rigid insulation with two layers of polyiso insulation with minimum insulation value of R-30. Polyiso insulation will have minimum compressive strength of 25 psi. Replace and repair all damaged weather resistive air barrier.
   b. Install self-adhering high temp roofing underlayment over entire roof surface.
   c. Install new 24-gauge standing seam metal roof panel system. Provide detailed work plan, details and shop drawings for approval prior to material order.
      1) Standing seam roof to be constructed using no exposed fasteners.
      2) At roof slope transition, breaking (bending) standing seam panel to make transition is **NOT** acceptable. Provide manufacture detail for this transition. See NRCA 2024 detail AVM-19B as basis of design.
      3) Each standing seam section will be constructed from single panel. Laps are not acceptable. (Ridge to slope change one panel, then slope change to eve one panel).
   d. Install new 24-gauge barrel roof standing seam at entrances to match main roof.
   e. Roof system will be covered by a 20-year watertightness warranty.
   f. Install new gutter, downspouts, and hangers to match existing and compliant with roof manufacturers system.
   g. Provide new flashing at all roof penetrations.
   h. Reinstall solar water heating panels and flashing for pipe penetrations. Mounting hardware will clamp to new standing seam ribs, provide details and new mounting hardware calculations.
   i. Reinstall and repair lighting protection system to meet current standards. System will be installed and certified per current NFPA 780 and UFC 3-575-01.
   j. Provide snow and ice protection system around the perimeter of roof. Basis of design is S-5 SnoRail system.
   k. New roof system installation and details shall be in accordance with (NRCA) National Roofing Contractors Association manuals.

1.4 GENERAL PROJECT NOTES:

A. Contractor is responsible for protection of all existing facilities, to include but not limited to landscaping, sidewalks, structures, utilities, and equipment. All damage to government property will be repaired to like new condition at Repair of any damage is contractors' responsibility.

B. For all buildings that have metal roofs and on all roofs that have existing snow guards, the Contractor shall install snow guards.

C. If the Threatened and Endangered Species becomes listed prior to the start of construction of individual Bid Items, the Bid Items not yet under construction may be subject to re-review by EQD and may result in a Stop Work action. Bid

Items that have commenced construction prior to any Threatened and Endangered Species being listed are not subject to this additional re-review.

1.5 Incidentals: The foregoing outline of principal features does not limit the responsibilities of the Contractor to perform all work and furnish all materials required by the drawings and specifications and to perform other work items that may be required or associated with this type of work unless specifically listed below as Government Furnished.

1.6 GOVERNMENT FURNISHED EQUIPMENT AND/OR MATERIAL: NONE

1.7 GOVERNMENT FURNISHED INFORMATION

A. As-builts:

1. B935 Original As-builts Partial.pdf
2. B2605 Renovation Design Partial.pdf
3. B3020 Original As-builts Partial.pdf

1.8 CONTRACT DRAWINGS

1) The following drawings form a part of this contract: NONE

2) One electronic set of contract drawings and specifications will be furnished to the Contractor. Upon request one full size hard copy of contract drawings will be provided without charge. Reference publications will not be furnished.

3) Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

a. Record drawings of past work performed on the applicable facility may be on file at the Directorate of Public Works, Engineering Division, building 1950, and are available for review by the offerors during normal business hours. A reasonable number of copies will be provided upon request. The Government assumes no responsibility for any deductions or conclusions made from record drawings. Proposals shall be based upon data obtained through contractor's field verification of existing conditions at the facility where work is to be performed.

1.9 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK

A. The Contractor will be required to commence work under this contract 10 calendar days after the date of receipt by contractor of notice to proceed, to prosecute said work diligently, and to complete the entire work ready to use no later than **90** calendar days after the date of receipt by contractor of notice to proceed. The time stated for completion shall include **10** weather days, receipt of approved As-Built drawings, receipt of approved Operation and Maintenance manuals, all final close out documents, mobilization and final clean up.

If options are awarded, add the following time to the period of performance:

B 2605 (Bid Item 0002) Option 1	30 Days
B 3020 (Bid Item 0003) Option 2	120 Days

B. The Contractor will be required to submit a Payment Estimate – Contract Performance Statement, Fort Sill Form 94, in accordance with base specification section 01 32 00. Close out documents, to include As-Built Drawings and Operations and Maintenance (O&M) Manuals shall be indicated as 10% of the job in section 11b.1 of FS Form 94. Liquidated Damages will be assessed if close out documents are not received and approved by the Government with the time period stated herein.

1.10 OPERATIONS SECURITY

1) Per AR 530-1 Operations Security, the contractor employees must complete Level I OPSEC Awareness training. New employees must be trained within 30 calendar days of their reporting for duty and annually thereafter. https://www.cdse.edu/Training/eLearning/GS130-signup/

PART 2 - PRODUCTS
NOT USED

PART 3 - EXECUTION
NOT USED

END OF SECTION

SECTION 01 14 00

WORK RESTRICTIONS

PART 1 - GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. U.S. ARMY CORPS OF ENGINEERS (USACE) EM 385-1-1 Safety and Health Requirements Manual

1.2 MEASUREMENT AND PAYMENT

A. Payment for work under this contract and all costs associated shall be included in the applicable bid item to which the work pertains.

1.3 ASSIGNMENT OF WORK

A. Work will be assigned by the Contracting Officer only and will be in writing.

1.4 EXISTING WORK

A. Protect existing vegetation, structures, equipment, utilities, pavement and improvements. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work to remain or to be reused.

B. Repair or replace portions of existing work that has been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.5 INSPECTION OF WORK

A. Technical surveillance of workmanship and inspection of materials for work being performed for this project shall be the responsibility of the Directorate of Public Works.

B. This provision in no way authorizes anyone other than the Contracting Officer to commit the government to changes in the terms of the contract. (FAR Clause 52.246-12)

1.6 SUBMITTALS

A. Provide submittals as required by the Contract specifications in accordance with specification section 01 33 00. Provide a submittal register for review and approval. The submittal register, 25-020 SUBMITTAL REGISTER, an Excel Spreadsheet used in addition to ENG Form 4288-R, is attached. The submittals listed on the submittal register may not be all inclusive and any submittal required in the specifications but not shown on this list is still a requirement of this Contract. Submittal due dates are provided on the SUBMITTAL REGISTER. Provide submittal information to the Contracting Officer's Representative.

B. Government approval of submittals does not relieve the Contractor from providing all work in compliance with the contract.

C. As-Built Drawings: All sheets in the As-Built drawing set shall be dated and marked "As-Built". As-Built drawings shall reflect the actual as-built construction. The one-half size hard copy and two electronic copies of the As-Built drawings shall be submitted to the Contracting Officer. The electronic copies shall be in PDF format and a format editable by MicroStation. The As-Builts are required for all specification sections whether or not specifically indicated in each individual section. The drawings shall be in accordance with AEC CAD Standard.

1.7 OCCUPANCY OF PREMISES

A. Before work is started, the Contractor shall arrange with the Contracting Officer a sequence of procedure, means of access, and space for storage of materials.

B. Coordination and notification of commencement of work shall be given to the appropriate building occupants a minimum of two weeks prior to beginning work in the affected areas with approval through the Contracting Officer.

C. The Contractor shall provide signs, barriers, and barricades to provide a safe work area and protect building occupant entry and egress.

1.8 ACCESS TO FORT SILL

A. Contractor Access to Fort Sill: Effective 30 January 2015, personnel requiring access to the installation shall possess a Long Term Unescorted Access Pass or Military ID, or Individual temporary pass issued by the Fort Sill Directorate of Emergency Services (DES) pursuant to Army Directive 2014-05, Policy and Implementation Procedures for Common Access Card Credentialing and Installation Access for Un-cleared Contractors. Fort Sill has initiated a system which provides two forms of access documentation based upon the duration of required access and DOD Network requirements. The two forms are as follows: (1) Long Term Unescorted Access Pass or Military ID; or an (2) Individual Temporary Pass. The Contractor shall provide the COR the required documentation for each prime or sub-contract employee who requires a Long-Term Unescorted Access Pass as described below within 10 calendar days of contract award. The COR will initiate and coordinate the process for obtaining Contractor Long Term Unescorted Passes (for contract employees not possessing a current military ID) with the Directorate of Emergency Services (DES). Failure to receive a Long-Term Unescorted Access Pass or Individual Temporary Pass will result in the contractor personnel being denied admission to the installation.

1. Long Term, Unescorted Access Pass: This pass is required for Contractors, Sub-contractors and Vendors requiring physical access to the installation on a recurring basis (greater than 24 hours) and who do not require access to a DOD computer network. The expiration date of the access will be the end of the contract period of performance or 365 day whichever comes first. Sub-contractors shall be bound by this same requirement. Prime Contractors are responsible for obtaining timely sub-contractor documents necessary to secure required access documents. Contractors and their employees shall pass a NCIC Interstate Identification Index check in order to secure this pass.

    a. Military ID: Military ID cards for retirees, reservists and dependents are acceptable for unescorted access onto Fort Sill.

    b. To avoid delays in gaining access to the installation, contractors are encouraged to contact their Contracting Officer Representative (COR) to begin the process of securing long term passes as soon as possible.

2. Individual Temporary Pass: All contractors and sub-contractors who do not possess a CAC, a valid Military ID, or a current long term unescorted pass shall report to the Visitors Control Center located near Sheridan gate to obtain an Individual temporary pass. A temporary pass will ONLY be issued to persons who produce a valid current federal or state issued ID with a picture and passes a NCIC Interstate Identification Index check and local exclusion roster. Acceptable forms of ID are:

a. ID cards for installation access must be REAL ID Act compliant.

b. Valid current Permanent Resident Card or Alien Registration Receipt Card (Form I-551)

c. Valid current Employment Authorization Document (Card) that contains a photograph (Form I-766)

d. Passport (Foreign Passports must show point of entry stamp).

3. The contractor shall return issued Passes to the designated COR at the end of the contract period of performance or the end of the individual employee's tenure, whichever comes first. The contractor shall also coordinate with the COR for new or replacement Long Term Unescorted Passes as required.

4. For additional information, see:

a. https://sill-www.army.mil/vcc/

b. https://sill-www.army.mil/USAG/forms.html

c. Fort Sill unescorted access regulation (to be published).

d. Homeland Security Presidential Directive 12, Policy for a Common Identification Standard for Federal Employees and Contractors located at https://www.dhs.gov/homeland-security-presidential-directive-12#1

e. Army Regulation (AR) 190-13, the Army Physical Security Program located at https://www.irp.fas.org/doddir/army/ar190-13.pdf

1.9 ACCESS TO SITE

A. Normal duty hours for work shall be from 7:30 a.m. to 4:00 p.m., Monday through Friday. Access to the site shall be coordinated and approved by the Contracting Officer.

B. Requests for additional work periods shall require written approval from the Contracting Officer 7 days in advance of the proposed work period. Weekend work requests may be approved on a case-by-case basis on the Wednesday prior to the desired weekend.

1.10 DEFINITIONS

A. Whenever the specifications require approval or selection of any item, it shall be construed to mean approval or selection by the Contracting Officer in writing.

B. Whenever the specifications require submittal of reports or certifications, it shall be construed to mean submitted to the Contracting Officer in writing.

C. Approvals made by the Contracting Officer prior to final project inspection and acceptance do not relieve the Contractor from his obligation to perform the work in accordance with the specifications and drawings. These approvals do not prohibit the Government from subsequently asserting any other contract rights under this contract.

1.11 SAFETY

A. Requirements of EM 385-1-1 shall be strictly enforced and adhered to at all time at the job sites.

B. The contractor shall adhere to the requirements of the Occupational Safety and Health Administration as applicable to all work activities.

C. Each contractor shall have a properly trained Safety Officer (OSHA 30-hour Construction) who is responsible for the overall safety program for the company. The Safety Officer shall be familiar with the requirements of EM385-1-1 and have experience in the areas of hazard identification and safety compliance. The Safety Officer shall make regular (minimum of 1 per week) safety inspections of each project site.

D. When working within six feet of any railroad track, the contractor shall ensure that all workers are trained in Blue Flag Protection in accordance with CFR49, part 218, the General Code of Operating Rules (GCOR), 5.13 and TM 4-14.21 Rail Safety; and are qualified on Roadway Worker Protection in accordance with CFR49, part 214.

1.12 SEQUENCING AND SCHEDULING

A. Contractor shall furnish the Contracting Officer a Contract Progress Schedule in the form of a Gantt chart that clearly shows the critical path for construction progress prior to issuance of the Notice to Proceed. See section 01 33 00 SUBMITTAL PROCEDURES for a detailed description of the Progress Schedule. The Progress Schedule shall include, but is not limited to, the following information:

1. Projected dates of the start and completion of work.
2. Projected start and completion dates of each major phase of construction.
3. Major submittals and submittal processing time.
4. Major equipment lead time.

B. Changes to the Progress Schedule shall be submitted by the Contractor to the Contracting Officer, in writing, two weeks prior to the scheduled start of the affected work on the job sites, or as directed by the Contracting Officer.

1.13 UTILITIES

A. All reasonable amounts of water, electricity, and gas required for the performance of the work under this contract will be made available to the Contractor by the Government from existing distribution systems at no cost to the Contractor.

B. Connection and disconnection shall be the responsibility of the contractor.

C. Connection and disconnection shall be made in a manner approved by the Government.

D. Abuse of this policy may result in disconnection from utilities.

E. Contractor shall submit an energy and water conservation plan prior to issuance of the Notice to Proceed.

1. The plan shall outline all expected activities that will consume water, electricity, and natural gas along with estimates of consumption.
2. Plan shall outline a plan to install any and all necessary meters (i.e. job trailers or buildings unoccupied with exception of the contractor). It shall include a detailed map showing the location of the meters. Contractor shall install all meters for temporary utility hookups.
3. All meters shall comply with all local codes and regulations and will include any additional equipment necessary such as backflow preventers. Contractor shall remove all temporary meters and equipment when project is completed.
4. Plan shall describe effort to comply with reporting standards stated herein.
5. Plan must demonstrate efforts to conserve electricity, natural gas and water in compliance with Ft. Sill policies and best management practices on conservation of electricity, natural gas, and water.

6. If there is a change in the project that will or may change the utility connection requirements, the Contractor shall submit a revised compliance plan to the Contracting Officer.
7. Contractor shall sign and return to the Contracting Officer a Memorandum of Understanding for Sale of Utility Services (DA2100-R) before utilities will be turned on.
8. Contractor shall report meter readings to the Contracting Officer or the Contracting Officer's Representative on the 15th of each month or immediately upon disconnection of utilities.
9. Meter readings shall be reported from the beginning of the construction to the completion of construction. This requirement includes recording meter readings from water points on post. The meter reading reports shall include project name and contract number.

1.14 SALVAGE MATERIAL AND EQUIPMENT

A. No salvage is required.

1.15 CLEAN UP

A. The job site shall be cleaned up on a daily basis.

B. All trash and debris, except metal, generated from the construction operation shall be delivered to the Fort Sill sanitary landfill or rubble pit as directed by the Contracting Officer.

C. All metal shall be disposed off Government property.

D. No material shall be burned at the project site. (FAR Clause 52.236-12)

1.16 CONDUCT OF EMPLOYEES

A. The Contractor's employees shall not be permitted to carry firearms or other lethal weapons while on Fort Sill in accordance with Fort Sill Regulation 190-1. Knives or other bladed instruments or tools are authorized for use only for the utilitarian purpose for which it was designed.

B. The contractor and the contractor's employees shall adhere to the United States Army's Sexual Harassment/Assault Response Prevention (SHARP) policies and regulations in addition to state and federal laws.

1. Army's Policy on sexual harassment

a. Sexual harassment is unacceptable and will not be tolerated.
b. Sexual harassment destroys teamwork and negatively affects combat readiness.
c. Army leadership at all levels will be committed to creating an environment conducive to maximum productivity and respect for human dignity.
d. The success of the mission can be achieved only in an environment free of sexual harassment for all personnel.
e. The Army's SHARP policies apply without regard to a person's rank, age, gender, and are sexual orientation neutral. A person's sexual orientation is a personal and private matter.

2. Army Policy on Sexual Assault
   a. Sexual assault is a criminal offense.
   b. It degrades mission readiness.
   c. Soldiers and civilians who are aware of a sexual assault incident should report it immediately (within 24 hours).
   d. Sexual assault is incompatible with Army Values and is punishable under the UCMJ and other federal and local civilian laws.
   e. The Army's SHARP policies apply without regard to a person's rank, age, gender and sexual orientation neutral. A person's sexual orientation is a personal and private matter.
   f. All victims of sexual assault will be treated with dignity, fairness, and respect.

3. SHARP Contact information
   a. 911
   b. Department of Defense Safe Helpline (https://www.safehelpline.org/) Helpline: 1-877-995-5247
   c. RAINN (Rape, Abuse, and Incest National Network, https://www.rainn.org/) National Sexual Assault Hotline: 1-800-656-HOPE (4673)
   d. Oklahoma Coalition Against Domestic Violence and Sexual Assault (https://www.ocadvsa.org/) Oklahoma Safe line: 1-800-522-7233
   e. Sexual assault victim advocate and counseling available FREE of charge. https://www.mariedetty.com/ Hotline: (580) 357-2500 Office: (580) 357-6141

4. References
   a. 29 CFR Part 1614
   b. AR 600-20
   c. AR 690-600
   d. Title 42 United States Code Chapter 21 Subchapter VI

1.17 WORK FORCE

A. The contractor shall not hire persons not legally residing in the United States. The contractor shall not subcontract work to companies that hire persons not legally residing in the United States.

1.18 IDENTIFICATION OF CONTRACTOR EMPLOYEES AND VEHICLES

A. Each side of Contractor-owned vehicles shall bear the Contractor's name in 2-inch letters.

B. Each Contractor employee shall possess an identification card to include employee's name, name of Contractor, current photo, and card serial number. Additionally, each Contractor employee shall display on his/her person a badge or nametag which shall include the name of the employee and the Contractor's name.

C. The Contractor shall collect Contractor-furnished identification badges upon termination of employee.

1.19 APACHE GATE DELIVERY INFORMATION

A. All delivery trucks, transportation trucks, vehicles pulling trailers, every type of cargo or construction vehicle must enter through Apache Gate. Location of Apache Gate: Take the Medicine Park exit 45 off Interstate 44, proceed west on highway 49 (approximately 1/2 mile). Entrance to Apache Gate is on the left (south).

1.20 ANTITERRORISM (AT)

A. Access and General Protection/Security Policy and Procedures: Contractor and all associated sub-contractors' employees shall comply with applicable installation, facility, and area commander installation/facility access and local security policies and procedures (provided by government representative). The contractor shall also provide all information required for background checks to meet installation access requirements to be accomplished by installation Provost Marshal Office, Director of Emergency Services, or Security Office. Contractor workforce must comply with all personal identity verification requirements as directed by DOD, HQDA, and/or local policy. In addition to the changes otherwise authorized by the changes clause of this contract, should the Force Protection Condition (FPCON) at any individual facility or installation change, the Government may require changes in contractor security matters or processes.

B. The Contractor must pre-screen Candidates using the E-verify Program (https://www.uscis.gov/e-verify) website to meet the established employment eligibility requirements. The Vendor must ensure that the Candidate has two valid forms of Government issued identification prior to ensure the correct information is entered into the E-verify system. An initial list of verified/eligible Candidates must be provided to the COR no later than 3 business days after the initial contract award.

C. All contractor employees, to include subcontractor employees, requiring access to Army installations, facilities, and controlled access areas shall complete AT Level I awareness training within 30 calendar days after contract start date or effective date of incorporation of this requirement into the contract, whichever is applicable. The contractor shall submit certificates of completion for each affected contractor employee and subcontractor employee to the COR or to the KO, if a COR is not assigned within 10 calendar days after completion of training by all employees and subcontractor personnel. AT level I awareness training is available at the following website: https://jko.jten.mil/courses/AT-level1/launch.html

D. The contractor and all associated sub-contractors shall brief all employees on the local iWATCH program (training standards provided by the requiring activity ATO). This locally developed training will be used to inform employees of the types of behavior to watch for and instruct employees to report suspicious activity to the COR. This training shall be completed within 30 calendar days of contract award and within 14 calendar days of new employees commencing performance with the results reported to the COR NLT 35 calendar days after contract award. This training may be accomplished by viewing the video at the following website: https://www.youtube.com/embed/vIzYhQp7fPw

PART 2 - PRODUCTS
NOT USED

PART 3 - EXECUTION
NOT USED

-- END OF SECTION --

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Provide rough carpentry:

1. Wood grounds, nailers, and blocking.
2. Wood furring.
3. Backing panels.
4. Sheathing.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Lumber Standards and Grade Stamps: DOC PS 20, American Softwood Lumber Standard and inspection agency grade stamps.

C. Construction Panel Standards: DOC PS 1, U.S. Product Standard for Construction and Industrial Plywood; APA PRP-108.

D. Preservative Treatment: AWPA C2 for lumber and AWPA C9 for plywood; waterborne pressure treatment. Provide for wood in contact with soil, concrete, masonry, roofing, flashing, dampproofing and waterproofing.

E. Fire-Retardant Treatment: AWPA C20 for lumber and AWPA C27 for plywood; noncorrosive type. Provide at building interior where required by code.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Dimension Lumber:

1. Light Framing: Stud, No. 3 or Standard grade.
2. Structural Framing: No. 2 grade.
3. Species: Any species of grade indicated.
4. Exposed Framing: Appearance grade.

B. Boards:

1. Exposed Boards: 15 percent moisture content.
2. Concealed Boards: 19 percent moisture content.

C. Miscellaneous Lumber:

1. Moisture Content: 19 percent.
2. Grade: Standard grade light framing.

D. Construction Panels:

1. Plywood Wall Sheathing: Exterior, Structural I.
2. Plywood Roof Sheathing: Exterior, Structural I sheathing.
3. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated.

E. Auxiliary Materials:

1. Framing Anchors and Fasteners: Non-corrosive, suitable for load and exposure. Drywall screws are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated,

B. Provide nailers, blocking and grounds where required. Set work plumb, level and accurately cut.

C. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with other work.

