SECTION 074116 - INSULATED METAL ROOF PANELS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
   * + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
      1. SUMMARY
         1. Section includes insulated metal roof panels.

Refer to sections listed below for cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections. Sections listed below are for spec editor’s and design team coordination and are to remain as Editor’s Notes. Remove referenced specification sections within the body of the specification if not applicable to the project.

Section 074293 "Soffit Panels" for metal panels used in horizontal soffit applications.

Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.

* + - 1. PREINSTALLATION MEETINGS

Retain "Preinstallation Conference" paragraph below if Work of this Section is extensive or complex enough to justify a conference.

* + - * 1. Preinstallation Conference: Conduct conference at Project site.

Retain subparagraphs below if additional requirements are necessary; revise to include more specific information about conference.

Meet with Director’s Representative, Architect, Director’s Representative’s insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.

Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

Review methods and procedures related to metal panel installation, including manufacturer's written instructions.

Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.

Review structural loading limitations of purlins and rafters during and after roofing.

Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.

Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

Review temporary protection requirements for metal panel systems during and after installation.

Review of procedures for repair of metal panels damaged after installation.

Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

* + - 1. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
         2. Manufacturer’s installation instructions shall be provided along with product data.
         3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
         4. Product Data: For each type of product.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

Manufacturer’s installation instructions.

* + - 1. Sustainable Design Submittals:
         1. Shop Drawings:

Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

Retain "Samples for Initial Selection" and "Samples for Verification" paragraphs below for two-stage Samples.

* + - * 1. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

Include similar Samples of trim and accessories involving color selection.

* + - * 1. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

* + - * 1. Quality Control Submittals:

Qualification Data: For Installer.

Product Test Reports: For each product, for tests performed by a qualified testing agency.

Field quality-control reports.

Sample Warranties: For special warranties.

* + - * 1. Contract Closeout Submittals:

Maintenance Data: For metal panels to include in maintenance manuals.

* + - 1. QUALITY ASSURANCE
         1. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
         2. Benchmarks: Build Benchmarks to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

Retain first subparagraph below for large-scale Benchmark. Indicate portion of roof represented by Benchmark on Drawings or draw Benchmark as separate element.

Build Benchmarks of typical roof area and eave [, **including fascia,] [and soffit**] as shown on Drawings; approximately [**48 inches] [12 feet] <Insert dimension**> square by full thickness, including attachments[, **underlayment**,] and accessories.

Retain first subparagraph below for limited benchmark.

Build Benchmarks for typical roof area only, including accessories.

Size: [**12 feet long by 6 feet] <Insert dimension**>.

[**Each type of exposed seam and seam termination] <Insert Benchmark item**>.

Approval of Benchmarks does not constitute approval of deviations from the Contract Documents contained in benchmarks unless Director’s Representative specifically approves such deviations in writing.

* + - 1. DELIVERY, STORAGE, AND HANDLING
         1. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
         2. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
         3. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
         4. Retain strippable protective covering on metal panels during installation.
      2. FIELD CONDITIONS
         1. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.
      3. COORDINATION
         1. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
         2. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
      4. WARRANTY

When warranties are required, verify with Director’s Representative that special warranties stated in this article are not less than remedies available to the Facility under prevailing local laws.

* + - * 1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

Failures include, but are not limited to, the following:

Structural failures including rupturing, cracking, or puncturing.

Deterioration of metals and other materials beyond normal weathering.

Verify available warranties and warranty periods for metal panels.

Warranty Period: [**Two] <Insert number**> years from date of Substantial Completion.

* + - * 1. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

Usually retain "Exposed Panel Finish" subparagraph below for fluoropolymer or siliconized-polyester finishes; verify availability with manufacturer.

Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

Color fading more than 5 Hunter units when tested according to ASTM D2244.

Chalking in excess of a No. 8 rating when tested according to ASTM D4214.

Cracking, checking, peeling, or failure of paint to adhere to bare metal.

