

## SECTION 07411 - METAL ROOF PANELS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Contract Drawings and general provisions of the Construction Contract, including Contract Clauses and Conditions (CC &C), Supplemental Contract Clauses and Conditions, and Division 1 sections of these Contract Specifications, apply to work of this Section.
- B. Related Sections include the following:
  - 1. Refer to Section 07620, "Sheet Metal Flashing and Trim" for fasciae, copings, flashings and other sheet metal work not part of metal roof panel assemblies.
  - 2. Refer to Section 07920, "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Factory-formed and field-assembled, concealed-fastener, lap-seam metal roof panels.
  - 2. Metal soffit panels.
  - 3. Standing seam metal roofing.

#### 1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- B. Air Infiltration: Air leakage through assembly of not more than 0.3 L/s per sq. m of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
  - 1. Test-Pressure Difference: Negative 75 Pa.
  - 2. Positive Preload Test-Pressure Difference: Greater than or equal to 720 Pa and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
  - 3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.
- C. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

1. Test-Pressure Difference: 137 Pa.
  2. Positive Preload Test-Pressure Difference: Greater than or equal to 720 Pa and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
  3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.
- D. Water Absorption: Maximum 1.0 percent absorption rate by volume when tested according to ASTM C 209.
- E. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
1. Fire/Windstorm Classification: Class 1A-90.
  2. Hail Resistance: MH or SH, as required per geographic location
- F. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592 or ASTM E 330:
1. Wind Loads: Resist wind positive and negative pressures calculated according to ASCE 7-1998, "Minimum Design Loads for Buildings and Other Structures, " Section 6, and the following wind load criteria:
    - a. Basic Wind Speed (3 second gust) = 45 m/s.
    - b. Wind Load Importance Factor  $I_w = 1.15$  (GSO & NOB); 1.00 (other buildings).
    - c. Wind Speed Category = Exposure C.
  2. Deflection Limits: Engineer metal roof panel assemblies to withstand design loads with vertical deflections no greater than 1/180 or 1/240 of the span as required.
- G. Seismic Performance: Provide metal roof panel assemblies capable of withstanding the effects of earthquake motions determined according to requirements of the International Building Code/2000, Section 1621, "Architectural, Mechanical and Electrical Component Seismic Design Requirements," and the following seismic criteria:
1. Seismic Use Group: II (GSO & NOB); I (other buildings).
  2. Site Class: B (Consular CAC, Service CAC, UTL, & NOB); D (other buildings).
  3. Seismic Design Category: D.
  4. Seismic Importance Factor  $I_E = 1.25$  (GSO & NOB); 1.00 (other buildings).
  5. Design Spectral Response Acceleration coefficient at short periods,  $S_{DS}$  : Refer to Structural Drawings.
  6. Design Spectral Response Acceleration at 1-second period,  $S_{D1} =$  Refer to Structural Drawings.
- H. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants,

failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 67 deg C, ambient; 100 deg C, material surfaces.
- I. Thermal Performance: Provide insulated metal roof panel assemblies with thermal-resistance value (R-value) indicated when tested according to ASTM C 236 or ASTM C 518.
- J. Solar Reflectance for Roofs with Slopes of 2:12 or Less: Initial solar reflectance of not less than 0.65 when tested according to ASTM E 903, and maintained, under normal conditions, solar reflectance of not less than 0.50 for 3 years after installation.
- K. Solar Reflectance for Roofs with Slopes Steeper Than 2:12: Initial solar reflectance of not less than 0.25 when tested according to ASTM E 903, and maintained, under normal conditions, solar reflectance not less than 0.15 for 3 years after installation.

#### 1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
  1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
    - a. Flashing and trim.
    - b. Gutters.
    - c. Downspouts.
    - d. Roof curbs.
  2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:
  1. Roof panels and attachments.
  2. Purlins and rafters.
  3. Roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
- D. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.
  1. Include similar Samples of trim and accessories involving color selection.

- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
    - 1. Metal Roof and Soffit Panels: 300 mm long by actual panel width. Include fasteners, clips, battens, closures, and other metal roof panel accessories.
    - 2. Trim and Closures: 300 mm long. Include fasteners and other exposed accessories.
    - 3. Vapor Retarders: 150-mm square Samples.
    - 4. Accessories: 300-mm long Samples for each type of accessory.
  - F. Qualification Data: For Installer professional engineer testing agency.
  - G. Material Certificates: For thermal insulation and vapor retarders, signed by manufacturers.
  - H. Field quality-control inspection reports.
  - I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:
    - 1. Metal Roof and Soffit Panels: Include reports for air infiltration, water penetration, thermal performance, fire-test-response characteristics, and structural performance.
    - 2. Insulation and Vapor Retarders: Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
  - J. Maintenance Data: For metal roof panels to include in maintenance manuals.
  - K. Warranties: Special warranties specified in this Section.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
    - 1. Installer's responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.
    - 2. Engineering Responsibility: Preparation of data for metal roof panels, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
  - B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
  - C. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.
  - D. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal roof panels and are based on the specific system indicated.
  - E. Fire-Resistance Ratings: Where indicated, provide metal roof panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Combustion Characteristics: ASTM E 136.
  2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
  3. Metal roof panels shall be identified with appropriate markings of applicable testing and inspecting agency.
- F. Surface-Burning Characteristics: Provide insulated metal roof panels having insulation core material with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Spread Index: 25 or less, unless otherwise indicated.
  2. Smoke-Developed Index: 450 or less, unless otherwise indicated.
- G. Preliminary Roofing Conference: Before starting roof deck, and sheathing construction, conduct conference at Project site.
1. Meet with the COR Representative, Government's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, deck and sheathing Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
  2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
  4. Examine deck substrate and sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
  5. Review structural loading limitations of deck sheathing during and after roofing.
  6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
  7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
  8. Review temporary protection requirements for metal roof panels during and after installation.
  9. Review roof observation and repair procedures after metal roof panel installation.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
  - B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
  - C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.
- E. Protect foam-plastic insulation as follows:
  - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
  - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

#### 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.

#### 1.9 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations, which are specified in Division 7 Section "Roof Accessories."
- B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of decks, parapets, walls, and other adjoining work to provide a leak proof, secure, and noncorrosive installation.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including rupturing, cracking, or puncturing.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: Five (5) years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
  - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
1. Weathertight Warranty Period: Ten (10) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

### 2.2 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: 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 (Class AZM150 coating designation, Grade 275), structural quality.
    - 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 Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2605.
      - 2) Available Polyvinylidene Fluoride (PVDF) Resin Manufacturers:
        - a) Solvay Solexis - "Hylar 5000"
        - b) Arkema - "Kynar 500"
        - c) Approved equivalent.
      - 3) Available Coating Manufacturers:
        - a) Akzo Chemical.

- b) Glidden Co.
  - c) Morton International.
  - d) PPG Industries, Inc.
  - e) Valspar Corp.
  - f) Approved equivalent.
- 4) Color of the Finish System: As selected by the Architect from the coating manufacturer's full range of colors.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.013 mm.
- B. Panel Sealants:
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 13 mm wide and 3 mm thick.
  2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

### 2.3 UNDERLAYMENT MATERIALS

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

### 2.4 MISCELLANEOUS METAL FRAMING

- A. General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, Z120, hot-dip galvanized zinc coating.
- B. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: As indicated
  2. Depth: As indicated.
- C. Cold-Rolled Furring Channels: 1.37-mm bare steel thickness, with minimum 13-mm-wide flange.
1. Depth: As indicated.
  2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.79 mm.
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 1.59-mm- diameter wire, or double strand of 1.21-mm- diameter wire.

- D. Z-Shaped Furring: With slotted or nonslotted web, face flange of 32 mm, wall attachment flange of 22 mm, minimum bare metal thickness of 0.45 mm, and depth required to fit insulation thickness indicated.
- E. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## 2.5 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.
  - 1. Fasteners for Roof Panels: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal roof panels.
  - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
  - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 0.4-mm dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.6 CONCEALED-FASTENER, LAP-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Standing-Seam-Profile, Concealed-Fastener Metal Roof Panels: Formed with raised, curved-top, standing-seam-shaped major rib at panel edge and intermediate stiffening ribs symmetrically spaced between major rib and panel edge.
  - 1. Available Manufacturers:
    - a. Morin Corporation, a Metecno Group Company.
    - b. Approved equivalent.
  - 2. Material: Aluminum-zinc alloy-coated steel sheet, 0.70 mm thick.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.