D. Comply with manufacturer's requirements for cutting, handling, fastening and working treated materials.

E. Restore damaged components. Protect work from damage.

END OF SECTION

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SECTION 07 22 00

ROOF AND DECK INSULATION
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2017) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C208	(2022) Standard Specification for Cellulosic Fiber Insulating Board
ASTM C578	(2022) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C728	(2017a; R 2022) Standard Specification for Perlite Thermal Insulation Board
ASTM C1177/C1177M	(2017) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C1278/C1278M	(2017) Standard Specification for Fiber-Reinforced Gypsum Panel
ASTM C1289	(2023) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C1902	(2022) Standard Specification for Cellular Glass Insulation Used in Building and Roof Applications

ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D226/D226M	(2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D312/D312M	(2016a) Standard Specification for Asphalt Used in Roofing
ASTM D2178/D2178M	(2015a; R 2021) Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4586/D4586M	(2007; R 2018) Asphalt Roof Cement, Asbestos-Free
ASTM D4601/D4601M	(2004; R 2020) Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D4897/D4897M	(2016) Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4450	(1989) Approval Standard for Class 1 Insulated Steel Deck Roofs
FM 4470	(2022) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1	(2021) Fire Code

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

UNDERWRITERS LABORATORIES (UL)

UL 1256	(2002; Reprint Jul 2013) Fire Test of Roof Deck Constructions
UL 2818	(2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Insulation Board Layout and Attachment; G[, [_____]

Verification of Existing Conditions; G[, [_____]]

SD-03 Product Data

Insulation; G[, [_____]]

Cover Board; G[, [_____]]

Fasteners; G[, [_____]]

Sheathing Paper; G[, [_____]]

Moisture Control; G[, [_____]]

[Asphalt Products; G[, [_____]]

] Recycled Content For Insulation; S

SD-05 Design Data

Wind Resistance; G[, [_____]]

SD-06 Test Reports

Flame Spread Rating; G[, [_____]]

SD-07 Certificates

Installer Qualifications; G[, [_____]]

Certificates Of Compliance For Felt Materials; G[, [_____]]

Indoor Air Quality For Insulation; S

Acceptable Foam Blowing Agents; S

SD-08 Manufacturer's Instructions

Nails and Fasteners; G[, [_]]

Roof Insulation; G[, [_____]]

1.3 SHOP DRAWINGS

Submit insulation board layout and attachment indicating methods of attachment and spacing of fasteners on each board, transitions, tapered components, thicknesses of materials, and closure and termination conditions. Show locations of ridges, valleys, crickets, interface with, and slope to, roof drains. Base shop drawings on verified field measurements and include verification of existing conditions.[Show wood nailers.][Show location and spacing of wood nailers required for securing of insulation [and backnailing of roofing felts]].

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for cover board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 MANUFACTURER'S INSTRUCTIONS

Include field of roof, perimeter, and corner attachment requirements. Provide a complete description of installation sequencing for each phase of the roofing system. Include weatherproofing procedures.

1.6 QUALITY CONTROL

Provide certification of installer qualifications from the insulation manufacturer confirming the specific installer has the required qualifications for installing the specific roof insulation system(s) indicated.

Provide certificates of compliance for felt materials.

1.7 WIND RESISTANCE REQUIREMENTS

The complete roof system assembly must be rated and installed to resist wind loads calculated in accordance with ASCE 7 and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Coordinate with roof covering attachment requirements and submit wind resistance test certification, attachment patterns for field, perimeter, and corner roof areas along with perimeter and corner boundary dimensions.

1.8 FIRE PERFORMANCE REQUIREMENTS

1.8.1 Insulation in Roof Systems

Comply with the requirements of ICC IBC [or UL 1256] [or FM 4450][or FM 4470]. Roof insulation must have a flame spread rating of 75 or less when tested in accordance with ASTM E84. Additional documentation of compliance with flame spread rating is not required when insulation of the type used for this project as part of the specific roof assembly is listed and labeled as FM Class 1 approved.[Only roof assemblies that pass FM 4450 are permitted.]

1.8.2 Thermal Barrier Requirements

Separate [polyurethane][or][polystyrene] insulation from a [combustible][steel]deck with a thermal barrier of glass mat gypsum roof board or other approved barrier material in accordance with the requirements of the ICC IBC[or FM 4450][or FM 4470][or UL 1256].[Only roof assemblies that pass FM 4450 are permitted.]

1.8.3 Fire Resistance Ratings for Roofs

Provide in accordance with ICC IBC Chapter 7 and Table 721.1(3) Min [Fire and Smoke] Protection For Floor and Roof Systems.

1.9 CERTIFICATIONS

Provide products certified to meet indoor air quality requirements by UL 2818(Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification by other third-party programs. Provide current product certification documentation from certification body.

1.10 DELIVERY, STORAGE, AND HANDLING

1.10.1 Delivery

Deliver materials to the project site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer

b. Brand designation

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification

d. Asphalt flashpoint (FP), equiviscous temperature (EVT), and finished blowing temperature (FBT).

Deliver materials in sufficient quantity to allow continuity of the work.

1.10.2 Storage and Handling

Store and handle materials in accordance with manufacturer's printed instructions. Protect from damage, exposure to open flame or other ignition sources, wetting, condensation, and moisture absorption. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment.[Store felt rolls on ends. For the 24 hours immediately before application of felts, store felts in an area maintained at a temperature no lower than 10 degrees C 50 degrees F above grade and having ventilation on all sides.] Replace damaged material with new material.

1.11 ENVIRONMENTAL CONDITIONS

As per manufacturer's recommendations or Government's instructions, do not install roof insulation during inclement weather or when air temperature is below 4 degrees C 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

1.12 PROTECTION

1.12.1 Flame Heated Equipment

1.12.1.1 Fire Protection

Locate melt kettles no closer than 8 meters 25 feet from buildings or combustible materials. Do not place kettles or other flame-heated equipment on roofs. Provide and maintain two approved 4-A:40-B:C fire extinguishers within 8 meters 25 feet of each operating kettle. Fire extinguishers, operations and locations must comply with NFPA 1 Section Tar Kettles. Equip asphalt (tar) kettles with tight fitting lids.

1.12.1.2 Operational Requirements

Equip kettles with automatic thermostatic control capable of maintaining asphalt temperature. Calibrate and maintain controls in working order for the duration of the work. Equip kettles with means of agitation and ensure they are operating as necessary to produce a controlled uniform temperature throughout kettle contents to prevent spot heating. Do not heat contents above flash point. Do not place flame heated equipment on the roof.

][1.12.2 Special Protection

Provide special protection as approved by the insulation manufacturer.

][1.12.3 Drippage of Bitumen

Seal joints in and at edges of deck as necessary to prevent drippage of asphalt into the building or onto adjacent surfaces.

]1.12.4 Completed Work

Cover completed work with cover board for the duration of construction. Avoid traffic on completed work particularly when ambient temperature is above 27 degrees C 80 degrees F. Replace crushed or damaged insulation prior to roof surface installation.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Provide one, or an assembly of a maximum of three, of the following roof insulation materials. Provide roof insulation that is compatible with attachment methods for the specified insulation and roof membrane.

a. Polyisocyanurate Board: Provide in accordance with ASTM C1289 REV A [Type I, foil faced both sides] [or] [Type II, fibrous felt or glass mat membrane both sides], except minimum compressive strength of [172] [140] kilopascal (kPa) [25] [20] pounds per square inch (psi).

b. Extruded Polystyrene (XPS) Board: In accordance with ASTM C578 REV A, Type IV or X.

c. Provide in accordance with ASTM C1289 REV A, [Type III, perlite insulation board faced on one side with fibrous felt or glass fiber mat membrane on opposite side.] [Type V, oriented strand board or waferboard on one side and fibrous felt or glass fiber mat membrane or aluminum foil on opposite side (Polyisocyanurate-perlite).]

d. Expanded Perlite Board: Provide in accordance with ASTM C728. Minimum 19 mm 3/4 inch thick when both top and bottom surfaces must be in contact with asphalt.

e. Cellular Glass Boards: ASTM C1902, Type [____].

2.1.2 Recycled Materials

Provide thermal insulation materials containing recycled content. Unless specified otherwise, the minimum required recycled content for listed materials are:

Perlite Composition Board:	23 percent postconsumer paper
Polyisocyanurate/polyurethane:	9 percent recovered material
Cellular Glass Insulation:	60 percent recovered content
Fiberglass Insulation:	25 percent recovered content
Fiber (felt) or Fiber composite:	75 percent recovered content

Provide data identifying percentage of recycled content for insulation.

2.1.3 Indoor Air Quality

Provide certification of indoor air quality for insulation.

2.1.4 Prohibited Materials

Products that contain high ozone depleting or high Global Warming Potential (GWP) blowing agents are prohibited. For a list of acceptable substitute foam blowing agents for the type of insulation used see https://www.epa.gov/snap/foam-blowing-agents. Provide validation of acceptable foam blowing agents that no prohibited materials are used.

2.1.5 Insulation Thickness

As necessary to provide the thermal resistance (R-value) indicated[for average thickness of tapered system]. Base calculation on the R-value for aged insulation.[For insulation over steel decks, satisfy both specified R-value and minimum thickness for width of rib opening recommended in insulation manufacturer's published literature].

[2.1.6 Tapered Roof Insulation

One layer of the tapered roof insulation assembly must be factory tapered to a slope of not less than one in [24] [48] [20 mm] [40 mm] per 1 M [1/4] [1/2] inch per foot. Factory fabricate mitered joints from two diagonally cut boards or one board shaped to provide required slopes.

][2.1.7 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation. When unavailable, provide pressure-preservative treated wood, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer for the specific application, unless otherwise indicated. Face of cant strips to incline at 45 degrees with a minimum vertical height of 100 mm 4 inches. Taper edge strips at a rate of 85 to

125 mm per meter one to 1 1/2 inch per foot down to approximately 3 mm 1/8 inch thick.

2.2 COVER BOARD

For use as a thermal barrier (underlayment), fire barrier (overlayment), or cover board for hot-mopped, torched-down, or adhesive-applied roofing membrane over roof insulation.

2.2.1 Glass Mat Gypsum Roof Board

ASTM C1177/C1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E84, 3450 kPa 500 psi, Class A, non-combustible, [6][13][16] mm [1/4][1/2][5/8] inch thick, 1220 by 2440 mm 4 by 8 feet board size.

2.2.2 Fiber-Reinforced Gypsum Board Panels

Provide non-glass-faced fiber-reinforced gypsum board panels in accordance with ASTM C1278/C1278M.

2.2.3 High Density Wood Fiber Board

Provide high density wood fiber board, Grade 2 in accordance with ASTM C208 with a transverse load of 53.4 N 12 lbf.

2.3 BITUMENS

[2.3.1 Asphalt Primer

Provide in accordance with ASTM D41/D41M.

2.3.2 Asphalt

Provide in accordance with ASTM D312/D312M, Type III or IV. Asphalt flash point, finished blowing temperature, and equiviscous temperature (EVT) for mop and mechanical spreader application must be indicated on each container.

2.3.3 Asphalt Roof Cement

Provide in accordance with ASTM D4586/D4586M, Type I, for horizontal surfaces and surfaces sloped from 0 by 76 mm per 1 M 0 to 3 inches per foot. Type II for vertical and surfaces sloped more than 76 mm per 1 M 3 inches per foot.

2.4 SHEATHING PAPER FOR WOOD DECKS

Rosin-sized building paper or unsaturated felt weighing not less than 2.5 kilograms per 10 square meters 5 pounds per 100 square feet.

2.5 MOISTURE CONTROL

2.5.1 Vapor Retarder

2.5.1.1 Asphalt Saturated Felt Base Sheet for Single Layer Application

Provide in accordance with ASTM D4601/D4601M, weighing not less than 17.5 kilograms per 10 square meters 35 pounds per 100 square feet.

][2.5.1.2 Asphalt-Coated Glass Felt

Provide in accordance with ASTM D2178/D2178M, Type [IV] [VI].

]][2.5.2 Ventilating Felt for [Poured] [Precast] Concrete Decks

Provide in accordance with ASTM D4897/D4897M, Type II, non-perforated, with spot mopping holes where specified.

]2.5.3 Organic Roofing

Provide in accordance with ASTM D226/D226M, Type I.

2.6 FASTENERS

Provide flush-driven fasteners through flat round or hexagonal steel or plastic plates. Provide zinc-coated steel plates, flat round not less than 35 mm 1 3/8 inch diameter, hexagonal not less than 0.4 mm 28 gage. Provide high-density plastic plates, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 75 mm 3 inches in diameter. Fully recess fastener head into plastic plate after it is driven. Form plates to prevent dishing. Do not use bell or cup shaped plates. Provide fasteners in accordance with insulation manufacturer's recommendations for holding power when driven, or a minimum of [178] [534] N [40] [120] pounds each in steel deck, whichever is the higher minimum. Provide fasteners for steel or concrete decks in accordance with FM APP GUIDE (https://www.approvalguide.com/) for Class I roof deck construction, and spaced to withstand uplift pressure of [2.87] [4.3] [_____] kPa [60] [90] [_____] pounds per square foot.

2.6.1 Roofing Nails for Wood Decks

Barbed 3 mm 11 gage, zinc-coated nails with 11 to 16 mm 7/16 to 5/8 inch diameter heads or annular ring shank, square head, one piece composite nails. Provide nails long enough to penetrate wood deck at least 16 mm 5/8 inch without protruding through underside of decking.

2.6.2 Fasteners for Plywood Decks

Annular ring shank, square head, one-piece composite nails long enough to penetrate into plywood decks approximately 13 mm 1/2 inch without protruding through underside of decking.

2.6.3 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws in accordance with FM 4450 and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of [2.87] [4.31] [_____] kPa [60] [90] [_____] psf in accordance with FM APP GUIDE.

2.6.4 Fasteners for Poured Concrete Decks

Approved hardened fasteners or screws to penetrate deck at least 25 mm one inch but not more than 38 mm 1 1/2 inches, in accordance with FM 4470, and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand an uplift pressure of [2.87] [4.31] [_____] kPa [60] [90] [_____] psf in accordance with FM APP GUIDE.

2.7 FOAM ADHESIVE

Foam adhesive as recommended by the insulation manufacturer for adhering the insulation to concrete surfaces or underlying insulation layers and

resist the required wind uplift pressure. Product must be compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.8 [WOOD][ENGINEERED METAL FRAMING] NAILERS

[Pressure-preservative treated wood as specified in Section 06 10 00 ROUGH CARPENTRY.] [Provide galvanized steel or aluminum engineered metal framing for use as nailers and attached to substrate with self-tapping screws.]

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Ensure surfaces are clean, smooth, and dry prior to application.[Ensure surfaces receiving vapor retarder are free of projections that might puncture the vapor retarder.] Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The [Contractor must] [Contracting Officer will] inspect and approve the surfaces immediately before starting installation. Prior to installing [vapor retarder] [ventilating felt] [insulation], perform the following:

[a. Examine wood decks to ascertain that deck boards have been properly nailed in accordance with IBC and wind uplift requirements and that exposed nail heads have been set.

][b. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

][c. Examine precast concrete decks to ensure that joints between precast units are properly grouted and leveled to provide suitable surfaces for installation of [ventilating felt] [vapor retarder] [and] insulation.

][d. In the presence of the Contracting Officer perform the following surface dryness test on concrete substrates:

(1) Foaming: When poured on the deck, one pint of asphalt when heated in the range of 176 to 204 degrees C 350 to 400 degrees F, does not foam upon contact.

(2) Strip ability: After asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from surface, do not consider surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been re-tested by method above and found dry.

][e. Prior to installing any roof system on a concrete deck, moisture test the deck in accordance with ASTM D4263. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

]3.1.2 Surface Preparation

To correct defects and inaccuracies in roof deck surface to eliminate poor drainage from hollow or low spots, perform the following:

a. Provide wood nailers of the same thickness as the insulation at eaves, edges, curbs, walls, and roof openings for securing of cant strips, gravel stops, [gutters,] flashing flanges, and curbs.[On decks with slopes of one in 12 (80 mm per 1 M) (one inch per foot) or more, install wood nailers perpendicular to slope for securing insulation [and for backnailing of roofing felts]. Space nailers in accordance with approved shop drawings.]

b. Fill or cover cracks or knot holes larger than 13 mm 1/2 inch in diameter in wood decks as necessary to form an unyielding surface.

c. Cover wood decks with a layer of rosin-sized building paper or unsaturated felt. Lap sides and ends not less than 75 mm 3 inches. Nail sufficiently to prevent tearing or buckling during installation.

d. Cover steel decks with a layer of insulation board of sufficient width to span the width of a deck rib opening, and in accordance with fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement in accordance with FM APP GUIDE. Locate insulation joints parallel to ribs of deck on solid bearing surfaces only, not over open ribs.

e. Solidly apply asphalt primer to [poured] [precast] concrete decks at the rate of 4 liters per 10 square meters one gallon per 100 square feet of roof surface[, stopping approximately 100 mm 4 inches from joints between precast concrete units]. Allow primer to dry thoroughly.[Place felt strips, 100 mm 4 inches or more in width, over joints, 50 mm 2 inches on each side, between precast concrete units in a heavy coating of cold-applied asphalt roof cement.]

]3.2 INSTALLATION OF VAPOR RETARDER

Install vapor retarder in direct contact with [roof deck surface] [ventilating felt] [insulation]. Unless otherwise specified, vapor retarder must consist of [either] two plies of No. 15 asphalt-saturated felt, two plies of asphalt-coated glass felt[, or one layer of asphalt-saturated felt base sheet]. Lay vapor retarder at right angles to direction of slope. Install first ply of felt [or base sheet] as specified herein for the specific deck. Apply second ply of 2-ply vapor retarder system using asphalt at rate of 10 to 18 kgs per 10 square meters 20 to 35 lbs per 100 square feet, applied within plus or minus 15 degrees C 25 degrees F of EVT. Do not heat asphalt above asphalt's FBT or 275 degrees C 525 degrees F, whichever is less. Use thermometers to check temperatures during heating and application. Completely seal side and end laps. Asphalt must be visible beyond all edges of each ply as it is being installed. Lay plies free of wrinkles, buckles, creases or fishmouths. Do not walk on mopped surfaces while asphalt is sticky. Press out air bubbles to obtain complete adhesion between surfaces. At walls, eaves, rakes, and other vertical surfaces, extend vapor retarder organic felts or separate plies 225 mm 9 inches, with not less than 225 mm 9 inches on the substrate, and the extended portion turned back and mopped in over the top of the insulation. At roof penetrations other than walls, eaves and rakes, and vertical surfaces, extend vapor retarder or separate plies 225 mm 9 inches to form a lap folded back over the edge of the insulation. Provide asphalt roof cement under the vapor retarder for at least 225 mm 9 inches from walls, eaves, rakes and other penetrations.

[3.2.1 Vapor Retarder on Poured or Precast Concrete Decks

Evenly mop primed substrate with asphalt at a rate of 10 to 18 kgs per 10 square meters 20 to 35 lbs per 100 square feet before installing vapor retarder. Lay first ply of two-ply system with each sheet lapping 480 mm 19 inches over the preceding sheet. Lap ends not less than 100 mm 4 inches. Stagger laps a minimum of 300 mm 12 inches.[For a vapor retarder consisting of one layer of asphalt base sheet, provide side and end laps not less than 100 mm 4 inches. Stagger laps a minimum of 300 mm 12 inches. Cement base sheets together with a solid mopping of asphalt.

3.2.2 Vapor Retarder on Wood Decks

Lay first ply of two-ply system dry with each sheet lapping 50 mm 2 inches over the preceding sheet. Lap ends not less than 100 mm 4 inches. Stagger laps a minimum of 300 mm 12 inches. Nail felt at 150 mm 6 inch intervals alongside laps and install two rows of nails approximately 275 mm 11 inches apart down longitudinal center of each sheet, with nails staggered at 450 mm 18 inches on center.[For vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 100 mm 4 inches over the preceding sheet. Provide end laps not less than 100 mm 4 inches and stagger laps a minimum of 300 mm 12 inches.] Cement side and end laps together with solid mopping of asphalt or heavy coat of asphalt roof cement. Nail side laps at 150 mm 6 inch intervals. Apply asphalt mopping at a rate of 10 to 18 kgs per 10 square meters 20 to 35 lbs per 100 square feet. Install two rows of nails approximately 275 mm 11 inches apart down longitudinal center of each sheet, with nails staggered at 450 mm 18 inches on center.

][3.2.3 Vapor Retarder on Steel Decks

Even mop the mechanically secured insulation surface with asphalt before installing vapor retarder. For a two-ply vapor retarder, install each sheet lapping 480 mm 19 inches over the preceding sheet. Lap ends not less than 100 mm 4 inches. Stagger the laps a minimum of 300 mm 12 inches. Cement felts together with solid mopping of asphalt. Apply asphalt moppings at rate of 10 to 18 kgs per 10 square meters 20 to 35 lbs per 100 square feet.[For a vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 100 mm 4 inches over preceding sheet. Lap ends not less than 100 mm 4 inches, and stagger laps a minimum of 300 mm 12 inches. Cement base sheets together with solid mopping of asphalt.]

]3.2.4 Over Gypsum Insulating Concrete or Lightweight Insulating Concrete

Lay one ply of venting inorganic base sheet, without mopping, at a right angle to the slope with 100 mm 4 inch side laps and 150 mm 6 inch end laps. Bond laps with hot asphalt. Stagger end laps.[Nail base sheet 220 mm 9 inches on center at side laps and in 2 rows 270 mm 11 inches apart down the center of the sheet with nails 450 mm 18 inches on centers and staggered][attach to the concrete deck in accordance with uplift requirements]. Apply 2-ply vapor retarder over the base sheet as specified above.

3.2.5 Over Concrete Decks and First Layer of Insulation on Steel Decks

Apply 2-ply vapor retarder as specified above except delete the venting inorganic base sheet.

3.2.6 Over Structural Concrete on Non-Venting Support

Lay one ply of venting inorganic base sheet with mopping holes at a right angle to the slope with 100 mm 4 inch side laps and 150 mm 6 inch end laps then apply the vapor retarder as specified.

[3.3 INSTALLATION OF VENTILATING FELT

Apply ventilating felt in accordance with manufacturer's printed instructions[, spot mopped with asphalt to concrete deck]. Extend over roof cants, up vertical surfaces and terminate under cap flashing. At roof edges terminate under outside edge of perimeter edge nailers or undergravel stop fascia.

]3.4 INSULATION INSTALLATION

Apply insulation in two layers with staggered joints when total required thickness of insulation exceeds 13 mm 1/2 inch. Lay insulation so that continuous longitudinal joints are perpendicular to direction of [felts for the built-up] roofing, as specified in Section [_____], and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, provide joints of each succeeding layer that are parallel and offset in both directions with respect to the layer below. Keep insulation 13 mm 1/2 inch clear of vertical surfaces penetrating and projecting from roof surface. Verify required slopes to each roof drain.

[3.4.1 Installation Using Asphalt

Firmly embed each layer in solid asphalt mopping; mop only sufficient area to provide complete embedment of one board at a time. Provide 10 to 18 kgs 20 to 35 lbs of asphalt per 10 square meters 100 square feet of roof deck for each layer of insulation. Apply asphalt when temperature is within plus or minus 15 degrees C 25 degrees F of EVT. Do not heat asphalt above asphalt's FBT or 275 degrees C 525 degrees F, whichever is less, for longer than 4 consecutive hours. Use thermometers to check temperatures during heating and application.

][3.4.2 Installation Using Asphalt on Steel Decks

Secure first layer of insulation [and thermal barrier] to deck with piercing or self-drilling, self-tapping fasteners. Engage fasteners by driving them through insulation into top flange of steel deck. Use driving method prescribed by fastener manufacturer. Locate insulation joints parallel to ribs of deck on solid bearing surfaces only, not over open ribs. Secure succeeding layers with solid asphalt moppings. Where insulation is applied over steel deck, locate long edge joints so that they bear continuously on the steel deck. Insulation that can be readily lifted after installation is not considered adequately secured. Apply insulation only in quantities that can be entirely waterproofed the same day. Phased construction is not permitted. Apply impermeable faced insulation without damage to the facing.