Verify available warranties for metal panel finishes and insert number in "Finish Warranty Period" subparagraph below. A 20-year period is available for fluoropolymer finish and is the maximum included with manufacturers' published data; a 10-year period is usually available for siliconized polyester. Longer periods for premium finishes may be available.

Finish Warranty Period: [**20] [10] <Insert number**> years from date of Substantial Completion.

* + - * 1. Special Warranty: The one year period required by Paragraph 9.8 of the General Conditions is extended to 2 years for the Work of this Section. Refer to Supplementary Conditions.

Insert requirements for special weathertightness warranty if needed; panel manufacturers do not typically offer such warranties.

1. PRODUCTS

See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products.

* + - 1. PERFORMANCE REQUIREMENTS

Retain first "Energy Performance" paragraph below for roofs that must comply with the EPA/DOE's ENERGY STAR requirements. The EPA/DOE's ENERGY STAR "Roof Product List" is available in PDF at www.energystar.gov.

* + - * 1. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for [**low] [steep**]-slope roof products.

Retain "Energy Performance" paragraph below for roofs that must comply with local "cool-roof" energy legislation; verify requirements with authorities having jurisdiction. Example and options below are for low-slope roofs that must comply with prescriptive approach of CCR Title 24 (California Building Standards Code).

* + - * 1. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

Three-year, aged solar reflectance of not less than [**0.55] <Insert value**> and emissivity of not less than [**0.75] <Insert value**>.

Three-year, aged Solar Reflectance Index of not less than **[64] <Insert value**> when calculated according to ASTM E1980.

* + - * 1. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

Wind Loads: As indicated on Drawings.

Other Design Loads: [**As indicated on Drawings] <Insert loads**>.

Deflection Limits: For wind loads, no greater than [**1/180] [1/240] <Insert deflection**> of the span.

<**Insert serviceability requirements**>.

ASTM E1680 in "Air Filtration" paragraph below has replaced ASTM E283 for testing metal roof panels; retain option to allow products to be tested according to ASTM E283.

* + - * 1. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 [ **or ASTM E283**] at the following test-pressure difference:

Value in first option in "Test-Pressure Difference" subparagraph below is equivalent to a 25-mph wind and is ASTM E1680 default. Products tested to value in second option below, equivalent to a 50-mph wind, are widely available. Revise to suit Project.

Test-Pressure Difference: [**1.57 lbf/sq. ft.] [6.24 lbf/sq. ft**.].

ASTM E1646 in "Water Penetration under Static Pressure" paragraph below has replaced ASTM E331 for testing metal roof panels; retain option to allow products to be tested according to ASTM E331.

* + - * 1. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 [ **or ASTM E331**] at the following test-pressure difference:

Value in first option in "Test-Pressure Difference" subparagraph below is equivalent to a 34-mph wind and is ASTM E1646 default. Products tested to value in second option below, equivalent to a 50-mph wind, are widely available. Revise to suit Project.

Test-Pressure Difference: [**2.86 lbf/sq. ft.] [6.24 lbf/sq. ft**.].

Retain "Wind-Uplift Resistance" paragraph below if UL-class roof is required. Verify that product is listed in UL's "Roofing Materials & Systems Directory." UL listings include requirements for the entire assembly and not solely metal roof panels.

* + - * 1. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

The higher the value in the options in "Uplift Rating" subparagraph below, the greater the uplift resistance.

Uplift Rating: [**UL 30] [UL 60] [UL 90].**

Retain "FM Global Listing" paragraph below if Project is FM Global insured or if FM Global requirements will set a minimum quality standard. Coordinate requirements of FM Global classification with other requirements in this Section. Verify availability of metal roof panel systems that meet these classifications.

* + - * 1. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

Retain one option in "Fire/Windstorm Classification" subparagraph below based on windstorm classification of Project; the higher the value in the option, the greater the uplift resistance. FM Global Loss Prevention Data Sheet 1-28 multiplies the actual field-of-roof uplift pressure by a factor of 2 to obtain the factored pressure, the number that establishes the minimum FM Global approval rating. Verify availability of roofing systems that meet these classifications. Other options for classifications increase in increments of 15 (e.g., Class 1A-135, Class 1A-150, Class 1A-165, and higher). Class 1A signifies complying with ASTM E108, Class A fire performance for FM Global-approved, Class 1 panel roofs.