## 2.7 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
  - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
  - 2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.
  
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and snapping panels together.
  - 1. Available Manufacturers:
    - a. Morin Corporation; a Metecno Group Company.
    - b. Approved equivalent.
  - 2. Material: Aluminum-zinc alloy-coated steel sheet, 0.85 mm thick.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.

## 2.8 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
  
- B. Metal Soffit Panels: Match profile and material of metal roof panels.
  - 1. Finish: Match finish and color of metal roof panels, unless otherwise indicated.
  
- C. Metal-Faced Composite Soffit Panels: Provide factory-formed and –assembled metal-faced composite panels fabricated from two metal facings bonded, using no glues or adhesives, to solid extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for system.
  - 1. Available Products:
    - a. Alucobond; Alusuisse Composites, Inc.
    - b. UNA-FAB Series 1000; Copper Sales Inc.
    - c. Alpolic; Mitsubishi Chemical America, Inc.
    - d. Reynobond PE; Reynolds Metals Company.

2. Aluminum-Faced Composite Soffit Panels: Formed with 0.50 mm thick painted aluminum sheet facings.
  - a. Panel Thickness: 6 mm, unless otherwise indicated.
  - b. Core: Standard.
  - c. Exterior Finish: Fluoropolymer.
3. Attachment System Components: Formed from extruded aluminum.
  - a. Include manufacturer's standard panel stiffeners, panel clips, and anchor channels as required.
4. Flashing and Trim: Same material, finish, and color as facings of adjacent composite panels, unless otherwise indicated.

## 2.9 ACCESSORIES

- A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 25-mm- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.45-mm-thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim 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 roof panels.

## 2.10 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, 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.
- B. Provide panel Flat profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. 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.
2. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.
  - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

## 2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical 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 not noticeable from a distance of 10 feet from material. Noticeable variations in the same piece are not acceptable.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. 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 work.
  1. 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.
  2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

- B. Substrate Board: Install substrate boards over roof deck on entire roof surface. Attach with substrate-board fasteners.
  - 1. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
  - 2. Comply with UL requirements for fire-rated construction.
- C. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
- D. Install fasciae and copings to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
- E. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written recommendations.
  - 1. Soffit Framing: Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

### 3.3 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment on roof sheathing under metal roof panels, unless otherwise recommended by metal roof panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels. Apply at locations indicated on Drawings in shingle fashion to shed water, with lapped joints of not less than 50 mm.
  - 1. Roof perimeter for a distance up from eaves of 600 mm beyond interior wall line.
  - 2. Valleys, from lowest point to highest point, for a distance on each side of 460 mm. Overlap ends of sheets not less than 150 mm.
  - 3. Rake edges for a distance of 460 mm.
  - 4. Hips and ridges for a distance on each side of 300 mm.
  - 5. Roof to wall intersections for a distance from wall of 460 mm.
  - 6. Around skylights, and other penetrating elements for a distance from element of 460 mm.
- B. Install flashings to cover underlayment to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

### 3.4 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Field cutting of metal roof panels by torch is not permitted.
  - 2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels.
  - 3. Provide metal closures at peaks, and each side of ridge and hip caps.
  - 4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.

5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install ridge and hip caps as metal roof panel work proceeds.
7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

1. Coat back side of aluminum roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.

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

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.

### 3.5 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal roof panels.
3. 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.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps, and on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weatherproof to driving rains.
7. At panel splices, nest panels with minimum 150-mm end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
- C. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
  - 1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.
- D. Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

### 3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. 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 as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without excessive oil canning, 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 to result in waterproof and weather-resistant performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 m with no joints allowed within 600 mm of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with mastic sealant (concealed within joints).

### 3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 6 mm in 6 m on slope and location lines as indicated and within 3-mm offset of adjoining faces and of alignment of matching profiles.

3.8 FIELD QUALITY CONTROL

- A. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- B. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07411