][3.4.3 Installation of Protection for Asphalt Work

Before starting asphalt work, protect surrounding areas and surfaces from spillage and migration of asphalt onto other work. Provide non-combustible protective coverings at surfaces adjacent to hoists and kettles. Lap protective coverings at least 150 mm 6 inches, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of asphalt work.

][3.4.4 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation with penetrating type fasteners.

][3.4.5 Installation Using Mechanical Fasteners and Foam Adhesive

Secure first layer of insulation [and thermal barrier] to deck with piercing or self-drilling, self-tapping fasteners. Engage fasteners by driving them through insulation into top flange of steel deck. Use driving method prescribed by fastener manufacturer. Locate insulation joints parallel to ribs of deck on solid bearing surfaces only, not over open ribs. Secure succeeding layers with foam adhesive using installation procedures as recommended by the insulation manufacturer for adhering the insulation and resisting the required wind uplift pressure. Installation must bond insulation securely to substrates without damaging insulation and substrates.

][3.4.6 Installation on Concrete Substrates

Install using foam adhesive using installation procedures as recommended by the insulation manufacturer for adhering the insulation to concrete surfaces and resist the required wind uplift pressure. Installation must bond insulation securely to substrates without damaging insulation and substrates.

]3.4.7 Special Precautions for Installation of Foam Insulation

[3.4.7.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install cover board over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

][3.4.7.2 Polystyrene Insulation

a. Over the top surface of non-composite polystyrene board, install 13 mm 1/2 inch thick high density wood fiberboard, 19 mm 3/4 inch thick expanded perlite board insulation, glass mat gypsum roof board, or other overlayment approved by roofing sheet manufacturer. Tightly butt and stagger joints of field applied overlayment board at least 150 mm 6 inches with respect to the polystyrene board below. Apply 150 mm 6 inch wide glass fiber roofing tape centered over joints and edges of overlayment board.

b. Where composite boards consisting of polystyrene insulation are provided, apply 150 mm 6 inch wide glass fiber roofing tape centered over joints and edges of composite board. Apply joint strips as recommended by roofing sheet manufacturer.

]3.4.8 Cant Strips

Where indicated, provide cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Wood cant strips must bear on and be anchored to wood blocking. Fit cant strips flush to vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in [heavy mopping of asphalt or set in a heavy coating of asphalt roof cement] [an approved adhesive].

3.4.9 Tapered Edge Strips

Where indicated, provide edge strips in the right angle formed by the juncture of roof and wood nailing strips that extend above the level of the roof. Install edge strips flush to vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in [a heavy mopping of asphalt or set in a heavy coating of asphalt roof cement] [an approved

adhesive].

3.5 PROTECTION

3.5.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with finished roofing specified in [_____] on same day. Phased construction is not permitted. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces is not permitted. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight in accordance with [indicated live load limits of roof construction] [a [_____] kg/sq. m psf live load limit]. Protect exposed edges of insulation with cutoffs at the end of each workday or whenever precipitation is imminent. Cutoffs must be two layers of bituminous-saturated felt set in plastic bituminous cement [or single ply] [or EPDM membrane] set in roof cement. Fill all profile voids in cutoffs to prevent trapping moisture below the membrane. Remove cutoffs when work resumes.

3.5.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.6 INSPECTION

Establish and maintain inspection procedures to assure compliance of the installed roof insulation with Contract requirements. Remove, replace, correct in an approved manner, any work found not in compliance. Quality control must include, but is not limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

b. Verification of certification, listing or label compliance with FM Data Sheets.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.

e. Inspection of mechanical fasteners; type, number, length, and spacing.

f. Coordination with other materials, cants, sleepers, and nailing strips.

g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

h. Installation of cutoffs and proper joining of work on subsequent days.

i. Continuation of complete roofing system installation to cover insulation installed same day.

j. Verification of required slope to each roof drain.

-- End of Section --

SECTION 07 31 00

SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide shingles for roofing applications.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

C. Warranty: Submit manufacturer’s standard warranty. Include labor and materials to repair or replace defective materials.

1. Warranty Period: Limited Lifetime

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt Shingles:

1. Manufacturers: Owens-Corning Duration Storm, CertainTeed Landmark TL, GAF Armorshield II, TAMKO Stormfighter FLEX4, Malarkey Legacy, or approved equal.
2. Salient characteristics: Color, Antique Silver, Limited Lifetime Warranty, 130 MPH Wind Resistance, 10-year Algae Resistance, Class 4 Impact Resistance.
3. Applicable Standards and Codes:

UL 2218, Class 4
ASTM D 3462
ASTM E 108, Class A
ASTM D 3161, Wind

ASTM D 3018, Type 1
ASTM D 228
UL 790, Class A
ASTM D7158, Class H Wind

4. Type: Three-dimensional, impact resistant, laminated strip shingles.
5. Accessories:
   a. Hip and ridge shingles.
   b. Self-Adhering Polymer Modified Bituminous Underlayment meeting ASTM D1970, similar to 75 mil TW Metal and Tile Underlayment as manufactured by Tamko Building Products, 60 mil Atlas Roofing WeatherMaster® TU Ultra, 60 mil CertainTeed MetaLayment, or approved equal.
   c. Metal flashing and drip edge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with recommendations of NRCA Steep Roofing Manual.

B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. Preparation verify deck is dry, sound, and smooth. It shall be free of any depressions, waves, and projections. Cover with sheet metal, all holes over 1 inch in diameter, cracks over ½ inch in width, loose knots and excessively resinous areas.

D. Previously installed self-adhered underlayment, remove any loose or unbonded area, and ensure deck below is sound meeting the standards above in section 3.1.C.

E. Install edge metal and drip metal prior to installation of underlayment.

F. Install Self-Adhered underlayment over entire deck surface.

G. Install water protection sheet at valleys, ridges, and eaves.

H. Install manufactured approved starter strip.

I. Install manufacture approved hip and ridge shingles.

J. Restore damaged components. Clean and protect work from damage.

END OF SECTION

SECTION 07 32 13
ROOF TILES
Fort Sill Standard – June 2023

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes

ASTM INTERNATIONAL (ASTM)

ASTM C1167	(2011) Standard Specification for Clay Roof Tiles
ASTM C1177/C1177M	(2013) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C270	(2012a) Standard Specification for Mortar for Unit Masonry
ASTM C67	(2013a) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM D2178/D2178M	(2013a) Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D226/D226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D412	(2006a; R 2013) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
ASTM D4586/D4586M	(2007; E 2012; R 2012) Asphalt Roof Cement, Asbestos-Free
ASTM E108	(2011) Fire Tests of Roof Coverings

ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ROOFING CONTRACTORS' ASSOCIATION (NRCA)

NRCA 0418	(2009) Steep-slope Roof System Manual

1.2 SUBMITTALS

Government approval is required for submittals. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Clay tile roofing system

SD-03 Product Data

Clay tile
Underlayment membrane
Flexible hip and ridge flashing

Glass mesh mortar units

Fiberglass-faced gypsum roof board

Submit data including tile properties, styles, and configurations.

SD-04 Samples

Manufacturer's color charts for Clay tile

Submit an appropriate number of tiles for each type to illustrate the full range of colors and surface finish.

SD-06 Test Reports

Self-adhering membrane underlayment

Glass mesh mortar units

Fiberglass-faced gypsum roof board

Preservative-Treated lumber

SD-07 Certificates

Qualifications of roofing personnel

SD-08 Manufacturer's Instructions

Installation

1.3 DELIVERY AND STORAGE

Deliver materials in the manufacturer's unopened bundles and containers bearing the manufacturer's brand name. Keep materials dry, completely covered, and protected from the weather. Store according to manufacturer's written instructions.

1.4 WARRANTIES

1.4.1 Contractor's Warranty

The Contractor shall warrant for 5 years that the tile roofing system, as installed, is free from defects in workmanship. When repairs due to defective workmanship are required during the Contractor's warranty period, the Contractor shall make such repairs within 72 hours of notification. When repairs are not performed within the specified time, emergency repairs performed by others will not void the warranty.

1.5 COORDINATION

Coordinate with the installation of flashing and gutters provided under Section 07 60 00 FLASHING AND SHEET METAL to ensure proper sequencing. Do not install roofing materials until vent stacks and other penetrations through roof deck have been installed.

1.6 EXTRA STOCK

Provide an extra two percent of each type and color of tile used in clean marked containers. In the extra stock provided, include hip, ridge, and other special shapes in the same proportion as used on the project.

1.7 QUALITY ASSURANCE

1.7.1 Qualifications of Roofing Personnel

Submit documentation showing qualifications of personnel proposed to perform the roofing work and a listing identifying prior installations completed by the

Contractor.

1.7.2 Clay Tile Roofing System Drawings

Submit drawings showing clay tile roofing installation and details for appearance, flashing and fastening of tiles.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Clay Tile

ASTM C1167, Grade 1, Machine formed natural clay tiles, Flat Bar Tile with interlocking edges, kiln-fired to vitrification and free from surface imperfections. Provide specially shaped, color-matched units as indicated or required, including hip and ridge covers, rake covers and birdstops. Provide with fastening holes preformed at factory prior to firing.

2.2 UNDERLAYMENT MEMBRANE

Provide underlayment membrane on surfaces that will be covered with tile. Membrane shall consist of high strength composite self-adhering membrane.

Provide Type II, No. 30 asphalt felt in accordance with ASTM D226/D226M.

2.2.3 Flexible Hip and Ridge Flashing

SBS modified rubberized asphalt adhesive on a lineal, low density polyethylene membrane with a 60 mil total thickness.

2.2.4 Self-Adhering Membrane Underlayment

ASTM D412, high strength polyethylene-sheet-backed, rubberized asphalt membrane, 40 mil thickness.

2.2.5 Primer for Self-Adhering Membrane Underlayment

VOC compliant primer as recommended by membrane manufacturer for application on concrete substrates.

2.3 SUBSTRATE PANELS

2.3.1 Glass Mesh Mortar Units

ASTM E84, exterior type panels consisting of portland cement, light weight

aggregate, with vinyl-coated woven glass fiber mesh imbedded in both surfaces, 7/16 inch thickness by 36 inch width by 48, 60, 72 or 96 inch lengths.

2.3.2 Fiberglass-Faced Gypsum Roof Board

ASTM C1177/C1177M, non-structural, fiberglass faced, silicone treated core gypsum panels, 48 by 96 by 1/2 inch thickness.

2.4 FASTENERS

2.4.1 Nails For Applying Felt Underlayment

Hot dip galvanized steel, thick 11 gage, sharp pointed, conventional roofing nails with barbed shanks, minimum 3/8-inch diameter head, and of sufficient length to penetrate 3/4 inch into nailable through substrate panels. Verify that nails are compatible with flashing materials to prevent galvanic action.

2.4.2 Nails for Installation of Tile

Copper ring shank nails, 10 gage, with minimum 7/16-inch diameter head or 10 gage stainless steel ring shank nails with minimum 3/8 inch head and of sufficient length to penetrate 3/4 inch into wood ridge and hip boards. Verify that chemicals used in pressure treatment of ridge and hip boards are compatible with copper nails.

2.4.3 Twisted-Wire Tie System

Continuously twisted 10 gage [copper][brass] [12 gage galvanized steel]wire with loops formed at 6 inches on center and with tie wires of 14 gage [copper] [brass] [16 gage galvanized steel] [0.037 inch diameter stainless steel] wire. Provide clips for anchorage of twisted-wire tie system to substrate as recommended by manufacturer.

2.4.4 Single-Line Wire Tie System

(10 gage copper) (10 gage brass] [12 gage galvanized steel] [0.084 inch stainless steel] pre-formed wire ties with a hook on one end and a loop on the other end. Lengths as required for manufacturer's recommended exposure.

2.4.5 Wind Locks

[10 gage copper] [10 gage brass] [12 gage galvanized steel] [0.084 inch diameter stainless steel] formed wire clips. Select material type as recommended by manufacturer for specific locations.

2.4.6 Hurricane Clips

Tile edge clips fabricated from [18 gage brass] [19 gage galvanized steel] [0.042 inch, type 302 stainless steel strips, 1/2 inch wide. Provide with two nail holes in horizontal leg for anchorage to deck or substrate. Select material type as recommended by manufacturer for specific locations.

2.5 PRESERVATIVE-TREATED LUMBER

AWPA C1, provide treated ridge and hip boards, eave starter strips and battens.

2.7 MORTAR

ASTM C270, Proportion specification for Type M mortar mix.

2.8 ASPHALT PLASTIC CEMENT ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

Examine roof deck for compliance with requirements of selected system. Verify that roof penetrations and openings are installed in their proper location.

3.2 PREPARATION

3.2.1 Cleaning

Clean roof deck surfaces to receive substrate panels or underlayment.

3.3 INSTALLATION

Comply with manufacturer's installation instructions and recommendations, but not less than recommended by NRCA 0418. Comply with local building code requirements for special fastening requirements such as wind locks and hurricane clips in high wind areas.

3.3.2 Felt Underlayment

Apply one layer of felt underlayment horizontally over entire surface to receive roofing tile, lapping succeeding courses a minimum of 2 inches, end laps a minimum of 6 inches, and hips and valleys a minimum of 12 inches. Fasten felt with sufficient number of roofing nails to hold underlayment in place until roofing tile installation. Provide additional layer of felt underlayment when recommended by roof tile manufacturer.

3.3.3 Self-Adhering Membrane Underlayment

Apply self-adhering membrane over [wood deck] [concrete deck] [substrate panels] in accordance with manufacturers recommendations. Provide manufacturer recommended primer for application on concrete surfaces.

3.3.4 Clay Roofing Tile Installation

Beginning at eaves, install roofing tiles as indicated and in accordance with recommendations of the tile manufacturer and fastening system manufacturer. Sawcut tiles at hips valleys and ridges. Cut tile at valleys to form a straight border. Taper valleys from a 2-inch exposure on each side of valley at top and increase exposure one inch, each side, per 8 feet of valley length. Set ridge and hip tile in a full bed of mortar and strike mortar flush with face of cover tiles. Apply flexible hip and ridge flashing over ridge and hip boards and top edge of tile. Apply asphalt plastic cement at lap between tiles at hip and ridge. Nail hip and ridge tiles to hip and ridge boards.
and nail through each tile into batten. Sawcut tiles at valleys to form a straight border. Taper valleys from a 2-inch exposure on each side of valley at the top and increase exposure by one inch, each side, per 8 feet of valley length. Set ridge and hip tile in a full bed of mortar and strike mortar flush with face of cover tile. Apply flexible hip and ridge flashing over ridge and hip boards and top edge of tile. Apply asphalt plastic cement between tiles at hip and ridge. Nail hip and ridge tiles to hip and ridge boards.

3.3.7 CLEANING

Remove mortar and asphalt plastic cement spatter from exposed surfaces of tiles. Upon completion of work, remove excess materials and all refuse generated by the work of this section.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of English unit measurement, and not on metric measurement commonly agreed to by the manufacturers or other parties. The English and metric units for the measurements shown are as follows:

Products	English Units	Metric Units
Nails - diameter	11 gage	2.9 mm
head diameter	3/8 inch	9.5 mm
Nails - diameter	10 gage	3.3 mm

head diameter	7/16 inch	11 mm
Wire	10 gage	3.3 mm
	12 gage	2.5 mm
	14 gage	1.8 mm
	0.037 inch	9.4 mm
	0.084 inch	2.13 mm
Edge Clips	18 gage	1.2 mm
	19 gage	1.05 mm
	0.042 inch	1.07 mm
	1/2 inch	13 mm
Birdstop	26 gage	0.5 mm

-- End of Section --

SECTION 07 32 14
CLAY TILE ROOFING REPLACEMENT OR REPAIR
Fort Sill Standard – June 2023

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B370	(2012) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C1167	(2011) Standard Specification for Clay Roof Tiles
ASTM C1184	(2014) Standard Specification for Structural Silicone Sealants
ASTM D146/D146M	(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D226/D226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D412	(2006a; R 2013) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D4586/D4586M	(2007; E 2012; R 2012) Asphalt Roof Cement, Asbestos-Free

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA	The NRCA Roofing and Waterproofing Manual - 2023

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

1.2 SUBMITTALS

Government approval is required for submittals. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Clay Tile Roofing Systems

Drawings showing clay tile installation and appearance details, flashing details and fastening details for the tiles.

SD-03 Product Data

Clay Tile Roofing Systems

Manufacturer's catalog data and installation instructions.

Qualifications

Documentation showing qualifications of personnel proposed to perform the roofing work, and a listing identifying prior installations completed by the Contractor.

SD-04 Samples

Clay Roofing Tile: One representative tile of each type.
Sealant: 8 ounces of each type.
Underlayment Membrane:1 by 1 foot section of each type.
Fasteners: Representative samples of each fastener with identifying tags.

SD-07 Certificates

Material

Certificates of compliance attesting that the materials meet specification requirements.

1.3 QUALIFICATIONS

The Contractor shall provide qualified workers, trained, and experienced in installing clay tile roofing systems of this configuration, and shall submit documentation of 5 consecutive years of work of this type. The Contractor shall be familiar with and shall perform work in accordance with SMACNA 1793 or NRCA Roof and Waterproofing Manual - 2023. A list of installations shall be provided which identifies when, where, and for whom the installations were made.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in manufacturer's unopened bundles and containers with the manufacturer's brand and name marked clearly thereon. Tiles shall be stored in accordance with manufacturer's printed instructions. Roll goods shall be stored on end in an upright position. Immediately before laying, roofing felt shall be stored for 24 hours in an area maintained at a temperature not lower than 50 degrees F.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Environmental Requirements

Clay tile roofing work shall proceed when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

1.5.2 Material Storage

Materials shall not be stored on roof decks in such a manner as to overstress and/or damage the deck and supporting structure. Placing of loads at midspans of framing shall be avoided. Superimposed loads shall be well distributed.

1.5.3 Units of Work

Units of work shall be established, including removal of existing materials, preparation of existing surfaces and application of underlayment and nailers, and related temporary and/or permanent flashing so that it can be completed prior to the end of each working day.

1.5.4 Temporary Protection Materials

Materials shall be provided and maintained on the site at all times for temporary roofing, flashing, and other protection when delays and/or changed weather conditions do not permit completion of each unit of work prior to the end of each working day. Materials which have been used for temporary roofing, flashing and other protection shall be removed and discarded.

1.6 WARRANTY

A material and labor warranty shall be furnished against defects in material and workmanship that affect the appearance, leak resistance, and attachment of clay tile roof assembly, including related metal flashing for a period of 10 years from date of final acceptance of the work. Warranty shall also cover the blow-off at wind gusts up to, and including, 90 mph.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Existing Clay Tile

Intact and serviceable existing clay tiles shall be salvaged and reused whenever possible. New clay tiles being incorporated into existing clay tile roofs shall match existing as closely as possible. Clay tiles from the same manufacturer as the original shall be used if possible.

2.1.2 Clay Roofing Tile

Clay roofing tile shall be minimum Grade 1 tile conforming to ASTM C1167. Tile shall be one-piece barrel type matching existing. Tile shall be glazed.

2.1.2.1 Colors

Clay tile color shall match existing.

2.1.2.2 Fittings

Clay tile fittings shall be as required by manufacturer's instructions.

2.1.3 Underlayment Membrane

An underlayment membrane shall be furnished on surfaces to be covered with tile. Membrane shall consist of asphalt-saturated felt and high strength composite self-adhering membrane.

2.1.3.1 Roofing Felt

Roofing felt shall be asphalt-saturated rag felt, Type II, No. 30 asphalt felt in accordance with ASTM D226/D226M.

2.1.3.2 Elastomeric Membrane Underlayment

Elastomeric membrane shall be a cold applied composite self-adhering membrane, minimum 0.004 inch thick, high strength polyethylene film with slip resistant embossing, coated on one side with a thick layer of adhesive-consistency rubberized asphalt, interwound with a disposable silicone coated release sheet. The tensile strength and elongation values shall be not less than 250 psi when tested in accordance with ASTM D412 and pliability shall be unaffected when tested in accordance with ASTM D146/D146M.

2.1.3.3 Elastomeric Membrane Accessories

Two component urethane, mastic and primer shall be as approved by the membrane manufacturer. Flashing, expansion joint covers, temporary UV protection and corner fillets shall be as recommended by the membrane manufacturer.

2.1.4 Fasteners

2.1.4.1 Nails

Nails shall be solid copper, Number 11 gauge nails, minimum 5/16 inch head. Nails shall be of sufficient length to adequately penetrate the roof sheathing.

2.1.4.2 Miscellaneous Fasteners

Miscellaneous fasteners may include but are not limited to: wind locks, hurricane clips, tile attachment brackets, tile nails, twisted wire (tile-tie),deck anchor systems, and flashing cleats. shall be made of solid copper (wind locks and hurricane clips can be made of stainless steel.

2.1.5 Flashing

Flashing shall be 0.57 kg 20 ounce, light cold-rolled temper (H00) copper conforming to ASTM B370. Like metals shall be used on all components of fastening systems and flashing in order to avoid galvanic action. Flashing shall be in accordance with the requirements as specified in Section 07 60 00 FLASHING AND SHEET METAL.

2.1.6 Plastic Cement

Plastic cement for gable rakes, hip rolls, ridges, stringers and other conditions shall be non-running, heavy body plastic cement composed of ingredients complying with ASTM D4586/D4586M.

2.1.7 Sealant

Sealant, when used in lieu of plastic cement, shall be silicone in accordance with ASTM C1184.

2.1.8 Mortar

Mortar for filling the openings of cut valley tiles shall consist of 1 part portland cement to 3 parts damp plaster sand, and shall be colored to the nearest possible match with the color of the tile.

2.1.9 Wood Strips

Wood strips for nailers, battens, cant strips, and eave strips shall be of foundation grade redwood or preservative treated Douglas fir. Sizes and lengths shall be provided per tile manufacturer's installation details.

2.1.10 Snow Guards

Snow guards which are compatible with the roof tile shall be provided as indicated.

PART 3 EXECUTION

3.1 PROTECTION OF ROOF SURFACES

Equipment (such as padded ridge ladders) and techniques shall be used which prevent damage to roof as a result of foot or material traffic. Contractor shall be responsible for controlling breakage of new or existing tile beyond what is indicated. The progression of work shall be laid out and presented to the Contracting Officer to prevent other trades from working on or above completed roofing. Personnel who are working on the roof shall have proper shoes which will not further damage tiles and shoe soles shall be made of a material which will aid in preventing falls.

3.2 TILE REMOVAL

Where work involves partial replacement or repair of roof, Contractor shall verify each tile for tightness and continued use. Tiles which have been identified for replacement or re-installation shall be marked for approval within 30 days of Notice to Proceed. Tiles identified for removal shall be marked with a non-destructive color mark which can be easily removed. Tiles fastened with non-copper fasteners shall be re-fastened with proper copper fasteners.