Fire/Windstorm Classification: Class 1A-[**60] [75] [90] [105] [120] <Insert number**>.

Retain one option in "Hail Resistance" subparagraph below. For areas that experience three or more hailstorms annually, FM Global recommends roofing systems rated SH (severe hail) instead of MH (moderate hail).

Hail Resistance: [**MH] [SH**].

* + - * 1. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

Differential values (for aluminum in particular) in "Temperature Change (Range)" subparagraph below are suitable for most of the U.S.; revise to suit Project.

Temperature Change (Range): [**120 deg F, ambient; 180 deg F, material surfaces] <Insert temperature range**>.

* + - 1. FOAMED-INSULATION-CORE METAL ROOF PANELS
         1. General: Provide factory-formed and -assembled metal roof panels fabricated from two sheets of metal with insulation core foamed in place during fabrication with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

Panel Performance:

Flatwise Tensile Strength: 30 psi when tested according to ASTM C297.

Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at 140 deg F and 100 percent relative humidity according to ASTM D2126.

Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at 200 deg F according to ASTM D2126.

Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus 20 deg F according to ASTM D2126.

Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. positive and negative wind load and with deflection of L/180 for 2 million cycles.

Autoclave: No delamination when exposed to 2-psi pressure at a temperature of 212 deg F for 2-1/2 hours.

Fire-Test-Response Characteristics: Class A according to ASTM E108.

Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

Closed-Cell Content: 90 percent when tested according to ASTM D6226.

Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D1622.

Compressive Strength: Minimum 20 psi when tested according to ASTM D1621.

Shear Strength: 26 psi when tested according to ASTM C273.

Copy paragraphs below and re-edit for each product.

Insert drawing designation for each product required. Use these designations on Drawings to identify each product.

* + - * 1. Lap-Seam-Profile, Foamed-Insulation-Core Metal Roof Panels <Insert drawing designation>: Formed for lapping side edges of adjacent panels and mechanically attaching to supports using exposed fasteners in side laps.

Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.

Nominal Thickness: [**0.022 inch] [0.028 inch] [0.034 inch**].

Exterior Finish: [**Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish**>.

Color: [**As indicated by manufacturer's designations] [Match Director’s Representative’s samples] [As selected by Director’s Representative from manufacturer's full range] <Insert color**>.

Interior Finish: [**Siliconized polyester] [Acrylic or polyester] <Insert finish**>.

Color: [**As indicated by manufacturer's designations] [Match Director’s Representative samples] [As selected by Director’s Representative from manufacturer's full range] <Insert color**>.

Retain "Batten" subparagraph below if required. A batten is an optional feature with some manufacturers; verify availability.

Batten: Same material, finish, and color as exterior facings of roof panels.

Panel Coverage: [**24 inches] [30 inches] [36 inches] [39.6 inches] [40 inches] [44.5 inches] <Insert dimension**>.

Panel Thickness: [**1.0 inch] [1.5 inches] [2.0 inches] [2.5 inches] [3.0 inches] [4.0 inches] [5.0 inches] [6.0 inches] <Insert dimension**>.

Coordinate thermal-resistance value in "Thermal-Resistance Value (R-Value)" subparagraph below with panel thickness in "Panel Thickness" subparagraph above.

Thermal-Resistance Value (R-Value): <**Insert numbe**r> according to ASTM C1363.

* + - * 1. Standing-Seam-Profile, Foamed-Insulation-Core Metal Roof Panels <**Insert drawing designation**>: Formed with vertical tongue-and-groove ribs at panel edges and [**intermediate stiffening ribs symmetrically spaced] [a flat pan**] between ribs; designed for sequential installation by interlocking tongue-and-groove panel edges and mechanically attaching panels to supports using concealed clips located between panels and engaging edges of adjacent panels, and mechanically seaming panels together.

Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.

Nominal Thickness: [**0.022 inch] [0.028 inch] [0.034 inch**].

Exterior Finish: [**Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish**>.

Color: [**As indicated by manufacturer's designations] [Match Director’s Representative’s samples] [As selected by Director’s Representative from manufacturer's full range] <Insert color**>.

Interior Finish: [**Siliconized polyester] [Acrylic or polyester] <Insert finish**>.

Color: [**As indicated by manufacturer's designations] [Match Director’s Representative’s samples] [As selected by Director’s Representative from manufacturer's full range] <Insert color**>.

Joint Type: [**Single folded] [Double folded] [As standard with manufacturer**].

Panel Coverage: [**36 inches] [42 inches ] <Insert dimension**>.

**Panel Thickness: [2.0 inches] [2.5 inches] [3.0 inches] [4.0 inches] [5.0 inches] [6.0 inches] <Insert dimension**>.

Coordinate thermal-resistance value in "Thermal-Resistance Value (R-Value)" subparagraph below with panel thickness in "Panel Thickness" subparagraph above.

Thermal-Resistance Value (R-Value): <**Insert number**> according to ASTM C1363.

* + - * 1. Batten-Seam-Profile, Foamed-Insulation-Core Metal Roof Panels <Insert drawing designation>: Formed with vertical or tapered tongue-and-groove ribs at panel edges and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between ribs; designed for sequential installation by interlocking tongue-and-groove panel edges and mechanically attaching panels to supports using concealed clips located between panels and engaging edges of adjacent panels, and installing snap-on battens over panel joints.

Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.

Nominal Thickness: 0.022 inch Exterior Finish: [**Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish**>.

Color: [**As indicated by manufacturer's designations] [Match Director’s Representative’s samples] [As selected by Director’s Representative from manufacturer's full range] <Insert color**>.

Interior Finish: [**Siliconized polyester] [Acrylic or polyester] <Insert finish**>.

Color: [**As indicated by manufacturer's designations] [Match Director’s Representative’s samples] [As selected by Director’s Representative from manufacturer's full range] <Insert color**>.

Retain "Batten" subparagraph below if required. A batten is an optional feature with some manufacturers; verify availability.

Batten: Same material, finish, and color as exterior facings of roof panels.

Clips: One piece; [**0.064-inch-] [0.097-inch-]** nominal thickness, [**zinc-coated (galvanized)] [or] [aluminum-zinc alloy-coated**] steel sheet.

Panel Coverage: [**36 inches] [39.6 inches] <Insert dimension**>.

Panel Thickness: [1**.75 inches] [2.0 inches] [2.5 inches] [3.0 inches] [4.0 inches] [5.0 inches] [6.0 inches] <Insert dimension**>.

Coordinate thermal-resistance value in "Thermal-Resistance Value (R-Value)" subparagraph below with panel thickness in "Panel Thickness" subparagraph above.

Thermal-Resistance Value (R-Value): <**Insert number**> according to ASTM C1363.

* + - 1. MISCELLANEOUS MATERIALS
         1. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653, G90 coating designation or ASTM A792, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

Retain panel accessories, flashing, and trim as required and coordinate with those specified in Section 076200 "Sheet Metal Flashing and Trim."

* + - * 1. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.

Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

* + - * 1. Flashing and Trim: Provide flashing and trim formed from same material as exterior facings of metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

If required, insert special requirements for ridge closures, corner units, copings, fasciae, and fillers.

* + - * 1. Gutters: Formed from same material, finish, and color as exterior facings of panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match [**metal roof panels] [roof fascia and rake trim**].
        2. Downspouts: Formed from same material, finish, and color as exterior facings of roof panels. Fabricate in 10-foot- long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
        3. Roof Curbs: Fabricated from same material, finish, and color as exterior facings of roof panels, [0.048-inch] <Insert dimension> nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch- nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

Insulate roof curb with 1-inch thick, rigid insulation.

