

SECTION 07 61 00 - SHEET METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sheet metal roofing material.
2. Underlayment.

B. Related Requirements:

1. Section 07 42 93 "Soffit Panels" for manufactured metal panels used in horizontal soffit applications.
2. Section 07 71 00 "Roof Specialties" for manufactured [**fasciae**][and][**copings**] that are not part of sheet metal roofing.
3. Section 07 72 53 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site and virtual.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review structural loading limitations of substrates during and after roofing installation.
3. Review insulation, air barrier, vapor retarder, and underlayment requirements.
4. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affect sheet metal roofing.
5. Review requirements for insurance and certificates if applicable.
6. Review roof observation and repair procedures after sheet metal roofing installation.

1.3 ACTION SUBMITTALS

A. Product Data: For sheet metal roofing panels. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and panel installation layouts, expansion joint locations, points of fixity, 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 expansion joints, including showing direction of expansion and contraction from points of fixity.
 6. Include details of roof penetrations.
 7. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, corners, flashings, and counterflashings.
 8. Include details of special conditions.
 9. Include details of connections to adjoining work.
 10. Detail the following accessory items, at scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Roof curbs.
- C. Samples: For each exposed product and for each color and texture specified, **12 inches** long by actual width.
- D. 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.
- E. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Roofing: **12 inches** 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** long and in required profile. Include fasteners and other exposed accessories.
 3. Other Accessories: **12-inch-** long Samples for each type of other accessory.
- F. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, on which the following items are indicated 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 Statements: For Installer fabricator.
1. Include listing of completed projects of comparable scale of this Project, including

name, address, telephone, and contact person for Architect, and name, address, telephone number, and contact person for building Owner.

- C. Product Test Reports: For self-adhering, high-temperature underlayment, from ICC-ES.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal roofing and accessories.
- B. Warranty Documentation:
 - 1. Manufacturers' special warranties.
 - 2. Installer's special warranties.

1.6 QUALITY ASSURANCE

- A. Roof Installer Qualifications: Entity that employs a supervisor who is an NRCA ProCertified Roofing Foreman.

1.7 WARRANTY

- A. Roofing System Installer's Warranty: Submit Roofing System Installer's warranty, on warranty form at end of this Section, signed by Roofing System Installer, covering the Work of this Section, including all components of roofing system, such as fasteners, adhesives, sheet metal roofing, and other components of roofing system.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 40 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, battens, underlayment, and accessories, is to comply with requirements without failure due to defective manufacture, fabrication, or installation, or due to other defects in construction. Sheet metal roofing is to 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. Energy Performance: Provide sheet metal roofing meeting one of the following when tested in accordance with CRRC-1:
 - 1. Three-year, aged, solar reflectance of not less than 0.63 and emissivity of not less than 0.75.
 - 2. Three-year, aged, Solar Reflectance Index (SRI) of not less than 75 when calculated in accordance with ASTM E1980.
- D. 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, ambient; 180 deg F, material surfaces.

2.2 SHEET METAL ROOFING MATERIAL

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

Last option in "Metallic-Coated Steel Sheet" Paragraph below may diminish oil-canning effect.

- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; with smooth, flat surface; prepainted by coil-coating process to comply with ASTM A755/A755M.
 - 1. Thickness: Nominal **[0.022 inch][0.028 inch]<Insert dimension>** unless otherwise indicated.
 - 2. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: 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.

3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of **0.5 mil**.

2.3 UNDERLAYMENT

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of **30 mils** thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