3.3 PREPARATION OF SURFACES

Roof deck surfaces shall be smooth, clean, firm, dry, and free from loose boards, large cracks, and projecting ends that might damage the roofing. Foreign particles shall be cleaned from all interlocking areas to ensure proper seating and to prevent water damming. Prior to installation of tile, vents and other projections through roofs shall be properly flashed and secured in position, and projecting nails shall be driven firmly home.

3.4 ROOFING FELT

3.4.1 Standard Application

Felt shall be laid in horizontal layers on deck areas to be covered with tile. Two layers of No. 30 felt shall be applied. Two layers shall be run down valley, ridges, and hips. Applications shall be doubled on rough surfaces and overlapped 12 inches on hips, valleys, and ridges. Membranes lapping valley felts shall be set in mastic. Joints shall be lapped 2-1/2 inches horizontally and 6 inches vertically. Felt shall be carried 6 inches up vertical surfaces and 4 inches over gutters. Edges shall be fastened with corrosion-resistant, 12-gauge, 3/8-inch head standard roofing nails on 6 inch centers. Felt shall be preserved unbroken.

3.5 ELASTOMERIC MEMBRANE UNDERLAYMENT

3.5.1 Surface Preparation

Dust, dirt, loose nails, or other protrusions shall be removed. Priming is not required for wood or metal surfaces but is necessary on concrete or masonry surfaces.

3.5.2 Primer

Primer shall be applied at a coverage rate of 250-350 sq. ft./gal. Primer shall be applied by spray or paint roller.

3.5.3 Temperature

Membrane shall be applied only in fair weather when air and surface temperatures are above 40 degrees F.

3.5.4 Membrane Application

Membrane shall be applied according to manufacturer's instructions. Membrane shall be adhered directly to roof deck. Pine wood decks shall be covered with minimum 1/4 inch plywood prior to receiving membrane coverage. Membrane shall be cut into 10 to 15 foot lengths and shall be re-rolled. The release paper shall be peeled back 1 to 2 feet and the membrane shall be aligned on the lower edge of the roof and the first 1 to 2 feet shall be placed. The release paper under the membrane shall be pulled and peeled from the membrane. The membrane shall be pressed in place. Lower edges shall be rolled firmly with a wallpaper or hand roller. For ice dam protection, membrane shall be applied to reach a point above the highest expected level of ice dams. Ends and edges shall be overlapped a minimum of 6 inches. Membrane shall not be folded onto an exposed face of the roof edge.

3.5.5 Valley and Ridge Application

The membrane shall be cut into 4 to 6 foot lengths. The release paper shall be peeled and the sheet centered over the valley or ridge, draped and pressed in place working from the center of the valley or ridge outward in each direction. For valleys, membrane shall be applied starting at the low point and working upwards. Sheets shall overlap a minimum of 6 inches.

3.5.6 Vertical Membrane Flashings

Vertical wall installations shall receive primer prior to the application of membrane. Primer shall be applied at a coverage rate of250-350 sq. ft./gal Membrane shall be turned up walls and dormers as indicated on the drawings. Vertical membrane terminations shall be mechanically fastened. Vertical terminations shall receive a troweling of mastic as approved by the membrane manufacturer. Membrane may be folded onto the fascia, provided it will be covered by a gutter metal edge or other material.

3.5.7 Protection

Elastomeric membrane underlayment shall not be left permanently exposed to sunlight. Membrane shall be covered with exposed roofing materials as soon as possible. Membrane damaged due to exposure to sunlight shall be patched prior to the application of final roof covering.

3.6 METAL FLASHING

Metal flashing shall be as shown at intersections of vertical or projecting surfaces through the roof or against which the roof abuts, such as walls, parapets, dormers, and sides of chimneys. Flashing installation shall be in accordance with Section 07 60 00 FLASHING AND SHEET METAL.

3.7 CLAY ROOFING TILE (GENERAL)

3.7.1 Repair and Replacement

Existing reusable clay tiles removed from the repair area shall be intermingled with new clay tiles to provide a smooth visual transition between new and existing areas.

3.7.2 Low Slope Pitches

Tiles on roof slopes of less than 3:12 shall be applied over indicated underlayment on solid decking. The mastic or sealant shall not stain the surface of the tile. Copper "hurricane clips" may be installed instead of using mastic or sealant.

3.7.3 Roof Decks and Fasteners

Tile shall be fastened to roof deck materials as follows:

DECK	FASTENER
Plywood	Slater's ring shank nail. Point shall just penetrate through underside of deck.
Plank board	Slater's plain shank nail, at least 25 m 1 inch or more in 1-1/2 inch thickness shall not penetrate deck.
Gypsum plank or Nailable Concrete	Stainless steel or silicone bronze nails with spiral threads, 1-1/2 or 2 inch long. Nail shall penetrate deck at least 1/2 thickness but no more than 3/4. Underside of deck shall not be penetrated. If deck material is old and excessively hard, smooth shank shall be used.
Metal	Sheet metal screw and mastic
Fibrous cement	Tile-tie system
Note: All fastening and flashing metals shall be of like material in order to avoid galvanic action.	

3.7.5 Chalk Lines

Horizontal and vertical guidelines shall be chalked on the membrane to assure proper appearance. The chalk lines shall be spaced by measuring the delivered tiles for average length and width exposures. An exposure length of 1/4 inch beyond the average shall not be exceeded.

3.8 ONE-PIECE BARREL TILE APPLICATION

3.8.1 Wood Strips

Wood stringers, 1 inch wide and of proper height, shall be applied on hips and ridges to carry hip roll and ridge. A 1 by 2 inch strip shall be applied for end bands. A 1 by 2 inch cant strip shall be applied at eaves if eave closures are not specified.

3.8.2 Tile Application

a. Eave closures shall be installed first.

b. Tiles shall be laid to straight lines parallel to ground level and shall be

lapped 3 inches vertically.

c. Each tile shall be fastened with the quantity of nails, wind locks and/or hurricane clips recommended by the manufacturer for the specified roof slope, building height, and wind velocity.

d. Nails on tiles overlapping sheet metalwork shall not puncture the sheet metal. Tiles overlapping sheet metal shall be fastened with copper wire and plastic cement.

e. Gable rakes shall be cemented to field tiles and fastened with 2” copper nails

f. Hip rolls shall be cemented in laps and fastened with 2 inch copper nails.

f. Ridges shall be cemented and fastened with 2-1/2-inch copper nails laps and where they rest on roof tiles.

g. Where tiles join hip stringers, they shall be made waterproof with flashing cement.

h. When hip starter and closed ridge end fittings have not been specified, the voids at ends of hips and ridges shall be filled with mortar colored to nearest match of tile color.

j. Tile in contact with cement mortar shall be immersed in water for at least 2 minutes before laying.

k. When ridge angles and hip/ridge terminals are not otherwise specified, they shall be mitered on job, nailed or wired, and set in plastic cement.

l. When short course tiles are not otherwise specified for rafters which do not accommodate full courses, they shall be cut and drilled on job by roofer unless a plus or minus 1 inch adjustment of regular tile overhang at eave is sufficient.

-- End of Section --

SECTION 07 41 00
CORRUGATED - PREFORMED ROOF AND WALL PANELS

PART 1 - GENERAL
1.01 Description

A. General

1. Furnish all labor, material, tools, equipment, and services for all preformed roofing, siding and mansard as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Related work specified elsewhere:

1. Structural steel: Section 05100.
2. Steel joists: Section 05200 or 05400
3. Flashing and sheet metal: Section 07600.

1.02 Quality Assurance

A. Applicable standards:

1. **SMACNA:** "Architectural Sheet Metal Manual" Sheet Metal and Air Conditioning Contractors National Association, Inc.
2. **AISC:** "Steel Construction Manual" American Institute of Steel Construction.
3. **AISI:** "Cold Form Steel Design Manual" American Iron and Steel Institute.
4. **ASTM A792-89:** Standard Specification for Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process, General Requirements
5. **ASTM A527-90:** Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
6. **ASTM A526-90:** Standard Specification for Steel Sheet, Zinc, Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
7. **ASTM A446-91:** Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
8. **ASTM B 117:** Salt spray testing of coating 1000 Hrs.
9. **ASTM G 23:** Accelerated testing of coating 2000 hrs.

B. Manufacturer's qualifications:

1. Manufacturer has a minimum of five years experience in manufacturing panels of this nature in a permanent, stationary, indoor production facility utilizing industrial equipment.
2. Manufacturer has current nationally recognized model building code agency product approvals for fastening design pressure capacities that meet projects uplift resistance test requirements per (UL 580 Class 90 or higher).

3. Manufacturer has an approved independent quality assurance inspection program to validate certified material and finished product specifications.
4. Manufacturer has permanent ink marking on panels that identifies the manufacturer, building code approvals, and date of production for material traceability and warranty validation.
5. Manufacturer's product is listed in the UL (Underwriters Laboratory) fire resistant directory.

C. Installer's qualifications:
1. Installation of panels and accessories by installers with a minimum of two years' experience in panel projects of this nature.

1.03 Submittals

A. Shop drawings:
1. Submit complete shop drawings and erection details to Government for review. Do not proceed with manufacture prior to review of shop drawings. Do not use drawings prepared by Architect for shop or erection drawings.
2. Shop drawings show methods of erection, elevations, and plans of roof panels, sections and details, anticipated loads, flashings, roof curbs, vents, sealants, interfaces with all materials not supplied and proposed identification of component parts and their finishes.

B. Samples:
1. Submit samples and color strips for all proposed finishes.
a. Submit one 12 in. long sample of panel.
b. Submit two 2 in round color chip samples in color selected by Government.

C. Warranty(s):
1. Metal panel manufacturer, upon final acceptance for project, furnish a warranty covering bare metal against rupture, structural failure, and perforation due to normal atmospheric corrosion exposure for a period of twenty-five (25) years.
2. Covering panel finish against cracking, checking, blistering, peeling, flaking, chipping, chalking, and fading for a period of twenty-five (25) years.

1.04 Product Delivery, Storage and Handling

A. Delivery:
1. Deliver panels to job site properly packaged to provide protection against transportation damage.

B. Handling:
1. Exercise extreme care in unloading, storing, and erecting panels to prevent bending, warping, twisting, end and surface damage.

C. Storage:

1. Store all material and accessories above ground on well skidded platforms.
2. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation buildup between each panel.

PART 2 - PRODUCTS

2.01 Materials

A. Panel profile:

1. 1/2" height rib x 24" width. 21 ½" Coverage (roofing) or 24" Coverage (walls)

B. Panel Style:

1. Exposed fastener

C. Gauge:

1. 24 gauge

D. Substrate

1. Galvalume steel sheet, AZ50, conforming to ASTM A792 for all panels

E. Texture:

1. Smooth

F. Finish:

1. Bare AZ-50 Acrylic Galvalume *(# 25-year warranty)*

G. Color:

1. Selected from manufacturer's standard line.

H. Acceptable manufacturers:

1. SOUTHEASTERN METALS MFG. CO.,
   FL,GA
   (800) 874-0335
2. DOT METAL
   PRODUCTS., TX
   (800) 331-9966
3. CONSTRUCTION METALS,
   INC., CA (800) 576-9810
4. WEATHER GUARD BUILDING
   PRODUCTS., CO (800) 999-6240
5. McELROY METAL
   (800) 950-6531
6. METAL BUILDING COMPONENTS
   INC.

(877) 713-6224

I. Other manufacturers desiring approval, comply with Section 01630.

2.02 Fabrication

A. Roll form panels in continuous lengths, full length of detailed runs.

B. Fabricate trim, flashing and accessories to detailed profiles.

C. Fabricate trim and flashing from same material as panel.

PART 3 - EXECUTION

3.01 Surface Conditions

A. Inspection:
   1. Inspect installed work of other trades and verify that such work is complete to a point where this work may continue.
   2. Verify that installation may be made in accordance with approved shop drawings and manufacturer's instructions.

B. Discrepancies:
   1. In event of discrepancy, notify Architect.
   2. Do not proceed with installation until discrepancies have been resolved.

3.02 Installation

A. Install panels so that they are weathertight, without waves, warps, buckles, fastening, stresses or distortion, allowing for expansion and contraction.

B. Install panels in accordance with manufacturer's installation instructions and shop drawings.

C. Provide concealed anchors at all panel attachment locations.

D. Install panels plumb, level, and straight with seams and ribs/battens parallel, conforming to design as indicated.

3.03 Cleaning, Protection

A. Dispose of excess materials and remove debris from site.

B. Clean work in accordance with manufacturer's recommendations.

C. Protect work against damage until final acceptance. Replace or repair to the satisfaction of

the Architect, any work that becomes damaged prior to final acceptance.

D. Touch up minor scratches and abrasions.

E. At completion of each day's work and at work completion, sweep panels and flashing clean. Do not allow fasteners, cuttings, filings or scrapes to accumulate on finished surfaces.

SECTION 07 41 13

METAL ROOF PANELS
05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100	(2012) North American Specification for the Design of Cold-Formed Steel Structural Members
AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1008/A1008M	(2018) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C552	(2017; E 2018) Standard Specification for Cellular Glass Thermal Insulation
ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C792	(2015; R 2020) Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D522/D522M	(2017) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D610	(2008; R 2019) Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	(2013; R 2018) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2017) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D1667	(2017) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D1970/D1970M	(2019) Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2015) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2019) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4587	(2011; R 2019; E 2019) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D5894	(2016) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E1592	(2017) Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E2140	(2001; R 2017) Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

FM GLOBAL (FM)

FM 4471	(2010) Class I Panel Roofs

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA RSDM	(2012) Metal Roofing Systems Design Manual

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA Roof Manual	(2022) Architectural Metal Flashing, Condensation and Air Leakage Control
NRCA Roof Manual	(2020) The NRCA Roofing Manual, Metal Panel And SPF Roof System

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006; Reprint Mar 2019) UL Standard for Safety Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	(updated continuously online) Building Materials Directory

1.2 DESCRIPTION OF METAL ROOF SYSTEM

1.2.1 Performance Requirements

Steel panels and accessory components must conform to the following standards:

ASTM A1008/A1008M
ASTM A123/A123M
ASTM A36/A36M
ASTM D522/D522M for applied coatings
UL Bld Mat Dir

1.2.1.1 Hydrostatic Head Resistance

No water penetration when tested according to ASTM E2140. Submit leakage test report upon completion of installation.

1.2.1.2 Wind Uplift Resistance

Provide metal roof panel system that conform to the requirements of ASTM E1592 and UL 580. Uplift force due to wind action governs the design for panels. Submit wind uplift test report prior to commencing installation.

Provide roof system and attachments that resist the wind loads as determined by ASCE 7-16, in pounds per square foot. Metal roof panels and component materials must also comply with the requirements in FM 4471 as

part of a panel roofing system as listed in Factory Mutual Guide (FMG) "Approval Guide" for class 1 or noncombustible construction, as applicable. Identify all materials with FMG markings.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing Panels; G

Flashing and Accessories; G

Gutter/Downspout Assembly; G

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Roof Panels; G

Recycled Content for Aluminum Roof Panels; S

Recycled Content for Steel Roof Panels; S

Energy Star Label for Metal Roofing Product; S

Heat Island Reduction; S

Factory-Applied Color Finish; G

Accessories; G

Fasteners; G

Pressure Sensitive Tape; G

Underlayments; G

Gaskets and Sealing/Insulating Compounds; G

Coil Stock; G

Aluminized Steel Repair Paint; G

Enamel Repair Paint; G

Galvanizing Repair Paint; G

SD-04 Samples

Factory-applied Color Finish, Samples, 9 inch lengths, full width; G

Accessories; G

Fasteners; G

Gaskets and Sealant/Insulating Compounds; G

SD-05 Design Data

Wind Uplift Resistance; G

SD-06 Test Reports

Leakage Test Report; G

Wind Uplift Test Report; G

Fire Rating Test Report; G

Factory Finish and Color Performance Requirements; G

SD-07 Certificates

Roof Panels; G

Coil Stock Compatibility; G

Self-Adhering Modified Bitumen Underlayment; G

Qualification of Manufacturer; G

Qualification of Applicator; G

SD-08 Manufacturer's Instructions

Installation Manual; G

SD-09 Manufacturer's Field Reports

Manufacturer's Field Inspection Reports; G

SD-11 Closeout Submittals

Warranties; G

Information Card; G

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Submit documentation verifying metal roof panel manufacturer has been in the business of manufacturing metal roof panels for a period of not less than 5 years.

Manufacturer must also provide engineering services by an authorized engineer, currently licensed in the geographic area of the project, with a minimum of five (5) years experience as an engineer knowledgeable in roof wind design analysis, protocols and procedures for MBMA RSDM, ASCE 7-16, UL 580, and FM 4471. Engineer must provide certified engineering

calculations for the project conforming to the stated references.

1.4.1.1 Single Source

Provide roofing panels, clips, closures, and other accessories that are standard products of the same manufacturer, and the most recent design of the manufacturer to operate as a complete system for the intended use.

1.4.2 Qualification of Applicator

Metal roof system applicator must be approved, authorized, or licensed in writing by the roof panel manufacturer and have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer, approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of 5 projects of similar size and scope constructed by applicator using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Field Verification

Prior to the preparation of drawings and fabrication, verify location of roof framing, roof openings and penetrations, and any other special conditions. Indicate all special conditions and measurements on final shop drawings.

1.4.4 Qualifications for Welding Work

Perform welding procedures in conformance to AWS D1.1/D1.1M for steel or AWS D1.2/D1.2M for aluminum.

Operators are permitted to make only those types of weldments for which each is specifically qualified.

1.4.5 Pre-roofing Conference

After approval of submittals and before performing roofing system installation work, hold a pre-roofing conference to review the following:

a. Drawings, specifications, and submittals related to the roof work. Submit, as a minimum; sample profiles of roofing panels, with factory-applied color finish samples, flashing and accessories, gutter/downspout assembly samples, typical fasteners and pressure sensitive tape, sample gaskets and sealant/insulating compounds. Also include data and 1/2 pint sample of , and technical data on coil stock and coil stock compatibility, and manufacturer's installation manual.

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Coordinate pre-roofing conference scheduling with the Contracting Officer. Attendance is mandatory for the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of metal roof system, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, and representative of the metal roofing manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, HANDLING, AND STORAGE

Deliver, store, and handle panel materials, bulk roofing products, accessories, and other manufactured items in a manner to prevent damage and deformation, as recommended by the manufacturer, and as specified.

1.5.1 Delivery

Package and deliver materials to the site in undamaged condition. Provide adequate packaging to protect materials during shipment. Do not uncrate materials until ready for use, except for inspection. Immediately upon arrival of materials at jobsite, inspect materials for damage, deformation, dampness, and staining. Remove affected materials from the site and immediately replace. Remove moisture from wet materials not otherwise affected, restack and protect from further moisture exposure.

1.5.2 Handling

Handle materials in a manner to avoid damage. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.5.3 Storage

Stack materials stored on site on platforms or pallets, and cover with tarpaulins or other weathertight covering which prevents trapping of water or condensation under the covering. Store roof panels so that water which may have accumulated during transit or storage will drain off. Do not store panels in contact with materials that might cause staining. Secure coverings and stored items to protect from wind displacement.

1.6 PROJECT CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements, and specified safety requirements.

1.7 FABRICATION

Fabricate and finish metal roof panels and accessories on a rolling mill to the greatest extent possible, per manufacturer's standard procedures and processes, and as necessary to fulfill indicated performance requirements. Comply with indicated profiles, dimensional and structural requirements.

Provide panel profile, as indicated on drawings including major ribs and intermediate stiffening ribs for full length of panel. Fabricate panel side laps with factory installed captive gaskets providing a weather tight seal and preventing metal-to metal contact, and minimizing noise from movements within the panel assembly.

1.7.1 Finishes

Finish quality and application processes must conform to the related standards specified within this section. Noticeable variations within the same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize any contrasting variations.

1.7.2 Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 as applicable to the design, dimensions, metal, and other characteristics of the item indicated.

a. Form exposed sheet metal accessories which are free from excessive oil canning, buckling, and tool marks, and are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

c. Sealed Joints: Form non-expansion, but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachments devices of size and metal thickness recommended by SMACNA or by metal roof panel manufacturer for application, but not less than the thickness of the metal being secured.

1.8 WARRANTIES

Provide metal roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to manufacturer's standard warranty as required to comply with the specified requirements.

1.8.1 Metal Roof Panel Manufacturer Warranty

Furnish the metal roof panel manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, components, trim, and accessories necessary for a watertight roof system construction. Make warranty directly to the Government, commencing at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period, the metal roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, displaces, corrodes, perforates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or

replacement of the defective and damaged materials of the metal roof system and correction of defective workmanship is the responsibility of the metal roof panel manufacturer. All costs associated with the repair or replacement work are the responsibility of the metal roof panel manufacturer.

b. If the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.8.2 Manufacturer's Finish Warranty

Provide a manufacturer's no-dollar-limit 20 year warranty for the roofing system. Issue the warranty directly to the Government at the date of Government acceptance, warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D2244.

1.8.3 Metal Roof System Installer Warranty

1.8.4 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the metal roof system manufacturer warranty for the remainder of the manufacturer warranty period.

1.9 CONFORMANCE AND COMPATIBILITY

Provide the entire metal roofing and flashing system in accordance with specified and indicated requirements, including wind resistance requirements. Perform work not specifically addressed and any deviation from specified requirements in general accordance with recommendations of the MBMA RSDM, NRCA Roof Manual, the metal panel manufacturer's published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

2.1 ROOF PANELS

2.1.1 Steel Sheet Panels

Roll-form steel sheet roof panels to the specified profile, with fy = 50 ksi,22 gauge and depth as indicated.

Provide steel panels with a minimum recycled content of 30 percent. Provide data indicating percentage of recycled content for steel roof panels.

Material must be plumb and true, and within the tolerances listed:

a. Galvanized steel sheet conforming to ASTM A653/A653M and AISI SG03-3.

c. Individual panels to have continuous length sufficient to cover the

entire length of any unbroken roof slope with no joints or seams and formed without warping, waviness, or ripples that are not a part of the panel profile and free from damage to the finish coating system.

d. Provide panels with thermal expansion and contraction consistent with the type of system specified, and the following profile:

(8) profile to be a 2 inch high standing seam, 16 inch coverage with mechanical crimping or snap-together seams with concealed clips and fasteners.

