

METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Factory-formed and field-assembled, standing-seam metal roof panels.
- B. Related Sections include the following:
 - 1. Division 06 Section "Steel Decking" for plywood roof deck supporting metal roof panels.
 - 2. Division 05 Section "Cold-Formed Metal Framing" for secondary support framing supporting metal roof panels.
 - 3. Division 07 Section "Sheet Metal Flashing and Trim" for flashings and other sheet metal work not part of metal roof panel assemblies.
 - 4. Division 07 Section "Manufactured Roof Specialties" for copings not part of metal roof panel assemblies.
 - 5. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

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 0.06 cfm/sq. ft. (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: Positive and negative 1.57 lbf/sq. ft. (75 Pa).
 - 2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (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: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12.0 lbf/sq. ft. (575 Pa).
 2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (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. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift resistance class indicated.
- 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.
- 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:
1. Wind Loads: As indicated on Drawings.
 2. Snow Loads: As indicated on Drawings.
 3. Deflection Limits: Engineer metal roof panel assemblies to withstand design loads with vertical deflections no greater than 1/180 of the span.
- G. 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): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- 1.5 ACTION SUBMITTALS
- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal roofing.
1. Include plans, elevations, sections, and attachment details.
 2. Detail fabrication and installation layouts, expansion joint locations, fixed points, and keyed details. Distinguish between shop- and field-assembled work.

3. Include details for forming, including seams and dimensions.
 4. Include details for joining and securing, including layout and spacing of fasteners, cleats, and other attachments. Include pattern of seams.
 5. Include details of termination points and assemblies.
 6. Include details of expansion joints, including showing direction of expansion and contraction from fixed points.
 7. Include details of roof penetrations.
 8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings.
 9. Include details of special conditions.
 10. Include details of connections to adjoining work.
 11. Detail the following accessory items, at scale of not less than 1-1/2 inches per 12 inches
 - a. Flashing and trim.
 - b. Gutters and downspouts as they relate to adjacent sheet metal roofing.
 - c. Roof curbs.
 - d. Attachment of snow guards.
- C. Samples for Initial Selection: For each type of sheet metal with factory-applied finishes.
1. Include Samples of trim and accessories involving finish or color selection.
- D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Roofing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, and other attachments.
 2. Trim and Metal Closures: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
 3. Other Accessories: 12-inch- (300-mm-) long Samples for each type of other accessory.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Sheet metal roofing, seam locations, and attachments.
 2. Roof hatches.
 3. Equipment supports, pipe supports, and penetrations.
 4. Lighting fixtures and cable runs.
 5. Snow guards.
 6. Items mounted on roof curbs.
 7. Details for penetrations.
- B. Qualification Data: For Installer.

- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing sheet metals and accessories to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An installer with not less than five (5) years of successful experience in installing metal roof panels similar to those required for this project and which is trained and approved by manufacturer.
 - 1. 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. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal roof panels and are based on the specific system indicated.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.9 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.

1.10 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. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal roof panels without field measurements, or allow for field-trimming of panels.

Coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.11 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 leakproof, secure, and noncorrosive installation.

1.12 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: Two 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: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Sheet metal roofing system including, but not limited to, metal roof panels, cleats, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, fascia panels, trim, underlayment, and accessories, shall comply with requirements without failure due to defective manufacture, fabrication, or installation, or due to other defects in construction. Sheet metal roofing shall remain watertight.
- B. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or indicated on Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Basis-of-Design Product: The design for each metal roof panel specified is based on the product named.

2.3 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.
2. Surface: Smooth, flat finish.
3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings.
 - a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Exposed Coil-Coated Finish: Manufacturer's standard two-coat fluoropolymer according to performance requirements in 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.
 - a) Humidity Resistance: 1000 hours.
 - b) Salt-Spray Resistance: 1000 hours.

- 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 1/2 inch (13 mm) wide and 1/8 inch (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.

2.4 UNDERLAYMENT MATERIALS

- A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.
- B. Self-Adhering, Polyethylene-Faced Sheet: ASTM D 1970, 40 mils (1.0 mm) thick minimum, consisting of slip-resisting polyethylene-film reinforcing and top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.
1. Products:
 - a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "A."
 - b. Grace, W. R. & Co.; Grace Ice and Water Shield.

c. Owens Corning; WeatherLock.

C. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft. (0.24 kg/sq. m), rosin sized.

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 15-mil (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 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.

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. Basis-of-Design Product: Snap-Seam panels as manufactured by Durolast Roofing Corp.
2. Material: Aluminum-zinc alloy-coated steel sheet, 0.0329 inch (0.85 mm) thick.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: Standard color to match Architect's samples.
3. Clips: Floating to accommodate thermal movement.
 - a. Material: 0.0428-inch (1.06-mm-) thick, zinc-coated (galvanized) steel sheet.
4. Panel Coverage: 12 inches (300 mm).
5. Panel Height: 1.5 inches (38 mm).
6. Uplift Rating: UL 90.

2.7 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 1-inch- (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 0.0179-inch- (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.
- C. Seam-Mounted Metal Snow Guard Pads:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.
 - b. Berger Building Products.
 2. Material, Finish, and Color: Cast aluminum; powder coat; color to match roof panels.
- D. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.8 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 profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- D. 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. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. 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.

2.9 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 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.

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. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
- C. Install fasciae and copings to comply with requirements specified in Division 7 Section "Manufactured Roof Specialties."

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.
1. Apply self-adhering sheet underlayment over entire roof.
- B. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal roofing and related flashing.
- C. Install flashings to cover underlayment according to requirements in Section 076200 "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. Predrill panels.
 3. Provide metal closures at peaks, rake edges, rake walls 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.
- 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.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.5 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

- A. 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. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

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 10 feet (3 m) with no joints allowed within 24 inches (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 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- C. Install snow guards according to manufacturer's written instructions. Space rows as indicated on drawings.
- D. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.8 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****