Insert requirements for explosion-relief panels, including special fasteners, cables, and supports, if required. Verify availability with manufacturers.

* + - * 1. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
        2. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

* + - 1. FABRICATION
         1. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
         2. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

Retain first paragraph below if gaskets or sealants are factory installed.

* + - * 1. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
        2. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

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

Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application but not less than thickness of metal being secured.

* + - 1. FINISHES
         1. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
         2. 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 same piece are unacceptable. 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.
         3. Exterior Facings and Accessories:

Retain one exposed fluoropolymer or siliconized-polyester finish from subparagraphs below. Verify availability of finishes for products specified. If retaining more than one, indicate location of each on Drawings or by inserts. To obtain a proprietary finish system, insert names of coating manufacturers and products.

Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.

* + - * 1. Interior Facings:

Retain one interior finish from "Siliconized Polyester" and "Acrylic or Polyester Finish" subparagraphs below. Verify availability of finishes for products specified. If retaining more than one, indicate location of each on Drawings or by inserts. To obtain a proprietary finish system, insert names of coating manufacturers and products.

Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.

Acrylic or Polyester Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

1. EXECUTION
   * + 1. EXAMINATION
          1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

* + - * 1. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
        2. Proceed with installation only after unsatisfactory conditions have been corrected.
      1. PREPARATION
         1. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
      2. METAL PANEL INSTALLATION
         1. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal roof panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.

Shim or otherwise plumb substrates receiving metal panels.

Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.

Install screw fasteners in predrilled holes.

Locate and space fastenings in uniform vertical and horizontal alignment.

Install flashing and trim as metal panel work proceeds.

Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.

Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

* + - * 1. Fasteners: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
        2. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
        3. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
        4. Lap-Seam, Foamed-Insulation-Core Metal Roof Panels: Fasten insulated metal roof panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

Lap ribbed or fluted sheets one full-rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or applications not true to line.

Provide metal-backed washers under heads of exposed fasteners bearing on weather side of insulated metal roof panels.

Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.

Provide sealant tape at lapped joints of insulated metal roof panels and between panels and protruding equipment, vents, and accessories.

Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to weatherproof panels.

Retain subparagraph below if required; coordinate with products retained in Part 2.

Apply snap-on battens to seams of insulated metal roof panels to conceal fasteners.

* + - * 1. Standing-Seam, Foamed-Insulation-Core Metal Roof Panels: Fasten insulated metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

Install clips to supports with self-tapping fasteners.

Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so cleat, insulated metal roof panel, and factory-applied side-lap sealant are completely engaged.

* + - * 1. Batten-Seam, Foamed-Insulation-Core Metal Roof Panels: Fasten insulated metal roof panels to supports with concealed clips at each batten-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

Apply battens to insulated metal roof panel seams, fully engaged to provide weathertight joints.

* + - * 1. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, provide types recommended in writing by metal roof panel manufacturer.

* + - * 1. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.

Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

* + - * 1. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eve with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
        2. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

Retain one of two subparagraphs below.

Provide elbows at base of downspouts to direct water away from building.

Connect downspouts to underground drainage system indicated.

* + - * 1. Roof Curbs: Install flashing around bases where they meet metal roof panels.
        2. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.
      1. ERECTION TOLERANCES

Generally retain this article only for sophisticated or highly finished metal roof panel assemblies.

* + - * 1. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

If less-stringent tolerances are required, consider inserting installation tolerances from MCA's "Guide Specification for Residential Metal Roofing."

* + - 1. FIELD QUALITY CONTROL

Retain "Manufacturer's Field Service" paragraph below to require a Company Service Advisor to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Service Advisor to test and inspect completed metal panel installation, including accessories. Report results in writing.
        2. Remove and replace applications where tests and inspections indicate that they do not comply with specified requirements.
        3. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
        4. Prepare test and inspection reports.
      1. CLEANING AND PROTECTION
         1. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
         2. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074116