2.2 FACTORY FINISH AND COLOR PERFORMANCE REQUIREMENTS

All panels are to receive a factory applied polyvinylidene fluoride finish consisting of a baked topcoat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with an acid rinse, and thorough drying.

b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. Oven cure the prime coat prior to application of the finish coat.

c. Exterior Finish Coating: Apply the exterior finish coating over the primer by roll coating to a dry film thickness of 0.80 plus 0.05 mils (3.80 plus 0.05 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). Oven cure this exterior finish coat.

d. Interior finish coating: Apply a wash coat on the reverse side over primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. Oven cure the wash coat.

e. Color: The exterior finish chosen from the manufacturer's standard color chart.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General:	ASTM D5894 and ASTM D4587
Abrasion:	ASTM D968
Adhesion:	ASTM D3359
Chalking:	ASTM D4214

Chemical Pollution:	ASTM D1308
Color Change and Conformity:	ASTM D2244
Creepage:	ASTM D1654
Cyclic Corrosion Test:	ASTM D5894
Flame Spread:	ASTM E84
Flexibility:	ASTM D522/D522M
Formability:	ASTM D522/D522M
Gloss at 60 and 85 degrees:	ASTM D523
Humidity:	ASTM D2247 and ASTM D714
Oxidation:	ASTM D610
Pencil Hardness:	ASTM D3363
Reverse Impact:	ASTM D2794
Salt Spray:	ASTM B117
Weatherometer:	ASTM G152, ASTM G153 and ASTM D822

2.2.1 Specular Gloss

Finished roof surfaces to have a specular gloss value of 15 or less at an angle of 85 degrees when measured in accordance with ASTM D523.

2.2.2 Energy and Cool Roof Performance

The roofing system will need to include a top surface finish that meets the criteria for Cool Roof Products. Provide emittance and reflectance percentages, solar reflectance index values,slopes , to meet sustainable third party certification requirements for Heat Island Reduction.

2.3 MISCELLANEOUS METAL FRAMING

2.3.1 General

Provide cold formed metallic-coated steel sheet conforming to ASTM A653/A653M, AISI S100, and as specified in 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.3.2 Fasteners and Miscellaneous Metal Framing

Provide compatible type, corrosion resistant, of sufficient size and length to penetrate the supporting element a minimum of one inch with other required properties to fasten miscellaneous metal framing members to substrates in accordance with the roof panel manufacturer's and ASCE 7-16 requirements.

2.3.2.1 Exposed Fasteners

Provide corrosion resistant coated steel or stainless steel fasteners for roof panels, compatible with the sheet panel or flashing material and of the type and size recommended by the manufacturer to meet the performance requirements and design loads. Provide fasteners for accessories that are the manufacturer's standard. Provide an integral metal washer, matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick for exposed fasteners.

2.3.2.2 Screws

Provide corrosion resistant screws, coated steel or stainless steel of the type and size recommended by the manufacturer to meet the performance requirements.

2.3.2.3 Rivets

Provide closed-end type rivets, corrosion resistant coated steel or stainless steel where watertight connections are required.

2.3.2.4 Attachment Clips

Provide hot-dip galvanized, conforming to ASTM A653/A653M or stainless steel, series 300 clips. Size, shape, thickness and capacity must meet the thickness and design load criteria specified.

2.3.3 Electrodes for Manual, Shielded Metal Arc Welding

Utilize electrodes for manual, shielded metal arc welding meeting the requirements of AWS D1.1/D1.1M, that are covered, mild-steel electrodes conforming to AWS A5.1/A5.1M.

2.4 ACCESSORIES

Provide accessories compatible with the metal roof panels. Sheet metal flashing, trim, metal closure strips, caps, and similar metal accessories must be not less than the minimum thicknesses specified for roof panels. Provide exposed metal accessories to match the panels furnished. Provide molded foam rib, ridge and other closure strips that are closed-cell or solid-cell synthetic rubber or neoprene premolded to match configuration of the panels and not absorb or retain water.

2.4.1 Pre-manufactured Accessories

Provide pre-manufactured accessories that are manufacturer's standard for intended purpose, compatible with the metal roof system and approved for use by the metal roof panel manufacturer. Construct curbs to match roof slope.

2.4.2 Metal Closure Strips

Provide factory fabricated steel closure strips of the same gauge, color, finish and profile as the specified roof panel.

2.4.3 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber closure strips conforming to

ASTM D1056 and ASTM D1667, extruded or molded to the configuration of the specified roof panel profile and in lengths supplied by roof panel manufacturer.

2.5 JOINT SEALANTS

2.5.1 Sealants

Sealants are to be an approved gun type for use in hand or air pressure caulking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F) with a minimum solid content of 85 percent of the total volume. Ensure sealant dries with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather tight joint. No migratory staining, in conformance with to ASTM C792, is permitted on painted or unpainted metal, stone, glass, vinyl or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the roof panel manufacturer.

2.5.1.1 Shop Applied Sealants

Provide sealant for shop-applied caulking that is an approved gun grade, non-sag one-component polysulfide or silicone conforming to ASTM C792 and ASTM C920, Type II, with a curing time which ensures the sealants plasticity at the time of field erection. Color to match panel color.

2.5.1.2 Field Applied Sealants

Provide sealants for field-applied caulking that is an approved gun grade, non-sag on-component polysulfide or two component polyurethane with an initial maximum Shore A durometer hardness of 25, conforming to ASTM C920, Type II. Color to match panel color.

2.5.1.3 Tape Sealants

Provide pressure sensitive, 100 percent solid tape sealant with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the roof panel manufacturer.

2.5.2 Sheet Metal Flashing and Trim

2.5.2.1 Fabrication, General

Custom fabricate sheet metal flashing and trim to comply with recommendations within the SMACNA 1793 that apply to design, dimensions, metal type, and other characteristics of design indicated. Shop fabricate items to the greatest extent possible. Obtain and verify field measurements for accurate fit prior to shop fabrication. Fabricate flashing and trim without excessive oil canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

2.5.2.2 Roof Drainage Sheet Metal Fabrications

Gutters: Refer to specification section 07 60 00 FLASHING AND SHEET METAL for gutter design requirements.

Downspouts: Refer to specification section 07 60 00 FLASHING AND SHEET

METAL for downspout design requirements.

2.6 INSULATION

Provide insulation, facer material and attachment compatible with metal roof system specified, as approved by the roof panel manufacturer, and conform to ASTM C552 (cellular glass) or ASTM C553 (fiber blankets).

2.7 UNDERLAYMENTS

2.7.1 Self-Adhering Modified Bitumen Underlayment

Provide self-adhering modified bitumen membrane underlayment material in compliance with ASTM D1970/D1970M, suitable for use as underlayment for metal roofing. Use membrane resistant to cyclical elevated temperatures for extended period of time in high heat service conditions. Provide membrane with integral non-tacking top surface of polyethylene film or other surface material to serve as separator between bituminous material and metal products to be applied above.

2.8 GASKETS AND SEALING/INSULATING COMPOUNDS

Provide gaskets and sealing/insulating compounds that are nonabsorptive and suitable for insulating contact points of incompatible materials. Utilize sealing/insulating compounds that are non-running after drying.

2.9 FINISH REPAIR MATERIAL

Only use repair and touch-up paint supplied by the roof panel manufacturer and is compatible with the specified system.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the work. Ensure surfaces are suitable, dry and free of defects and projections which might affect the installation.

Examine primary and secondary roof framing to verify that rafters, purlins, angels, channels, and other structural support members for panels and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer, UL, ASTM, and ASCE 7-16 requirements.

Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking; and that installation is within flatness tolerances required by metal roof panel manufacturer.

Examine rough-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of panels prior to installation.

Submit a written report to the Contracting Officer, endorsed by the installer, listing conditions detrimental to the performance of the work. Proceed with installation only after defects have been corrected.

Do not install items that show visual evidence of biological growth.

3.2 INSTALLATION

Perform installation meeting specified requirements and in accordance with the manufacturer's installation instructions and approved shop drawings. Do not install damaged materials. Insulate dissimilar materials which are not compatible when contacting each other by means of gaskets or sealing/insulating compounds. Keep all exposed surfaces and edges clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Remove stained, discolored, or damaged materials from the site.

3.2.1 Preparation

Clean all substrate substances which may be harmful to insulation, and roof panels including removing projections capable of interfering with insulation, and roof panel attachment.

Install sub-purlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

3.2.2 Underlayment

Install underlayment according to roof panel manufacturer's written recommendations and recommendation in NRCA "The NRCA Roofing and Waterproofing Manual".

3.2.2.1 Self-Adhering Sheet Underlayment

Install self-adhering sheet underlayment; wrinkle free on roof deck. Comply with low-temperature installation restrictions of manufacturer where applicable. Install at locations indicated on project drawings, lapped in a direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

3.3 INSULATION INSTALLATION

Install insulation concurrently with metal roof panel installation, in thickness indicated, to cover entire roof, according to manufacturer's written instructions.

3.4 PROTECTION OF APPLIED MATERIALS

Do not permit storing, walking, wheeling, and trucking directly on applied roofing/insulation materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing/insulation materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.5 FASTENER INSTALLATION

Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions.

3.5.1 Welding

Perform procedures for manual, shielded metal-arc welding, the inspection

and testing of welds made, and the methods used in correcting welding work in accordance with AWS D1.1/D1.1M.

3.6 FLASHING, TRIM, AND CLOSURE INSTALLATION

3.6.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently water tight and weather resistant. Work is to be accomplished to form weather tight construction without waves, warps, buckles, fastening stresses or distortion, and to allow for expansion and contraction. Perform cutting, fitting, drilling, and other operations in connection with sheet metal required to accomplish the work in conformance with the manufacturers written instructions.

3.6.2 Metal Flashing

Install exposed metal flashing at building corners, rakes, eaves, junctions between metal siding and roofing, valleys and changes off slope or direction in metal roofing, building expansion joints and gutters.

Utilize exposed metal flashing that is the same material, color, and finish as the specified metal roofing panels. Furnish flashing in minimum 8 foot lengths. Exposed flashing must have 1 inch locked and blind soldered end joints, with expansion joints at intervals of no greater than 16 feet.

Fasten flashing at not more than 8 inches on center for roofs, except where flashing is held in place by the same screws used to secure panels. Bed exposed flashing and flashing subject to rain penetration in specified joint sealant. Isolate flashing which is in contact with dissimilar metals by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.7 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels or other components of the Work securely in place, with provisions for thermal and structural movement in accordance with NRCA Roofing Manual.

Steel Roof Panels: Use stainless steel fasteners for exterior surfaces and galvanized fasteners for unexposed surfaces.

Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions. Provide all blocking and nailers as required.

Metal Protection: Where dissimilar metals contact each other or possibly corrosive substrates, protect against galvanic action by permanent separation as recommended by the metal roof panel

manufacturer.

Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and required for weatherproof performance of metal roof panel system. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

3.7.1 Handling and Erection

Erect roofing system in accordance with the approved erection drawings, printed instructions and safety precautions of the manufacturer.

Do not subject panels to overloading, abuse, or undue impact. Do not apply bent, chipped, or defective panels. Replace and remove from the site any damaged panels at the Contractor's expense. Erect panels true, plumb, and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with indicated rake, eave, and curb overhang. Allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Do not permit storage, walking, wheeling or trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of the roof construction.

Lay roof panels with corrugations in the direction of the roof slope. Lap ends of exterior roofing not less than 8 inches; lap sides of standard exterior corrugated panels not less than 2-1/2 corrugations.

Field cutting of metal roof panels by torch is not permitted. Field cut only as recommended by manufacturer's written instructions.

3.7.2 Closure Strips

Install metal closure strips at open ends of metal ridge rolls; open ends of corrugated or ribbed pattern roofs, and at intersection of wall and roof, unless open ends are concealed with formed eave flashing; rake of metal roof unless open end has a formed flashing member; and in other required areas.

Install closure strips at intersection of the wall with metal roofing; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.7.3 Workmanship

Make lines, arises, and angles sharp and true. Free exposed surfaces from any visible wave, warp, buckle and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793.

Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and as necessary to make the work watertight.

3.8 ACCEPTANCE PROVISIONS

3.8.1 Erection Tolerances

Erect metal roofing straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions. Horizontal lines must not vary more than 1/4 inch in 20 feet or 3/8 inch in 40 feet.

3.8.2 Leakage Tests

Finished application of metal roofing is to be subject to inspection and test for leakage by the Contracting Officer or his designated representative, and Architect/Engineer. Inspection and tests will be conducted without cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and removal/replacement of defective materials.

3.8.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials and as recommended by the metal roof panel manufacturer. Finished repaired surfaces must be uniform and free from variations of color and surface texture. Repaired metal surfaces that are not acceptable to the project requirements are to be immediately removed and replaced with new material.

3.8.4 Paint Finished Metal Roofing

Paint finished metal roofing will be tested for color stability by the Contracting Officer during the manufacturer's specified guarantee period. Remove and replace panels that indicate color changes, fading, or surface degradation, determined by visual examination with new panels at no expense to the Government. New panels will be subject to the specified tests for an additional year from the date of their installation.

3.9 CLEAN UP AND DISPOSAL

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating. Touch up scratches in panel finish with manufacturer supplied touch-up paint system to match panel finish. Treat exposed cut edges with manufacturer supplied clear coat.

Collect all scrap/waste materials and place in containers. Promptly dispose of demolished and scrap materials. Do not allow scrap/waste materials to accumulate on-site; transport immediately from the government property and legally dispose of them.

3.10 FIELD QUALITY CONTROL

3.10.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

Submit three signed copies of the manufacturer's field inspection reports to the Contracting Officer within one week of substantial completion.

3.11 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display.

Make card 8 1/2 by 11 inches minimum, identifying facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, roof panel manufacturer and product name, type underlayment(s), date of completion; installing contractor identification and contact information; manufacturer warranty expiration, warranty reference number, and contact information. Install card at location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

-- End of Section --

SECTION 07 53 24
THERMOPLASTIC POLYOLEFIN ROOFING
Fort Sill TPO Standard – June 2023

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI RD-1 Standard for Retrofit Roof Drains

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D 448 Sizes of Aggregate for Road and Bridge Construction

ASTM D 4811 Nonvulcanized (Uncured) Rubber Sheet Used as Roof Flashing

ASTM E 108 Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM AS 4470 Class I Roof Covers

FM P7825 Approval Guide

FM P7825c Approval Guide Building Materials

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA Roofing and Waterproofing Manual - 2023
NRCA NRCA Roofing Manual: Membrane Roof Systems-2023
NRCA NRCA Roofing Manual: Architectural Metal Flashing and Condensation and Air Leakage Control – 2022

UNDERWRITERS LABORATORIES (UL)

UL 790 Test Methods for Fire Tests of Roof Coverings

UL RMSD Roofing Materials and Systems Directory

UNIFIED FACILITIES CRITERIA (UFC)

UFC 3-110-03 (12June 2020) Roofing (With Change 5)

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEM

Fully Adhered 135 Mil FleeceBack TPO Roofing Membrane with flashings and accessories necessary to comprise a roofing system. All membrane thicknesses listed in this specification are nominal thicknesses. The work includes but is not necessarily limited to the installation of wood blocking (nailers), insulation, fasteners, roof membrane, roof membrane flashings, metal flashings, adhesives, and sealants.

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following:

Shop Drawings

Roof Plan Drawing
Wind Load Calculations
Slopes and Drain Locations

Product Data

FleeceBack TPO Sheet
Bonding Adhesive
Lap Splice Adhesive
Flashings
Flashing Accessories
Fasteners and Plates
Roof Insulation
Pre-Manufactured Accessories

Sample warranty certificate

Submit all data required together with requirements of this section. Include a written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided. List products in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

Design Data

Wind Uplift Calculations

Engineering calculations validating the wind resistance of roof system.

Certificates

Qualification of Manufacturer

Certify that the manufacturer of the roof membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator."

Fire Resistance classification

Submit the roof system assembly fire rating classification listings.

Manufacturer's Instructions

Application

Application Method, including pattern and frequency of mechanical attachments required in the field of roof, corners, and perimeters to provide for the specified wind resistance.

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's printed instructions and the specified requirements.

Closeout Submittals

Warranty
Information Card

Instructions To Government Personnel

Include copies of Material Safety Data Sheets for maintenance/repair materials.

1.3.1 Shop Drawings

Roof plan drawing depicting wind load calculations and boundaries of enhanced perimeter and corner attachments of roof system components, location of perimeter half-sheets, spacing of perimeter, corner, and infield fasteners, as applicable. The drawing must reflect the project roof plan of each roof level and conditions indicated. Provide all slopes and drain locations.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

TPO sheet roofing membrane manufacturer must have at least 5 years experience in manufacturing TPO roofing products.

1.4.2 Qualification of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the roof membrane manufacturer and must have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator must supply the names, locations and client contact information of 5 projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Fire Resistance

Complete roof covering assembly must:

a. Be Class A rated in accordance with ASTM E 108, FM AS 4470, or UL 790; and

b. Be listed as part of Fire-Classified roof deck construction in the UL RMSD or Class I roof deck construction in the FM P7825. FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

1.4.4 Wind Uplift Resistance

Complete roof covering assembly, including insulation, must be rated Class 1-90 in accordance with FM P7825 capable of withstanding an uplift pressure of 90 psf.

1.4.5 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

a. Drawings, specifications and submittals related to the roof work;

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in their original, unopened containers or wrappings with labels intact and legible. Where materials are covered by a referenced specification number, the labels must bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow continuity of work.

1.5.2 Storage

Store and protect materials from damage and weather in accordance with manufacturer's printed instructions, except as specified otherwise. Keep materials clean and dry. Store and maintain adhesives, sealants, primers and other liquid materials above 60 degrees F. Insulated hot boxes or other enclosed warming devices must be required in cold weather. Mark and remove damaged materials from the site. Use pallets to support and canvas tarpaulins to completely cover material materials stored outdoors. Do not use polyethylene as a covering. Locate materials temporarily stored on the roof in approved areas and distribute the load to stay within the live load limits of the roof construction. Remove unused materials from the roof at the end of each day’s work.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment so as not to damage materials or applied roofing. Do not use materials contaminated by exposure or moisture. Remove contaminated materials from the site. When hazardous materials are involved, adhere to the special precautions of the manufacturer. Adhesives may contain petroleum distillates and may be extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install FleeceBack TPO sheet roofing during high winds or inclement weather, or when there is ice, frost, moisture, or visible dampness on the substrate surface, or when condensation develops on surfaces during application. Unless recommended otherwise by the TPO sheet manufacturer and approved by the Contracting Officer, do not install TPO sheet when air temperature is below 40 degrees F or within 5 degrees F of the dew point. Follow manufacturer's printed instructions for installation during cold weather conditions.

1.7 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Application of roofing must immediately follow application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.8 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements.

1.8.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20 year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. The maximum wind speed coverage shall be peak gust 90 mph measured at 10 meters above ground level. The warranty must run directly to the Government and commence at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, shrinks to the point of bridging or tenting membrane at transitions, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship must be the responsibility of the roof membrane manufacturer. The roof membrane manufacturer is responsible for all costs associated with the repair or replacement work.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

c. Warranty shall also cover leaks caused by accidental punctures:

1. 16 man-hours per year for 135-mil FleeceBack TPO

d. Warranty shall also cover leaks caused by hail:

1. Hail up to 2” diameter when 135-mil FleeceBack TPO is installed.

e. Pro-rated System Warranties shall not be accepted.

f. All roof system components effected by moisture intrusion will be repaired or replaced under roof warranty.

1.8.2 Roofing System Installer Warranty

Warrant for a period of not less than two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. The warranty must run directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The installer is responsible for all costs associated with the repair or replacement work.

1.8.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period, as required, and accomplish in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.8.3

1.9 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system must be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA Roofing Manual, membrane manufacturer published recommendations and details, ASTM D 6369, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

2.1 MATERIALS

Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Protect materials provided from defects and make suitable for the service and climatic conditions of the installation.

2.1.1 TPO Sheet

The reinforced FleeceBack TPO membrane shall be a minimum of 80 mils TPO + 55 mil Fleece nominal thickness. Color shall be selected by the Contracting officer from the manufacturer’s full line of available colors. The FleeceBack TPO membrane is a reinforced thermoplastic polyolefin roofing membrane.

Do not allow contaminants such as petroleum, acid, solvents, etc. or direct steam venting to come into direct contact with the TPO Roofing Membrane. Do not install the FleeceBack TPO Roofing Membrane in direct contact with any product containing coal tar pitch, creosote or penta-based materials.

2.1.2 TPO Bonding Adhesive

A solvent-based rubberized adhesive for bonding the TPO Membrane to various vertical substrates and insulation boards. The TPO bonding adhesive is a two-surface contact adhesive applied to both the underside of the membrane and substrate surface. The product shall be compatible with polyisocyanurate and wood fiberboard insulations, masonry, metal and wood surfaces.

2.1.3 TPO Cut-Edge Sealant

A solvent-based, liquid sealant used to seal the cut edge of the FleeceBack TPO Membrane.

2.1.4 Membrane Flashings and Flashing Accessories

TPO Molded Pipe Seals, TPO Universal Corners.

2.1.5 Auxiliary Fasteners

Corrosion resistance screws, nails, or anchors suitable for intended attachment purpose and as recommended by the roof membrane manufacturer.

2.1.6 Pre-Manufactured Accessories

Pre-manufactured accessories must be manufacturer's standard for intended purpose, compatible with the membrane roof system and approved for use by the roof membrane manufacturer.

2.1.7 Rubber Walkboards

Preformed reprocessed rubber, compatible with the TPO sheet, 1/4 inch minimum thickness, and weighing not less than 1-1/2 pounds per square foot.

2.1.8 Roof Insulation Below TPO Sheet

Insulation system and facer material must be compatible with membrane application specified and as approved by the roof membrane manufacturer. Polyisocyanurate insulations having non-asphaltic facers (foil facers are not acceptable) meeting the physical property requirements of Fed. Spec HH-I-1972 and having a minimum compressive resistance of 18 psi. New Insulation thickness to meet ASHRAE 90.1-2022 for zone 3A.

2.1.9 Roof Board

Roof board to be compliant with TPO membrane and insulation warranty system for both wind and hail resistance.

2.1.10 Wood Products

Nailers shall be #2 or better lumber and shall be pressure treated for rot resistance. Creosote and asphaltic preservatives are not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. Drains, curbs, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.

c. The plane of the substrate does not vary more than 1/4 inch within an area 10 by 10 feet when checked with a 10 foot straight edge placed anywhere on the substrate.

d. Substrate is sloped to provide positive drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.

f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inch above finished roofing surface.

g. Pressure-preservative treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures. Surface-applied nailers are the same thickness as the roof insulation.

h. Avoid contact of TPO materials with fire retardant treated wood, except as approved by the roof membrane manufacturer and Contracting Officer.

i. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than 3-1/2 inch.

j. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled.
There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

3.2 APPLICATION

Apply entire TPO sheet utilizing fully adhered application method. Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer.

3.2.1 Special Precautions

a. Do not dilute coatings or sealants unless specifically recommended by the materials manufacturer's printed application instructions. Do not thin liquid materials with cleaners used for cleaning TPO sheet.

b. Keep liquids in airtight containers, and keep containers closed except when removing materials.

c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some elastomeric sheets and insulations; follow adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.

d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane

e. Do not use heat guns or open flame to expedite drying of adhesives or primers.

f. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.

g. Do not use equipment with sharp edges which could puncture the TPO sheet.

h. Shut down air intakes and any related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the Contracting Officer.

3.2.2 TPO Sheet Roofing

Provide a watertight roof membrane sheet free of contaminants and defects that might affect serviceability. Provide a uniform, straight, and flat edge. Unroll TPO sheet roofing in position without stretching membrane. Inspect for holes. Remove sections of TPO sheet roofing that are damaged. Allow sheets to relax minimum 30 minutes before seaming. Lap sheets as specified, to shed water, and as recommended by the roof membrane manufacturer's published installation instructions for the application required but not less than 3 inch in any case.

3.2.3 Application Method

3.2.3.1 Fully Adhered Membrane Application

Once several sheets are rolled out, carefully positioned with the proper overlaps and have relaxed, each sheet shall be folded in half, lengthwise. A smooth, even coat of TPO bonding adhesive shall be applied to both the insulation and the exposed bottom side of the membrane.
Adhesive shall be applied to each surface at a rate of approximately 120 square feet per gallon with minimum 1/2-inch thick nap solvent-resistant paint rollers. Due to the porosity of different insulations, coverage rates may vary. Once the membrane is mated to the substrate the "finished coverage rate" will be approximately 60 square feet per

gallon. Apply adhesive in smooth even coats, avoiding globs, puddles or other types of irregularities. Once the adhesive has dried to the point of being tacky but will not string or produce adhesive legs with a light touch of a finger, the membrane shall be rolled onto the coated substrate being careful not to wrinkle the sheet or trap pockets of air. Once the membrane has been mated to the insulation/substrate, the membrane surface shall be thoroughly broomed with a stiff bristled push broom to ensure proper contact and 100% adhesion. Care should be taken to ensure the TPO bonding adhesive is not applied to any membrane areas where seaming shall take place. All welding must be done to clean membrane. Repeat this procedure for the second half of the sheet and each successive sheet of membrane on the roof, remembering to shingle all laps. Do not run any seams through field drains or sumps. Any seams running through drains shall be cut out and target patches (36” x 36”) shall be installed. The TPO Membrane shall be mechanically attached at the base of all parapet walls, walls, curbs, at all peaks, valleys and slope intersections where the net change in slope is greater than 1-1/2 inches per foot (12 inches).

3.2.4 Adhesive Seams / Lap Splices

Weld all laps (seams and end laps) continuously with a minimum weld width of 1-1/2 inches. All field welds shall be completed with an automatic welder. All membrane overlaps shall be installed to facilitate the flow of water. Seams shall be shingled or run parallel to the flow of water. Backwater seams are not permitted.

3.3 FLASHINGS

3.3.1 General

Provide flashings in the angles formed at walls and other vertical surfaces and where required to make the work watertight, except where metal flashings are indicated.

3.3.2 Membrane Flashing

All membrane flashings are to be installed concurrently with the roof membrane as the project progresses. Should any water penetrate the new roofing because of incomplete flashings, the affected areas shall be removed and replaced at the contractor's expense.

All TPO Membrane flashings shall be fully adhered to vertical surfaces/substrates using TPO bonding adhesive. The following conditions must be met:

a. All surfaces to be fully adhered should be compatible, dry and smooth with no excessive surface roughness.

b. All flashing membrane shall be cut from the standard field sheet/half sheet. Non-Reinforced Flashing is a .060 non-reinforced material that is used only to flash corners, field flash pipes and other details that require the product to be molded into place.

c. After the surface has been properly prepared, TPO bonding adhesive shall be applied to the substrate (surface to be flashed) using a minimum 1/2" nap paint roller at a rate of approximately 1 gallon per 120 square feet of surface area. Coverage rates may vary due to the type of substrate. Apply adhesive in smooth even coats, avoiding globs, puddles or other types of irregularities.

d. TPO membrane used as flashing shall be cut to a workable length and shall have an even coat of TPO bonding adhesive applied to it at a rate of approximately 1 gallon per 120 square feet. Let adhesive dry to be tacky when touched with a dry, clean finger but does not produce strings. Carefully roll onto the previously coated substrate after the adhesive coating the membrane has dried to the point of being tacky.

All flashings shall extend a minimum of 8 inches above roof membrane level, where possible. Do not cover "thru-wall" flashings and weep holes.

All flashings shall be hot air welded at their connections with the roofing membrane. All hand welds shall be a minimum of 1-1/2 inches wide.

All flashings shall be properly terminated according to published Standard Details.

3.3.3 Flashing at Roof Drain

Prepare the surface around each drain to prevent any distortion, tenting, or bridging of the membrane. A smooth transition shall be provided from the roof surface to the surface of the drain bowl/clamping ring. All existing roofing materials and metal flashings shall be removed.
Apply one full tube of Water Cut-Off Mastic per drain to the drain bowl, under the membrane, where the clamping ring will be seated. This will provide a continuous seal between the membrane and the drain bowl. Do not run field seams through drains or sumps. If sheet layout causes a seam to fall in line with a drain, a target patch (minimum 36” x 36”) shall be required.

3.3.4 Correction of Deficiencies

Where any form of deficiency is found, additional measures must be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions must be as directed by the Contracting Officer.

3.3.5 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.4 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied membrane roofing system from water intrusion.

3.5 FIELD QUALITY CONTROL

3.5.1 Construction Monitoring

During progress of the roof work, Contractor must make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Equipment is in working order. Metering devices are accurate.

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

d. Nailers and blocking are provided where and as needed.

e. Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

f. The proper number, type, and spacing of fasteners are installed.

g. Materials comply with the specified requirements.

h. All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.

i. Membrane is allowed to relax prior to seaming. Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required, including additional fastening of membrane in corner and perimeter areas as required.

j. Membrane is properly overlapped.

k. Membrane seaming is as specified and seams are hand rolled to ensure full adhesion and bond width. In-seam sealant is applied when adhesive seams are used in the field of the roof. All seams are checked at the end of each work day.

l. Applied membrane is inspected and repaired as necessary prior to ballast installation.

m. Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths.

n. Installer adheres to specified and detailed application parameters.

o. Associated flashings and sheet metal are installed in a timely manner in accord with the specified requirements.

p. Temporary protection measures are in place at the end of each work shift.

3.5.2 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Do not exceed additional inspections one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, submit a report signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.5.3 Roof Drain Test

After completing roofing but prior to Government acceptance, perform the following test for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

3.6 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.7 INFORMATION CARD

For each roof, furnish a typewritten minimum 8-1/2 inch by 11 inch information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Identify facility name and number; location; contract number; approximate roof area;

detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

-- End of Section -

SECTION 07 60 00
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sheet metal flashing and trim:
   1. Formed roof drainage system.
   2. Formed low-slope roof flashing and trim.
   3. Formed equipment support flashing.

B. Related Sections include the following:
   1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
   2. Section "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.2 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.

C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: Full-size Sample.

1.4 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated. Where a specific detail may not be indicated or referenced on the drawings, SMACNA published details shall be utilized and govern.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.6 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
2. Exposed Finishes: Apply the following coil coating:

a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Fluoropolymer 3-Coat System: Manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with physical properties and coating performance requirements of AAMA 2605, except as modified below:

a) Humidity Resistance: 2000 hours.
b) Salt-Spray Resistance: 2000 hours.

2) Color: As selected by Architect from manufacturer's full range. Selected colors to match Building 1721 located on the Ft. Sill Post.

B. Galvanized Sheet Steel: ASTM A 526/A 526M, G 90, commercial steel or ASTM A 527/A 527M, G 90 lock-forming quality, hot-dip galvanized sheet steel with 0.20 percent copper, mill phosphatized where indicated for painting; not less than 24 gauge thick.

C. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

2.2 UNDERLAYMENT MATERIALS

A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Solder for Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Burning Rod for Lead: Same composition as lead sheet.

E. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

F. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual".

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof and Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following materials:

1. Galvanized Steel: 0.034 inch thick (20 gauge).

B. Base Flashing: Fabricate from the following material:

1. Prepainted, Metallic-Coated Steel or Galvanized as indicated: 0.022 inch thick (24 gauge).

C. Counterflashing: Fabricate from the following material:

1. Prepainted, Metallic-Coated Steel or Galvanized as indicated: 0.022 inch thick (24 gauge).

D. Roof-Penetration Flashing: Fabricate from the following material:

1. Lead: 4.0 lb/sq. ft., hard tempered.

2.6 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following material:

1. Prepainted, Metallic-Coated Steel or Galvanized as indicated: 0.022 inch thick (24 gauge).

B. Intake/Exhaust hoods (indicated for replacement):

1. Prepainted, Metallic-Coated Steel or Galvanized as indicated: 0.022 inch thick (24 gauge).

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 EPDM FLASHINGS

A. EPDM Sheet Flashing Material: Uniform, flexible sheet formed from a terpolymer of ethene-propylene-diene, complying with ASTM D 4637, Type 1, of the following grade, class, thick ness, backing, and exposed face color:
   1. Grade and Class: Grade 1 and Class U, unreinforced.
   2. Thickness: 60 mils, nominal.
   3. Backing: Unbacked.
   4. Exposed Face Color: Black.

B. Auxiliary Materials:
   1. General: Furnish auxiliary materials recommended by EPDM manufacturer for intended use and compatible with EPDM membrane flashings.
      a. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.
   2. Bonding Adhesive: Manufacturer's standard bonding adhesive.
   3. Splice Adhesive and Cleaner: Single-component butyl splicing adhesive and solvent-based splice cleaner.
   4. Lap Sealant: Manufacturer's standard single-component sealant.
   5. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious substrates, install a course of felt underlayment and cover with a slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric or butyl sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion

joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric or butyl sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for screws.

1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.

H. Seal joints with elastomeric or butyl sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.

1. Do not solder prepainted, metallic-coated steel sheet.
2. Pretinning is not required for lead.
3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric or butyl sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Counterflashing to fit tightly to base flashing. Extend

counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric or butyl sealant.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
2. Seal with elastomeric or butyl sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as overflow scuppers.

B. Install EPDM parapet flashing where indicated by fully adhering to substrate. Install according to manufacturer's specifications and details.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric or butyl sealant to equipment support member.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 71 23
MANUFACTURED ROOF GUTTER SYSTEM AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. The work to be performed under this project consists of providing the labor, equipment, and approved methods and materials necessary to construct and install manufactured rainwater collection and disposal gutters, downspouts, and gutters with built-in scuppers (as applicable) that are externally mounted and drained for the roof system.

1.2 REFERENCES

A. It is the intent of this specification that whenever a procedure or technique is not called out herein, that the industry standard, as represented by ASTM, LANL, or other appropriate recommendation, shall be used.

B. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

C. Materials and execution of operations shall comply with the latest revision of the Codes and Standards listed below:

1. American Society for Testing and Materials (ASTM):
    a. ASTM A48/A48M: Standard Specification for Gray Iron Castings
    b. ASTM A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
    c. ASTM A653: Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed by the Hot Dip Process.
    d. ASTM A792: Standard Specification for Steel Sheet, 55 percent Aluminum Zinc Alloy Coated by the Hot Dip Process.
    e. ASTM A924: Standard Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.
2. National Roofing Contractors Association (NRCA):
    a. National Roofing Contractors Association (NRCA) "Roofing and Waterproofing Manual".
3. Sheet Metal & Air Conditioning Contractors' National Association (SMACNA)
    a. SMACNA Architectural Sheet Metal Manual.

4. Los Alamos National Laboratory (LANL)
    a. LANL Engineering Manual STD-342-100, Mechanical Chapter (plumbing).

1.3 SUBMITTALS

A. Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
    1. Samples:
    2. Shop Drawings:
    3. Product Data:
        a. Gutter and Downspout Manufacturer's Product Specifications Data and Installation Instructions
        b. Concrete Splash Block Manufacturer's Product Specifications Data and Installation Instructions
    4. Warranty:

1.4 QUALITY ASSURANCE

A. The Contractor shall have knowledge and understanding of the production and fabrication of exterior seamless sheet metal gutters and downspout systems on multi-story commercial buildings.
B. The Contractor shall have at least five (5) years of experience, knowledge and understanding of the products being used, and the application methods specified for the project.
C. The Contractor shall have access to the equipment necessary for successful completion of the project.
D. Provide products that are compatible with the existing roofing material and finish, and are from an acceptable manufacturer.
E. Products used shall have been in satisfactory use, in similar service, for not less than five (5) years.
F. Submit for approval one cross sectional sample of gutter and downspout, to include clips, brackets, and fasteners with color chip samples matching existing onsite gutters and downspouts as applicable to project.
G. Submit for approval complete shop drawings and erection details showing methods of erection, sections and details, flashings, scuppers, and all other accessories. Interface with all related work of other trades and proposed identification of component parts and finishes.
H. Perform work per SMACNA Architectural Sheet Metal Manual and NRCA Roofing and Waterproofing Manual.
I. Verify field measurements prior to fabrication.

1.5 STORAGE AND HANDLING

A. Store materials in accordance with the manufacturer’s recommendations.
B. Meet requirements of manufacturer’s recommendations for handling and protection of materials during installation.

C. Protect products from damage during handling and construction operations.

D. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation.

E. Slope materials and components to ensure drainage

F. Prevent contact with materials causing discoloration or staining.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Submit for approval manufacturer's product technical data, installation instructions, and general recommendations for each product needed for the complete installation of an externally mounted and drained rainwater collection and disposal system, to include gutters, downspouts, downspout outlets, gutter ends, anchoring straps, and mitered corners that meet the following requirements, and matches existing gutter and downspout sheet metal profile as indicated on drawings:

1. Pre-Finished Galvalume Steel Sheet: ASTM A755 coil coated or approved equal.
2. Base Metal: ASTM A792, aluminum-zinc alloy coating, or approved equal.
3. Exposed Finish: Silicone polyester, acrylic, electrolytic powder coating, or approved equal.
4. Unexposed Finish: Manufacturer's standard.

B. Submit for approval manufacturer's product data, installation instructions, and general recommendations for concrete splash blocks that meet the following requirements:

1. Precast steel reinforced 12" x 30" x 3" (minimum) concrete type, with standard profile and weight indicated.
2. Minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
3. Pitched to direct water runoff away from the building.

2.2 FABICATION

A. Gutters and downspouts shall be designed per LANL Engineering Manual STD-342-100, Mechanical Chapter (plumbing), for rainfall rate specified.

B. Field measure conditions prior to fabricating work.

C. Form sections as indicated in drawings. Square, true, and accurate in size. Form free from distortion or defects detrimental to appearance or performance. Allow for expansion at corners and joints.

D. Fabricate trim, flashing, and other metal components from same material as metal gutter sections.

E. Fabricate strap ties of compatible material as gutters, to interlock with gutter.

F. Fabricate connector/expansion clips of same material as gutter that interlock with gutter by mechanical fastener or welding.

G. Form gutter and downspout sections in longest practical lengths or in single length sheets where possible.

H. Hem exposed edges on 1/2-inch miter.

I. Provide expansion joints (slip joints) on gutters exceeding 50 feet in length, minimum or as shown on drawings.

    1. Provide manufacturer's standard expansion joint assemblies allowing for minimum 3/4" thermal movement; space per manufacturer's recommendation.

J. Metal strap supports roof side flange to extend up fascia or wall, and over top of nailers/blocking, and securely fastened per manufacturer's written instructions.

K. Roof side gutter flange to extend continuously up fascia or wall and as minimum terminate under nail-in termination bar and mastic. The roof side gutter flange must be bedded in silicone sealant, and fastened per manufacturer's written instructions.

L. Fabricate corners with 18 inch long legs. Weld mitered seam for rigidity, seal with sealant.

M. Install gutter connections per manufacturer's warranty requirements. Connections may be:

    1. Soldered:

        a. Riveted or screwed; then sealed with sealant.

    2. Profile Connectors:

        a. Riveted or screwed; then sealed with sealant.

N. Downspout collars on bottom of gutter trough must be either soldered, riveted, or screwed; then sealed with sealant.

O. Downspout Brackets: Fabricate brackets to match color, finish, and thickness of downspouts unless otherwise indicated.

P. Field measure conditions prior to fabricating work.

2.3 ACCESSORIES

A. Anchors and Supports: Profiled to suit gutter and downspout installation.

1. Anchoring Devices: Per SMACNA requirements, and type recommended by fabricator.

2. Gutter Supports: Brackets and straps attached with screws or approved equal.

3. Downspout Supports: Brackets and/or straps attached with screws or approved equal.

B. Fabricate and install gutter and downspout accessories; then seal watertight.

C. Fasteners: For fastening gutters and downspouts, use screws of suitable length made of compatible material and finish as gutters and downspouts, with neoprene gaskets, or approved equal.

D. Primer: Zinc molybdate, galvanized iron, Iron oxide linseed oil type, or approved equal.

E. Protective Backing Paint: Zinc molybdate alkyd or approved equal.

F. Solder: ASTM B32, 50/50 type or approved equal.

2.4 FACTORY FINISH

A. Exterior Finish: Class I Color Anodized Finish: AAMA 611, integrally colored anodic coating not less than 0.7 mils thick or approved equal.

B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer when pre-finished materials are specified.

C. Interior finish: Factory standard prime-coat, dry film thickness 0.5 mils minimum or approved equal.

D. Color: Gutters, downspouts, straps, and brackets to match color of existing gutters and downspouts or approved equal.

2.5 EXAMINATION

A. Examine surfaces and verify that surfaces are satisfactory for speedy and acceptable work, and ready to receive gutters and downspouts.

B. Confirm that there are no conflicts between this work and work by others.

2.6 PREPARATION

A. Paint surfaces that come in contact with dissimilar metals. Use protective backing paint to minimum dry film thickness of 15 mil or approved equal, and bed with silicone sealant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Gutters and Downspouts:

1. Install gutters and downspouts per manufacturer's instructions. If there is a conflict between contract documents and manufacturer's instructions, comply with most stringent requirements.
2. Take adequate precaution to protect gutters and downspouts from damage during installation process.
3. Install gutters and downspouts to provide ample support and proper drainage as follows:
    a. Use hangers and straps adequate in size and spacing to support loads.
    b. Seal all gutter joints, screws, rivets, etc. with approved sealant.
    c. Support every separate section.
    d. Do not mount gutter system or straps over top of TPO fleece back membranes nail-in termination bar.
    e. Install gutters with positive slopes, to prevent accumulation of standing water.
    f. Set gutter height to prevent possible overshoot of water.
    g. Provide 3" minimum gutter and downspout lap joints that match drainage flow.
    h. Provide movement slip joints on downspouts.
    i. Provide downspout extensions as necessary to adequately divert water away from building.
    j. Protect building surfaces from hanger and strap connection damage.
    k. Keep downspouts and gutters separated from wall surfaces to avoid staining and corrosion.

B. Roll Formed Gutter:

1. Join roll formed gutter lengths with formed watertight seams per manufacturer's instructions.
2. Soldered, mechanically fasten, or approved equal.
3. Flash and seal gutters to downspouts and accessories.
4. Slope gutters at 1/4 inch per foot (preferred), or at 1/8 inch per foot as a minimum.
5. If Solder metal joints are used, solder metal joints for full metal surface contact.
6. After soldering, wash metal clean with neutralizing solution and rinse with water.
7. Install gutters 3/4 inches below slope of roof at outside edge.
8. Attach gutters, hangers and strap ties to structure by direct fastening.
9. Locate and install fasteners and strap ties a maximum of 24 inches on center.
10. Approved hangers and brackets shall be securely attached to the fascia or building and shall contact the entire gutter bottom width.
11. If supports are screwed into the bottom of the gutter, the screw holes shall be sealed to prevent leakage.

C. Downspouts:

1. Locate downspouts per Drawings.
2. Strap fasten downspouts at maximum 30 inches on center.
3. Do not locate downspouts with outflow creating an icing problem on pedestrian walkways.
4. Hangers, brackets and straps used for support shall be securely anchored in a manner which will not prevent the entry of water into the gutter.

D. Splash Blocks:

1. Install splash blocks per manufacturer's instructions.
    a. Splash blocks shall be placed to adequately to catch downspout discharge.
    b. Set concrete splash blocks under downspouts at grade and secure in place.
    c. Layout of splash blocks shall provide positive drainage away from foundation.

3.2 INSPECTION

A. After roof gutter and downspout system is complete, fully test system with flowing water to assure proper runoff. Adjust and retest as required.

B. At completion of work, completely remove all debris generated from removal and installation of gutter and downspout materials.

C. Leave gutters and downspouts clear and clean of debris.

D. Repair or replace defective work as required.

3.3 WARRANTY

A. Submit warranty information from manufacturer covering against material and/or workmanship defect(s). Furnish 5 year manufacturer warranty for metal components against corrosion with an additional installers warranty for 5 years against fastener failure, water penetration at joints or failure to drain.

3.4 CLEAN UP

A. Job Site:

1. Clean up of work site and disposal of all debris generated.
2. Disposal of any trash, garbage, or domestic-type waste shall be at Ft. Sill sanitary landfill.
3. Disposal of all metals shall be accomplished off Government property.
4. Disposal of petroleum, oil, and lubricant (POL) products, chemicals, or other hazardous or toxic compounds shall be in accordance with Ft. Sill regulations USAFACFS regulation 200-2.
5. The Contractor shall be responsible for any fines levied against the Contractor or the Government for failure to obtain and adhere to required disposal methods.

END OF SECTION

SnoFence/SnoRail – Continuous/Fence Systems
www.S-5.com
(turn on Hiddent Text)

SECTION 07 72 53

SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Snow guards for metal roofs.
2. Non-penetrating attachment system.

1.2 RELATED SECTIONS

A. Division 01: Administrative, procedural and temporary work requirements apply to this section.

B. Section 07 41 13 – Metal Roof Panels

C. Section 07 61 00 – Sheet Metal Roofing

D. Section 07 62 00 – Sheet Metal Flashing and Trim

E. Section 07 72 53 – Roof Accessories – Snow Guards

F. Section 13 34 19 – Metal Building Systems

1.3 REFERENCES

A. Aluminum Association (AA) - Aluminum Standards and Data, Current Edition.

B. ASTM International (ASTM):

1. A484/A484M-16 – Standard Specifications for General Requirements for Stainless Steel Bars, Billets and Forgings.
2. A554-16 – Standard Specification for Welded Stainless Steel Mechanical Tubing.
3. A555/A555M-16 – Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods.
4. B85-03 - Standard Specification for Aluminum-Alloy Die Castings.
5. B221-04a - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
6. F836M-02 (Current) – Standard Specification for Style 1 Stainless Steel Metric Nuts (Metric).
7. F880-12 – Standard Specification for Stainless Steel Socket, Square Head, Torx and Slotted Headless-Setscrews.

C. ICC Evaluation Service (www.icc-es.org):

1. Division: 05 00 00 – METALS; Section: 05 05 23 – METAL FASTENERS Evaluation Report ESR-3869.

1.4 SUBMITTALS

A. Action Submittal:
   1. Shop Drawings: Include roof plans showing locations of snow guards on roof and attachment details and spacing.
   2. Product Data:
      a. Product description.
      b. Construction details.
      c. Material descriptions.
      d. Individual component dimensions.
      e. Finishes.
      f. Installation instructions.
   3. Samples:
      a. Clamp samples.
      b. 12-inch long cross member samples including all associated hardware.

B. Informational Submittals:
   1. Proof of Job-Specific Engineering: Include calculation for number and frequency of snow guard attachments based on design roof snow load, roof slope, roof dimensions, specific roof profile name, material type, gauge thickness and brand of manufacture; brand and model of snow retention device. **[(https://s-5.com/snow-calculator/)**
   2. Proof of Product Testing: Results of appropriate product tensile load testing, issued by a recognized ISO 17025 accredited independent testing laboratory, showing the mean (of a minimum three test pulls) ultimate load-to-failure value of attachment **[bracket] [clamping device]** proposed on the specimen material named in B.1.
   3. Proof of Certified Production: Copy of manufacturer current ISO 9001 certficate (latest edition).
   4. Proof of Best Practice Compliance: Manufacturer duly exected letter stating full compliance with all provisions of the Metal Construction Association technical bulletin, “Qualifying Snow Retention Systems for Metal Roofing” (latest edition).

C. Closeout Submittals:
   1. Certification: Installer's certification or duly executed letter stating snow guard system was installed in accordance with manufacturer's instructions and approved shop drawings.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer to specialize in production of snow guard products of the type specified with a minimum of 10 years documented experience.

B. Manufactured in an ISO 9001 certified facility; ICC audited facility.

C. Installer Qualifications: Installer to specialize in metal roof installation and installation of snow guard products with a minimum of 5 years documented experience.

D. Mockup:
   1. Size: Minimum **[8] [__]** feet long.
   2. Show: Snow guard attachment, cross members and accessories.
   3. Locate **[where directed] [____]**.
   4. Approved mockup may remain as part of the Work.

E. Warranty:
   1. Lifetime material/workmanship warranty on all products.

1.6 DELIVERY, STORGE AND HANDLING

A. Deliver components to jobsite properly packaged to provide protection during transport, delivery and handling.

B. Store products in manufacturer's original labeled and unopened packaging in a clean and dry location, protected from potential damage, until ready for application.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Attachment system to provide attachment to standing seam metal roofs:
1. With only minor dimpling of panel seams.
2. Without penetrations through roof seams or panels.
3. Without use of sealers or adhesives.
4. Without violation of roof warranty.

B. Performance Requirements: Provide snow guards to withstand exposure to the weather and environmental elements and resist design forces without failure due to defective material or manufacture.
1. Loading: Design snow guard system to resist minimum design roof snow load(s) **[of __] [See structural drawings for roof design snow loads]**.
2. Factor of Safety: Utilize a factor of safety ≥ **[2] [____]** to determine allowable loads from ultimate tested **[clamp] [bracket]** tensile mean load values.
3. Source Limitation: Provide snow guard system as designed and tested by the manufacturer as a complete system. Install all system components by the same manufacturer.

2.2 MANUFACTURER

A. Basis of Design: S-5!® div. of Metal Roof Innovations, Ltd., 500 W. Highway St., Iowa Park, TX 76367; Tel: 888-825-3432; Fax: 719-495-0045; Email: support@s-5.com; Web: www.s-5.com

B. Acceptable Manufactures if products meet specification requirements:
1. S-5!® div. of Metal Roof Innovations, Ltd. https://www.s-5.com/
2. LMCurbs. https://www.lmcurbs.com/
3. Rocky Mountain Snow Guards Inc. https://www.rockymountainsnowguards.com/

C. Substitutions: [Under provisions in Division 1.] Not permitted.

2.6 CONTINUOUS, FENCE-TYPE SNOW RETENTION SYSYEMS FOR STANDING SEAM METAL ROOFS

A. Basis of Design: SnoRail™ and SnoFence™, manufactured by S-5! div. of Metal Roof Innovations, Ltd.

1. Clamps:
   a. Manufactured from 6000-series aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.
      1) Clamp model: No. S-5-A and S-5-AE.
      2) Setscrews: 300-series stainless steel, 18-8 alloy, 3/8 inch (9.525 mm) diameter, with round nose point.

2. Cross Members **[and Posts]**:
   a. Manufactured from Type 300-series stainless steel conforming to ASTM A581/A581M or ASTM A 582.

b. Provide coupler ensuring alignment and structural continuity at end joints.

3. Ice and Snow Clips:
   a. Aluminum, with rubber foot, minimum 3 inches (76.2 mm) wide.
      1) Model: SnoClip II for standing seam heights 1 inch (25.4 mm) to 1.5 inches (38.1 mm).
      2) Model: SnoClip III for standing seam heights 1.75 inches (44.45 mm) to 3.25 inches (82.55 mm).

1. Clamps:
   a. Manufactured from red brass, Copper UNS Alloy No. C23000.
      1) Clamp model: No. S-5-B B and S-5-BE.
      2) Setscrews: 300 Series stainless steel, 18-8 alloy, 3/8 inch (9.525 mm) diameter, with round nose point.

2. Cross Members **[and Posts]**:
   a. Manufactured from brass 360 round rod, half hard temper conforming to ASTM B16.
   b. Provide coupler ensuring alignment and structural continuity at end joints.

PART 3- EXECUTION

3.1 EXAMINATION

Prior to beginning installation, verify:
1. Panel seaming is complete.
2. Panel attachment is sufficient to withstand loads applied by snow guard system.
3. Installation will not impeded roof drainage.

3.2 PREPARATION

A. Clean areas to receive attachments; remove loose and foreign matter that could interfere with installation or performance.

3.3 INSTALLATION

A. Install system in accordance with manufacturer's current instructions and approved Shop Drawings.

B. SnoRail and SnoFence Snow Retention Systems

1. Place clamps at maximum 32 inches (812.8 mm) on center or as required by certified calculation.

2. Place clamps in straight, aligned rows.

3. Place both setscrews on same side of clamp.

4. Tighten setscrews to manufacturer's recommended torque. Test setscrew torque using calibrated torque wrench.

5. Use **[S-5-AE] [S-5-BE]** clamps in lieu of standard clamp at each end of each assembly and at a frequency and spacing of one for each 50 feet (15.25 m) of assembly.

6. Install SnoPosts vertically in each clamp. Use SnoPost E at all (above) “E” clamp locations.

7. Install cross members through holes in clamps and posts.

8. Install coupler at cross member end joints.

9. Tighten setscrews against cross members at all “E” clamp and post locations.

10. Do not cantilever cross members more than 4 inches (101.6 mm) beyond last clamp at ends.

11. Install **[one SnoClip] [two SnoClips]** per panel between panel seams.

END OF SECTION

SECTION 07 92 00
ADHESIVES, SEALANTS, PRIMERS, MASTICS, JOINT, AND CRACK FILLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide adhesives, sealants, primers, mastics, joint and crack fillers for used to install a fully adhered Thermoplastic Polyolefin (TPO) fleece back membrane system to include but not limited to applicable termination edges, seams, flashing, insulation/cover board underlayment's, and substrates.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Samples: Submit a representative sample of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

1. Include manufacturer's full range of color and finish options if additional selection is required.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's written instructions.

B. Field-Constructed Mock-Ups: One of each type of joint, edge, penetration, and applicable adhesion encountered.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Thermoplastic Polyolefin (TPO) Bonding Adhesive:

1. Two-component Urethane bonding adhesive or approved equal shall be Factory Mutual (FM) approved, VOC-free, energy-absorbing, impact-resistant and able to provide a superior wind uplift resistance, fire-resistant, and non-penetrating roofing system.
2. Urethane bonding adhesive shall be used to fully adhere TPO fleece back membrane to high-density Polyisocyanurate cover board.
3. Urethane bonding adhesive shall be used to fully adhere high-density Polyisocyanurate cover board to a closed cell, expanded Polystryrene

(EPS) insulation board with grooved channels that shall be, in turn, mechanically fastened to the existing concrete substrate.

4. Urethane bonding adhesive can be used to fill substrate cracks and voids greater than 1/4 inch in width.

B. Cut-Edge Sealant:

Free flowing polymeric material or approved equal designed for sealing TPO fleece back membrane cut/exposed fabric edges.

C. Single-Ply Sealant: Master Seal:

1. 100% solids, solvent-free one-part polyether sealant or approved equal designed to provide a weather tight seal to TPO fleece back membrane and a variety of building substrate materials.

D. Thermoplastic One-Part Sealant:

1. A single component, moisture curing, elastomeric polyether sealant or approved equal that is compatible with Thermoplastic membranes designed to provide a flexible, durable and long lasting seal around hard-to-flash penetrations in Thermoplastic Roofing Systems.
2. Thermoplastic one-part sealant can be used for attaching lightning rod bases and ground cable clips to the TPO fleece back membrane surface as applicable.

E. Low-VOC TPO Primer:

1. Low solids solvent-based splice primer or approved equal used to prepare TPO membrane for improved adhesion to pressure sensitive TPO products.

F. Water Cut-Off Mastic:

1. A one-component, low viscosity, self-wetting butyl blend mastic or approved equal used specifically with roofing and waterproofing systems.
2. Applied at compression –type seal locations where TPO fleece back membrane is being terminated.

G. Vapor and Air Sealing Flashing Foam Joint Filler.

1. Low-pressure foam system or approved equal that conforms to ASTM E84 as a “Class 2(B) system requirements.
2. Specifically designed to be applied below insulation levels and capable of filling large substrate cavities.
3. Tightly adheres to building substrate materials and is effective for all roof penetrations
4. Creates a seamless, continuous seal that insulates and protects against vapor and air infiltrations.

H. Pre-formed Extruded Ethylene Propylene Diene Monomer Rubber (EPDM) Expansion joint sealant support:

1. Flexible transition expansion joint or approved equal installed between deck-to-wall, and deck-to-deck expansion joint locations.
2. Designed to support TPO fleece back membrane at joint locations
3. Designed to improve flexibility at joints with a minimum width of 3/4 inch and a not to exceed width of 3 inches.

I. Backer Rod:

1. Closed cell backer rod or approved equal used in conjunction with approved sealant to fill joints as applicable.

J. Bond Breakers:

1. Bond breakers or approved equal shall be applied to surfaces as applicable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrate; report unsatisfactory conditions in writing.

B. Provide materials in colors as selected from manufacturer's standards.

C. Install materials and systems in accordance with specifications, drawings, manufacturer's written instructions, and approved submittals.

D. Install materials and systems in proper relation with adjacent construction and with uniform appearance.

E. Coordinate with work of other sections.

F. Clean and prime joints.

G. Install bond breakers, backer rods, and sealant as applicable and recommended by manufacturers written instructions.

H. Depths and thickness of adhesives, sealants, primers, mastics, joint and crack fillers shall be as recommended by roofing system manufacturer’s written instructions.

I. Cure and protect sealants as recommended by manufacturer’s written instructions.

J. Replace or restore damaged sealants.

K. Clean adjacent surfaces to remove all spillage.

-- END OF SECTION--

Section 07 92 00.01
General Joint Sealant

PART 1 - GENERAL

1.1 SUMMARY

A. Provide joint sealers at interior and exterior vertical and horizontal joints.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

1. Include manufacturer’s full range of color and finish options if additional selection is required.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Field-Constructed Mock-Ups: Each joint type.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Urethane Elastomeric Joint Sealants:

1. Manufacturers: Pecora Corp., Sika Corp., Sonneborn, Division of ChemRex Inc, Tremco, or approved equal.
2. Type and Application: One-part nonsag urethane sealant, ASTM C 920:
   a. Application: For joints in vertical and horizontal surfaces.
   b. Exterior use.

B. Silicone Elastomeric Joint Sealants:

3. Manufacturers: Dow Corning, GE Silicones, Tremco, or approved equal.
4. Type and Application: One-part nonacid-curing silicone sealant, ASTM C 920, modulus as required for application:
   a. Application: For joints in vertical and horizontal surfaces.
   b. Exterior use.

C. Polysulfide Elastomeric Joint Sealants:

5. Manufacturers: W. R. Meadows, Pecora Corp., Sonneborn Building Products or approved equal.

6. Type and Application: Two-part nonsag polysulfide sealant, ASTM C 920, for joints in vertical surfaces:
   a. Exterior use.

D. Solvent-Release-Curing Joint Sealants:

7. Manufacturers: H.B. Fuller Company, Pecora Corporation, Polymeric Systems, Inc., Sonneborn Building Products, Tremco, or approved equal.
8. Type: Butyl, FS TT-S-001657.
9. Application: Exterior vertical surfaces with limited movement.

E. Compression Seals:

10. Type: Preformed foam sealant.
11. Application: Wide exterior joints in vertical surfaces.

F. Fire-Resistive Joint Sealers:

12. Type: Foamed-in-place fire-stopping sealants.
13. Application: Penetrations in fire-rated floor and wall assemblies.

G. Specialty Sealants:

14. Type and Application: Butyl-polyisobutylene sealant and tape sealant for concealed joints.

H. Auxiliary Materials:

15. Plastic foam joint fillers.
16. Bond breaker tape.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrate; report unsatisfactory conditions in writing. Beginning work means acceptance of substrates.

B. Provide sealants in colors as selected from manufacturer's standards.

C. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Clean and prime joints, and install bond breakers, backer rods and sealant as recommended by manufacturers.

D. Depth shall equal width up to 1/2 inch wide; depth shall equal 1/2 width for joints over 1/2 inch wide.

E. Cure and protect sealants as directed by manufacturers. Replace or restore damaged sealants. Clean adjacent surfaces to remove spillage.

-- End of Section--

DIRECTORATE OF PUBLIC WORKS
Fort Sill, Oklahoma
Project requirements
Updated: May 20, 2022

Point of Contact:
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Section 26 00 01
Fort Sill Electrical Requirements

1. General:
   (a) The Unified Facilities Criteria (UFC) system, the installation design guide and the most indicated stringent requirement shall be used as a guidance regarding the design and construction.
   (b) Provide details to show but not limited to transformers, pads, risers, trenching, lighting, pole details, controls, line diagrams etc.
   (c) As-built drawings: After completion of work, as built drawings red lines shall be provided electronically on CD to reflect as-built conditions after all related work are completed and shall be Micro Station “DGN” format, latest edition used by DPW.

1.1 References

As a minimum, all electrical work performed on Fort sill shall conform to the latest edition of the following requirement, codes and standards:

(1) NFPA 70, National Electrical Code (NEC)
(2) NPFA 70E Standard for Electrical Safety in the Workplace
(3) NFPA 72, National Fire Alarm and Signaling Code
(4) IEEE C2, National Electric Safety Code (NESC)
(5) UFC 3-501-01, Electrical Engineering
(6) UFC 3-520-01, Interior Electrical Systems
(7) UFC 3-530-01 Interior and Exterior Lighting and Controls
(8) UFC 3-550-01, Exterior Electrical Power Distribution
(9) UFC 3-560-01, Electrical Safety
(10) UFC 3-575-01 Lightning and Static Electricity Protection Systems
(11) UFC 3-600-01 Fire Protection Engineering for Facilities,
(12) UFC 4-010-01, DOD Antiterrorism Standards for Buildings
(13) UFC 4-021-1 Design and O&M: Mass Notification systems
(14) NEIS, National Electrical Installation Standards
(15) UFC-580-1 Telecommunications Building Cabling Systems Planning and Design
(16) ANSIA/TIA/EIA-568-B
(17) ANSIA/TIA/EIA-569-B

1.2 Design

(a) As a minimum, all electrical design shall conform to the latest edition of the above codes and standards.
(b) To the extent possible, Unified Facility Guide Specifications (UFGS) and standard detail shall be utilized in the design. All specifications and general notes shall have the non-applicable parts edited.

(c) Existing as-built drawings may be used as guidelines (if available). Information must be verified by field investigation. The Designer shall be responsible for the verification of all dimensions, measurements, and location of existing facilities, utilities, equipment and other existing conditions that may affect the design.

(d) The following items shall be taken into consideration and included as part of the design analysis:

(1) Exterior: Primary circuit availability and location.
(2) Exterior: Primary circuit loading. Future loops may be designed for higher capacities as long as analysis shows that existing switchgear/substations can support the higher requirement.
(3) Existing equipment age and condition, (equipment over 30 years in age must be updated to meet the current standards)
(4) Transformer/panel board/switchgear loading (existing and future).
(5) Non-linear loads (Fluorescent lighting, computers, variable frequency drives, etc)
(6) Energy Analysis

(e) All new building wiring systems shall use three phase system, using 480/277V and, or 208/120V unless otherwise approved by DPW. Designer shall make recommendations of building voltages at the design analysis phase of each project.

1.3 Installation

(a) As a minimum, all electrical installations shall conform to the latest edition of the above codes and standards.

(b) Only state licensed journeymen electricians or a minimum 10 years of verifiable experience or registered apprentices under the direct supervision of journeymen will be permitted to install, alter, or repair electrical systems.

(c) Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials in the same category shall be by a single manufacturer. Refurbished or Discontinued product lines shall not be accepted.

(d) All conductors shall be color-coded at panel boards, switchboard, terminations, junction boxes, manholes, hand holes, etc. Factory color-coding of insulation is preferred; however, colored tape may be used on current carrying conductors #6 and larger. Equipment grounding conductors (EGC) #6 and smaller must have factory color-coding of the insulation. A green equipment-grounding conductor shall be installed with all branch circuits. Circuit conductors shall be color coded as follows:

(1) All Configurations: Equipment Grounding Conductor, Green. (Exception: Where an isolated ground is required, the isolated ground shall be

identified as green with a yellow stripe.)

(2) 120V, 2-wire circuit: Grounded conductor (neutral), White; Ungrounded leg, Black.

(3) 240/120V, 1-phase, 3-wire circuit: Grounded conductor (neutral), White; One hot leg, Black; One hot leg; Red.

(4) 208Y/120V, 3-phase, 4-wire circuit: Grounded conductor (neutral), White; Phase A, Black; Phase B, Red; Phase C, Blue.

(5) 208V, 3-Phase, 3-wire circuit: Phase A, Black; Phase B, Red; Phase C, Blue.

(6) 480Y/277V, 3-phase, 4-wire circuit: Grounded conductor (neutral), Gray; Phase A, Brown; Phase B, Orange; Phase C, Yellow.

(7) 480V, 3-phase, 3-wire circuit: Phase A, Brown; Phase B, Orange; Phase C, Yellow.

1. ELECTRICAL DISTRIBUTION SYSTEM, AERIAL

1.1 Existing Medium Voltage (MV) distribution system is 13,200/7,620 Volt, 3-phase, 4 wires, multi-grounded system installed on wood poles and/or underground. New work shall be required to be underground. Coordinate with DPW.

1.2 Transformers: Provide non-polychlorinated biphenyl transformer with a spare capacity of 20% minimum. Provide Delta-Wye connection system, primary voltage: 13,200V, Secondary voltage 480/277V, 208/120V, copper windings, Coordinate voltages with DPW.

1.3 Pole-mounted sectionalizing switches: Provide sectionalizers as needed, coordinate with source.

1.4 Provide Fault Current Analysis, Protective Device Fully Coordination Study, see section 16375 below

1.5 Bare medium-voltage line conductors: Provide Aluminum-Conductor-Steel-Reinforced, ACSR.

1.6 Insulated Medium-Voltage line conductors: Provide 15kV, ethylene-propylene-rubber (EPR), 133 percent insulation level, copper.

1.7 Wood poles: Provide pressure treated, with creosote. Poles shall be branded with information such as height-class, year-month made, etc (ANSI standard info), metal tag is not acceptable. Poles with transformers, cutout or any equipment must be provided with metal tags showing feeder No., pole number, fuse ratings, and other information, coordinate with DPW.

1.8 Guy assemblies: Provide where required zinc-coated steel, extra-high-strength, with 8 feet, ¾” diameter guy rods minimum. Provide yellow Guy marker, 2” diameter and 8’ height minimum.

1.9 Provide Armless Construction, where single phase is used, prepare for 3-phase construction. Coordinate with DPW.

1.10 Guy assemblies: Provide zinc-coated steel, extra-high-strength, with 8 feet, ¾" diameter guy rods. Provide Guy marker, 2" diameter minimum where required.

1.11 Cutouts: Provide 15KV, type K fuse link.

1.12 Surge arresters: Provide for protection of aerial-to underground transitions, transformers and other equipment as required.

1.13 Air-break switches: Provide Gang operated switches Normally Open (NO) or Normally Closed (NC) switches to connect to other feeders as required.

1.14 Ground rod: Provide copper-clad steel not less than 3/4 inch in diameter by 10 feet in length. Ground rods must be driven into undisturbed earth, 2' minimum away from the pole edge, structure or concrete foundations. It is not acceptable to install rod in the hole with riser pole or driven into backfill

1.15 Provide Rigid Galvanized Steel Conduit for risers.

1.16 Provide Metal poles with velocity 100mph minimum at the base of the pole, 1.3 wind gust factor, height and drag factor as recommended by AASHTO LTS-4. Effective projected area of luminaries and other equipment shall be considered in the pole design. Calculation shall be provided to support the pole design. Chipped, scratched, stained or dented poles shall not be acceptable.

1.17 Ground conductor protection: Provide mower guard, 36" height minimum, above finished grade for all pole grounds protection.

2. SECTION: ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

2.1 Provide Medium Voltage Cables, MV with concentric neutral, copper, 15 kV, EPR, 133% insulation level, with ozone/sunlight resistant PVC jacket approved for direct burial application:

(a) MV cables, Main primary distribution system loop feeders shall be 750Kcmil minimum, installed in 6" conduit. Cables shall be routed and racked inside manhole to allow the longest possible length of spare cable in each manhole possible (minimum of 1 full loop around the interior of the manhole).

(b) MV cables, Radial feeders shall be #2 AWG minimum. Cables shall be routed and racked inside manhole to allow the longest possible length of spare cable in each manhole possible (minimum of 1 full loop around the interior of the manhole).

(c) MV Power cable test: New or existing cables shall be tested before energizing, by using Very Low Frequency (VLF) conforming to IEEE documents -

"IEEE Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems" and IEEE 400.2 "Guide for Testing of Shielded Power Cable Systems using Very Low Frequency (VLF)". Test duration shall not be less than 45 minutes.

2.2 Low Voltage Cables, service entrance: Provide copper conductor with XLP or EPR insulation.

2.3 Cables in the same duct with MV cables shall have same type insulation

2.4 Concrete Encased Duct Bank:

(a) MV, Duct lines shall be thick-wall type, PVC SCH 40, concrete-encased in trench, installed at 36 inches minimum below grade to the top of conduit. Concrete encased conduits shall have minimum spacing between conduits as specified by the NEC and at least 3 inches of concrete protecting them on top, bottom, and sides. Bore under roads, provide Galvanized Rigid Steel conduit, PVC coated or provide PVC conduit-in-casing, with interlocking plastic spacers, Underground Devices Incorporated product or equal. Provide spare conduit of equal size.

(b) The top of the concrete encasement shall be at least 30” below finished grade level at all points.

2.5 Direct Buried conduit:

(a) Low Voltage, Duct lines shall be direct-burial, thick-wall type SCH 40 or SCH 80, Concrete encased if installed in vehicular traffic areas. Top of conduit shall be installed at a minimum depth of 24” below grade.

(b) Do not use PVC conduit in areas subject to physical damage, including but not limited to mechanical, electrical rooms, penetrating fire rated walls, floors or partitions.

2.6 All conduits that transitions from below to above grade shall be galvanized rigid steel PVC coated conduit, starting from minimum depth as specified and include the 90 degree Elbow up to 12” above finished grade.

2.7 All conduits installed under roads and driveway crossings shall be bored and sleeved with single schedule 80 PVC or 1/4”-wall steel sleeve. Roadways and driveways shall not be crossed by open cut unless approved by DPW in writing. Wherever boring is impractical, street crossings shall be limited to three (3) days maximum (including trenching, compaction, and replacement of existing pavements). Contractor shall provide steel matting sufficient to carry the traffic load of the excavated area.

2.8 Manholes shall be 8’x8’x7’ (minimum inside dimension). Maximum spacing shall be 450 feet on centers. Cable Support Systems located in manholes shall be constructed of a nonconductive material. All cables in manholes shall be identified with a nonconductive tag & permanent marker,

tags shall identify circuit at each point where the cable either enters or exits the manhole.

2.9 All underground electrical and communication installations (conduit, duct bank, etc.) shall be identified using marking tape. Tape shall be placed 12-inches below finished grade. Tape shall have the following characteristics:

(a) 5-mil plastic
(b) Brightly colored (Electric–red; Communication– orange)
(c) Not be less than 6 inches in width
(d) Suitably inscribed at not more than 10 feet on centers
(e) Continuous metallic backing and a corrosion resistant 1-mil metallic foil core to permit easy location of duct line.

2.10 Pad Mounted equipment:

2.10.1 Transformer, Pad Mounted: Provide Loop feed type, dead front construction, copper windings and bussing, with current limiting and bayonet oil immersed expulsion fuses, arresters, High-voltage warning signs, Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device, Refer to UFC _3_550_01 Exterior Power Distribution guidance. Transformer pad shall be a minimum of 6 inches larger than the transformer enclosure to include the cooling system. Pre-manufactured pads for pad mounted equipment such as transformers; sectionalizeers etc. shall be not used. Concrete Pads shall be poured-in-place. Spare capacity of 20% minimum.

2.10.2 Pad Mounted Switch Gear: As a minimum, provide dead front pad mounted gear, PME-9, S&C or equal. Other circuit configuration shall be coordinated with DPW for approval. All switch and fuse components shall be included to include a minimum of 2 spare fuses. Switches shall be provided with Arc-resistance feature meet the requirement of IEEE standard C37.20.7 2001, “IEEE Guide for Testing Medium –Voltage Metal Enclosed switchgear for Internal arcing Faults”. Switches shall be provided with a manual, handle-type operator or a push-button mechanical spring tripping mechanism, utilizing a stored-energy (spring-driven) mechanism to simultaneously open or close all phases. Switch pad shall be a minimum of 6 inches larger than the switch. Pre-manufactured pads shall be not used. Concrete Pads shall be poured-in-place.

2.11 Metering

1. Watt-Hour Metering

(a) Watt-hour meters shall be installed on all facilities requiring new services and shall be connected to the base Energy Enterprise Data Reporting System, EEDRS (Note: Unless otherwise indicated, watt-hour metering will not be required where digital meters as specified below are provided). Watt-hour meters shall be integrated

and Contractor Field Tests (CFTs) performed and passed within a given specification.

(b) Watt-hour meter shall be surface-mounted, electronic-programmable type, with LCD display.

(c) Meter will display readings for usage (kWh), demand (kW), and peak demand (including date/time of peak demand).

(d) Meter shall be provided with a self-contained backup system to maintain memory and display during power failures.

(e) Meter shall be provided with a modular connector(s) to provide interfacing for:

(1) Automatic Meter Reading (AMR)
(2) Pulse modules
(3) Analog signal modules
(4) Energy control modules
(5) Instantaneous demand displays

(f) Meter shall communicate information to a remote data collection system, EEDRS.

(g) Meter shall conform to Unified Facilities Guide Specification (UFGS) 26 27 13.1030.

(h) Where practical and feasible, meters shall be installed in a self-contained unit. Center of the unit shall be mounted as close to eye level as possible, but in no instance more than 72” A.F.F.

2. Digital Metering

(a) Digital metering shall be installed in each switchboard or switchboard section for double ended applications. Monitors may also be remote mounted. Center of the monitor shall be mounted as close to eye level as possible, but in no instance more than 80” A.F.F.

(b) Metering shall conform to Unified Facilities Guide Specification (UFGS) 26 27 13.1030

(c) All setup parameters required by the electronic monitor shall be stored in non-volatile memory and retained in the event of a control power interruption. Any battery or other device used to provide non-volatile memory shall be user serviceable from the front of the monitor and servicing shall not require removing the monitor from the gear in which it is mounted.

(d) The monitor shall maintain in non-volatile memory maximum and minimum values for each of the instantaneous values reported as well as the time and date that the minimum or maximum was set.

(e) The monitor shall have the ability to communicate information to a remote data collection system.

(f) All necessary instrument transformers (CTs/PTs) shall be provided in the switchgear.

(g) The monitor shall be listed according to UL 508.

(h) The monitor shall provide true RMS metered values accurate for distorted, non-sinusoidal wave-shapes beyond the 30th harmonic (fundamental of 60 hertz).

(i) The monitor shall be accurate to ± 0.25% of reading ± 0.05% of full scale for voltage and current metering, and ±1.0% for all power and energy functions. The accuracy shall be maintained for both light and full loads. No annual re-calibration by users shall be required.

(j) Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).

(k) The monitor shall be equipped with an integral, continuous duty, long-life display to provide local access to the following metered quantities as well as the minimum and maximum value since last reset of each quantity:

(1) Current (RMS), per phase and neutral
(2) Voltage, phase-to-phase and phase-to-neutral
(3) Real power, per phase and 3-phase total
(4) Reactive power, per phase and 3-phase total
(5) Apparent power, per phase and 3-phase total
(6) Power factor, 3-phase total and per phase
(7) Frequency
(8) Demand current, per phase and three phase average
(9) Demand real power, three phase
(10) Demand apparent power, three phase
(11) Accumulated Energy, (MWH and MVARH)
(12) THD, current and voltage, per phase
(13) K-factor, current, per phase

(l) The following demand readings shall be reported by the monitor:

(1) Average demand current, per phase
(2) Peak demand current, per phase
(3) Average demand for real power, reactive power, and apparent power
(4) Predicted demand for real power, reactive power, and apparent power
(5) Peak demand for real power, reactive power, and apparent power
(6) The default demand calculations method shall be 15-minute interval.

(m) Installation contractor shall be required to provide documentation verifying proper meter calibration and verifying proper operation/readings during commissioning of the equipment.

2.12 Padlock: Provide provision for padlock for major equipment. Coordinate with DPW

2.13 COORDINATED POWER SYSTEM PROTECTION:

2.13.1 The study shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years.

2.13.2 Scope Analysis: The fault current analysis, and protective device coordination study shall begin at the source bus and extend down to system bused where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses. Coordinate with DPW

2.13.3 Determination of facts: The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall coordinate with the commercial power company for fault current availability at the site.

2.13.4 A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.13.5 Coordination Study: The study shall demonstrate that the maximum possible degree of selectively has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and any relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided.

2.13.6 Study Report: The report shall include

(a) narrative describing the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.
(b) Descriptive and technical data for the new protective devices proposed.

(c) Document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristics curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.

(d) Fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

(e) Provide the calculation performed for the analyses, including computer analysis programs utilized. A software package, of the same version used for the short circuit and coordination study shall be provided.

3. SECTION: MOTOR CONTROL CENTERS, SWITCHBOARDS/GEAR and PANELBOARDS

3.1 Motor control centers, switchboards/gear and Panels Bus bars shall be copper. Size 200% Neutral for non-linear load. Switchgear bus bars shall be silver plated. Provide directories to show load served and source.

3.1.1 Ground bus: Provide full width at the bottom of the motor control center line-up. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable minimum shall be provided at each end of the bus for connection to the main grounding system.

3.1.2 Neutral Bus: A fully rated neutral bus shall be provided continuous through the control center. 200% rated neutral shall be provided for panels supplying electronics

3.2 Voltage Fault Protection: Provide protection against voltage faults, phase unbalance, phase loss, phase reversal, under-voltage and over-voltage

3.3 Distribution Transformers: Provide 200% neutral for dry type transformers supplying nonlinear loads. Use K-Factor rated, K4 for 50% and K13 for 100% connected nonlinear loads. Provide Copper windings type.

3.4 Switchboards: Provide dead-front construction. Mount switchgear on concrete slab.

3.5 Size panels to provide a minimum of 25% minimum future expansion.

4. SECTION: ELECTRICAL WORK, INTERIOR

4.1 Use copper conductor only, Aluminum conductors shall not be used. Underground service entrance conductor shall be USE rated, with XLP or EPR insulation. Use THHN/THWN for interior wiring, minimum size for branch circuit conductor shall be No.12 minimum, no.8 AWG and larger shall be stranded, no.10 AWG and smaller shall be solid.

4.2 Equipment ground conductor: Provide insulated green conductor in all conduits.

4.3 Provide Transient voltage surge suppressors (TVSS) at service entrance panels, and panels supporting electronic equipment, shown on drawings schedules and/or line diagram.

4.4 CIRCUIT BREAKERS: Provide bolted type breakers**,** All ratings shall be clearly visible. Breakers used for switching shall be rated ”SWD”. Use of "Subfeed Breaker" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted on center, above or below branch breakers. Where "space only" is indicated, make provisions for future installation of breakers.

4.5 Electrical, Zinc-Coated Steel Metallic Tubing (EMT), (IMC): Use EMT in the interior and dry location areas. Unless otherwise noted, all conduits shall be concealed. Use EMT in mechanical and electrical rooms where conduits are physically protected, otherwise provide Galvanized Rigid steel conduit shall be used. The use of MC and Romex cables are not be acceptable, except MC cable may be used as whips to lighting fixtures.

4.6 Control wiring related to mechanical equipment such as HVAC, installed in the mechanical room, un-accessible areas and areas subject to traffic shall be installed in conduit. Cable shall be rated for the applications. All control related to electrical equipment, such as motors, lighting control, etc. shall be installed in conduit.

4.7 Each motor of 1/8 hp or larger shall be provided with thermal-overload protection and heavy duty disconnecting mean. Provide spare parts fuses.

4.8 Pull wires: Provide a pull wire in all empty raceway

4.9 Stub-Up & through slabs-on-grade conduits: Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Conduit shall be Galvanized rigid steel.

4.10 Communications: Use Army Technical Guide for Installation Information infra structure architecture (I3A). Coordinate with NEC.

4.11 Receptacles: Provide one receptacle per wall minimum, and every 12' maximum, install no more than 6 receptacles per branch circuit and as required per load. Use 20A heavy duty, grounding type receptacles, side wired. Receptacles with ground fault circuit interrupters shall be UL Class A type, with Set-reset buttons of contrast color.

4.11.1 Wet location Receptacles: Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn.

4.12 Switches: Switches shall be rated for quite type AC only, 120/277volts with 20A current rating. Use lighting control as required by UFC

3-350-01. 4.12.1 A neutral conductor shall be installed in all switch

4.13 Splices: Use wire nut connectors for no.10 AWG and smaller. Do not use Quick Connect type wire connectors. Use solderless connectors for No.8 and larger and cover with insulation material same rating as conductor insulation.

4.14 Provide calculations for Panel Loads, Lighting, Feeders, Voltage drop, short circuit, load analysis, Coordination study, etc. See other sections.

4.15 Use fluorescent lighting fixtures with 100% electronic high frequency type, instant start ballasts, 95% minimum HPF, with no magnetic core and coil. Ballast shall be connected in parallel, where if one or more lamps fails or are removed shall permit the operation of other lamps. Use 32W, T8 lamps, 10% THD maximum. Do not use ballast to serve multi fixtures. For emergency fixture, provide a backup power, red light indicator (LED) and test switch. Use other energy efficient lighting as coordinated and approved for the applications.

4.16 Use LED type exit light with backup power, red light indicator (LED) and test switch.

4.17 Contractor shall provide temporary power as required to keep the facility in operation during the construction period. Coordinate with DPW and the user.

4.18 For Facilities with COM and TV, provide copper bus bar suitable for indoor application to conform to TIA J-STD-607-A grounding requirements, size ¼" X 4" X (length as required)

5. ELECTRICAL WORK, EXTERIOR

General:

(a) Pad mounted equipment shall have permanently affixed identification labels. Labels shall be weather resistant, engraved, metal or phenolic

plastic. Labels shall indicate equipment identification, rating, and circuit designation. Information for equipment identification and circuit designation (line side, load side) will be Coordinated with DPW. Place label on the front door **of** the pad mounted transformer, this is in addition to the label located inside the transformer, see attachment#1.

(b) Cables shall have permanent identification tag installed at each manhole, hand hole, pull box, or termination. Labels shall be weather resistant, engraved, metal or phenolic plastic. Labels shall indicate at a minimum the circuit designation and To/From information. Information for circuit designation shall be Coordinated with DPW.

(c) All bussing in electrical equipment shall be copper.

(d) Bore under roads, provide Galvanized Rigid Steel conduit, PVC coated or provide PVC conduit-in-casing, with spacers. Provide spare conduit of equal size. Use Underground Devices Incorporated product or equal.

6. FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE
(Coordinate with the Fire Department, (580) 442-5911)

6.1 Use factory painted RED color EMT conduit inside the building

6.2 Use MONACO transceiver; transmit at a frequency of 141.3625 MHZ, Coordinate with Monaco Enterprise and the fire department.

6.3 Provide 72 hours battery backup power, 15 minutes Alarm test.

6.4 Fire Alarm system devices (initiating and notification) shall be addressable type, Class A, NAC devices style Z, IDC devices style D, SLC devices style 6, Size each SLC and NAC to provide a minimum of 40 percent expansion without hardware modifications to the panel. System shall be capable to communicate with the existing D-21 fire protection management system located at Fort Sill fire station and 911 center in Lawton.

6.5 Provide visual notification signals in areas where hearing protection is worn due to high ambient noise levels. Also, visual notification signals must be provided in all areas of the building, even if some areas in the building are only accessed occasionally by personnel who are hearing impaired and granted unaccompanied access, such as maintenance or cleaning personnel.

6.6 Provide OVERVOLTAGE AND SURGE PROTECTION at the input power of panels, circuits that exit or enter a building.

6.7 provide a graphic Annunciator panel or remote control (LCD) panel as required by the fire department.

6.8 Use single action key operated pull station. Break glass, wrench operated pull station are not acceptable.

7. Mass Notification System (MNS):
Coordinate with the fire department, (580)442-5911 & Force Protection, (580) 442-5973

8. LIGHTNING PROTECTION SYSTEM

8.1 Provide lightning protection as required. System shall be UL certified.

(a) Provide Safety Tip air terminals
(b) Where Ground grid/counterpoise is used, install 30 inches below grade minimum, at a distance not less than 3 feet nor more than 8 feet from the structure.

(c) All Connections between the building steel columns and ground (counterpoise, Rods) shall be at the bottom of the columns. Use Cad-weld connections.
(d) Where poles are used for overhead system and ground rods are required, install the first ground rod a minimum of 6 feet from the pole base.

9. CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)

9.1 Provide Cathodic Protection System, sacrificial Anodes to the sprinkler system riser entering the building from below grade. Coordinate with AWE for water piping and ONG for gas in other areas.

Attachment #1

Ft. Sill DPW
New Padmounted Transformer Labeling Information

(Place label on the front door of the padmounted transformer. This is in addition to the label located inside the transformer.)

Label Example:

500 kVA
13.2kV-208/120V
TP 2 1602

Label Explanation:

Number of XFMRs and Size: 3-25kVA, or 1-50, 2-37.5kVA, or 500kVA
Voltage: 13.2kV-480/277V or 208/120V
Code: TP 2 1602
- **TP indicates – Transformer, Padmounted**
- **2 indicates – Feeder Number**
- **1602 indicated – Bldg Number**

Signature: _____ Date: _____

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM
11/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 780	(2017) Standard for the Installation of Lightning Protection Systems

U.S. AIR FORCE (USAF)

AFI 32-1065	(2017) Grounding Systems

UNDERWRITERS LABORATORIES (UL)

UL 96	(2016) UL Standard for Safety Lightning Protection Components
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL Electrical Construction	(2012) Electrical Construction Equipment Directory

1.2 RELATED REQUIREMENTS

1.2.1 Verification of Dimensions

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before making any departures from the design.

1.2.2 System Requirements

Provide a system furnished under this specification consisting of the latest UL Listed products of a manufacturer regularly engaged in production of

lightning protection system components. Comply with NFPA 70, NFPA 780, and UL 96.

1.2.3 Lightning Protection System Installers Documentation

Provide documentation showing that the installer is certified with a commercial third-party inspection company whose sole work is lightning protection, or is a UL Listed Lightning Protection Installer. In either case, the documentation must show that they have completed and passed the requirements for certification or listing, and have a minimum of 2 years documented experience installing lightning protection systems for DoD projects of similar scope and complexity.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overall lightning protection system; G

Each major component; G

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan; G

Lightning Protection and Grounding System Test; G

SD-07 Certificates

Lightning Protection System Installers Documentation; G

Component UL Listed and Labeled; G

Lightning protection system inspection certificate; G

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "must" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.4.1 Installation Drawings

1.4.1.1 Overall System Drawing

Submit installation shop drawing for the overall lightning protection system. Include on the drawings the physical layout of the equipment (plan view and elevations), mounting details, relationship to other parts of the work, and wiring diagrams.

1.4.1.2 Major Components

Submit detail drawings for each major component including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 Component UL Listed and Labeled

Submit proof of compliance that components are UL Listed and Labeled. Listing alone in UL Electrical Construction, which is the UL Electrical Construction Directory, is not acceptable evidence. In lieu of Listed and Labeled, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.4.3 Lightning Protection and Grounding System Test Plan

Provide a lightning protection and grounding system test plan. Detail both the visual inspection and electrical testing of the system and components in the test plan. Identify (number) the system test points/locations along with a listing or description of the item to be tested and the type of test to be conducted. As a minimum, include a sketch of the facility and surrounding lightning protection system as part of the specific test plan for each structure. Include the requirements specified in paragraph, "Testing of Integral Lightning Protection System" in the test plan.

1.4.4 Lightning Protection System Inspection Certificate

Provide certification from a commercial third-party inspection company whose sole work is lightning protection, stating that the lightning protection system complies with NFPA 780. Third party inspection company cannot be the system installer or the system designer. Alternatively, provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780.

Provide certification from a commercial third-party inspection company whose sole work is lightning protection, stating that the lightning protection system complies with NFPA 780 and AFI 32-1065. Third party inspection company cannot be the system installer or the system designer. Alternatively, provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780 and AFI 32-1065. In either case, AFI 32-1065 takes precedence over NFPA 780, whether or not it is more stringent.

Inspection must cover every connection, air terminal, conductor, fastener, accessible grounding point and other components of the lightning protection system to ensure 100% system compliance. This includes witnessing the tests for the resistance measurements for ground rods with test wells, and for continuity measurements for bonds. It also includes verification of proper surge protective devices for power, data and telecommunication systems. Random sampling or partial inspection of a facility is not acceptable.

1.5 SITE CONDITIONS

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before changing the design.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings, such as tin or lead, or oversize conductors. Where a mechanical hazard is involved, increase conductor size to compensate for the hazard or protect conductors. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic). All lightning protection components, such as bonding plates, air terminals, air terminal supports and braces, chimney bands, clips, connector fittings, and fasteners are to comply with the requirements of UL 96 classes as applicable.

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.1.2 Copper Only

Provide copper conductors, except where aluminum conductors are required for connection to aluminum equipment.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide solid air terminals with a blunt tip. Tubular air terminals are not permitted. Support air terminals more than 24 inches in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods made of copper-clad steel conforming to conform to UL 467. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length. Do not mix ground rods of copper-clad steel or solid copper on the job.

2.2.3 Grounding Plates

Provide grounding plates made of copper-clad steel conforming to UL 96.

2.2.4 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.5 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780 and UL 96.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Provide a lightning protection system that meets the requirements of NFPA 780. Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, and grounding electrodes. Expose conductors on the structures except where conductors are required to be in protective sleeves. Bond secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or below the level of the grounded metallic parts.

3.1.1 Roof-Mounted Components

Coordinate with the roofing manufacturer and provide certification that the roof manufacturer's warranty is not violated by the installation methods for air terminals and roof conductors.

3.1.1.1 Air Terminals

In areas of snow or constant wind, ensure that a section of roofing material (minimum dimensional area of 1 square foot) is first glued to the roof and then the air terminal is glued to it unless the roof manufacturer recommends another solution. Use a standing seam base for installation of air terminals on a standing seam metal roof that does not produce any roof penetrations.

3.1.1.2 Roof Conductors

Use a standing seam base for installation of roof conductors on a standing seam metal roof that does not produce any roof penetrations. Roof conductors are to be concealed within the attic space as much as practicable.

3.1.2 Down Conductors

Protect exposed down conductors from physical damage as required by NFPA 780. Use Schedule 80 PVC to protect down conductors. Paint the Schedule 80 PVC to match the surrounding surface with paint that is approved for use on PVC.

3.1.3 Ground Connections

Attach each down conductor to ground rods by welding (including exothermic), brazing, or compression. All connections to ground rods below ground level must be by exothermic weld connection or with a high compression connection using a hydraulic or electric compression tool to provide the correct

circumferential pressure. Accessible connections above ground level and in test wells can be accomplished by mechanical clamping.

3.1.4 Grounding Electrodes

Extend driven ground rods vertically into the existing undisturbed earth for a distance of not less 10 feet. Set ground rods not less than 3 feet nor more than 8 feet, from the structure foundation, and at least beyond the drip line for the facility. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum allowed resistance of a driven ground rod is 25 ohms, under normally dry conditions. Contact the Contracting Officer for direction on how to proceed when two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground ring electrode, provide continuous No. 1/0 bare stranded copper cable. Lay ground ring electrode around the perimeter of the structure in a trench not less than 3 feet nor more than 8 feet from the nearest point of the structure foundation, and at least beyond the drip line for the facility. Install ground ring electrode to a minimum depth of 30 inches. Install a ground ring electrode in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable.

3.1.5 Grounding Plates

Provide a grounding plate for each down conductor. Set grounding plates not less than 3 feet nor more than 8 feet, from the structure foundation, and at least beyond the drip line for the facility. Grounding plate is to be buried as deeply in the existing dirt as local conditions allow, without exceeding) 10 feet in depth.

3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so that they are electrically continuous, having a surface contact of at least 3 square inches.

3.3 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore, to original condition, the areas disturbed by trenching, storing of dirt, cable laying, and other work. Overfill to accommodate for settling. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.4 FIELD QUALITY CONTROL

3.4.1 Lightning Protection and Grounding System Test

Test the lightning protection and grounding system to ensure continuity is not in excess of 1 ohm and that resistance to ground is not in excess of 25 ohms. Provide documentation for the measured values at each test point.

Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of test points, measured values for continuity and ground resistances, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

-- End of Section --