1. Manufacturers: Subject to compliance with requirements, **[provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. **[ATAS International, Inc.]**
 - b. **[Carlisle WIP Products; a brand of Carlisle Construction Materials]**
 - c. **[GCP Applied Technologies Inc.]**
 - d. **[Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)]**
 - e. **[Owens Corning]**
 - f. **[Polyglass U.S.A., Inc.]**
 - g. **[Protecto Wrap Company]**
 - h. **[SDP Advanced Polymer Products Inc.]**
 - i. **<Insert manufacturer's name>**
- B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners [, **solder**], protective coatings, sealants, and other miscellaneous items as required for complete roofing system and as recommended by primary sheet metal manufacturer unless otherwise indicated.
- B. Wood Battens: Lumber in accordance with requirements for nailers for roofing in Section 06 10 00 "Rough Carpentry."
- C. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. General:
 - a. Exposed Fasteners: Heads matching color of sheet metal roofing, using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of roofing.
 - b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed; with hex-washer head.
 - c. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
 3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 4. Fasteners for Copper, Zinc-Tin Alloy-Coated Copper, or Copper-Clad Stainless Steel Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
 5. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
 6. Fasteners for Zinc Sheet: Series 300 stainless steel [**or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M**].
 7. Fasteners for Titanium Sheet: Titanium or Series 300 stainless steel.
- D. Solder:
1. For Zinc-Coated (Galvanized) Steel: ASTM B32, [**Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead**][with **maximum lead content of 0.2 percent**].
- E. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch** wide and **1/8 inch** thick.
- F. Elastomeric Sealant: ASTM C920, elastomeric [**polyurethane**][**polysulfide**][**silicone**] polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal roofing and remain watertight.
- G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187.
- I. Underlayment Adhesive:
1. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with underlayment.
 2. Cold-Applied Polymer-Modified Asphalt Adhesive: Underlayment manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with underlayment.

2.5 ACCESSORIES

- A. Sheet Metal Accessories: Provide components required for complete sheet metal roofing assembly, including trim, fasciae, corner units, clips, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items. Match material and finish of sheet metal roofing unless otherwise indicated.

Retain "Cleats" Subparagraph below and include details on Drawings. If intermittent and continuous cleat requirements are different for specific locations, consider copying subparagraph and naming two subparagraphs "Intermittent Cleats" and "Continuous Cleats." Indicate locations and sizes of cleats on Drawings. See discussion of cleats and clips in "Panels and Fasteners" Article in the Evaluations.

1. Cleats: Intermittent and continuous attachment devices for mechanically seaming into joints and formed from the following materials and thicknesses unless otherwise indicated:

Retain applicable materials in first six subparagraphs below. Optional dimensions below are for intermittent cleats. Continuous cleats can be thinner. Revere recommends that cleats for copper roofing be same weight as roofing metal.

- a. Metallic-Coated Steel or Aluminum Roofing: **[0.0250-inch-]<Insert dimension>** thick stainless steel.
 - b. Copper or Zinc-Tin Alloy-Coated Copper Roofing: **[16-inch-][20-inch-]<Insert weight (thickness)>** thick copper sheet.
 - c. Stainless Steel or Titanium Roofing: **[0.0250-inch-]<Insert dimension>** thick stainless steel.
 - d. Copper-Clad Stainless Steel Roofing: **[0.024-inch-]<Insert dimension>** thick, copper-clad stainless steel.
 - e. Zinc Roofing: Manufacturer's preformed stainless steel cleats.
2. Expansion-Type Cleats: Cleats of a design that allows longitudinal movement of roof panels without stressing panel seams; of same material as other cleats.
 3. Backing Plates: Plates at roofing splices, fabricated from material recommended by SMACNA's "Architectural Sheet Metal Manual."
 4. 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 sheet metal roofing profile. Provide closure strips where necessary to ensure weathertight construction.

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

5. Flashing and Trim: Formed from same material and with same finish as sheet metal roofing, minimum **[0.018 inch-]<Insert dimension>** thick.

Flashing in "Pipe Flashing" Paragraph below is not designed for high-temperature applications; revise to suit Project.

- B. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

Consider retaining "Roof Curbs" Paragraph below for custom curbs matching roofing. If manufactured roof curbs in Section 07 72 00 "Roof Accessories" are also required, indicate location of each type on Drawings.

- C. Roof Curbs: Fabricated from same material and finish as sheet metal roofing, minimum thickness [**matching the sheet metal roofing**]**<Insert dimension>**; with bottom of skirt profiled to match roof panel and seam profiles; with weatherproof top box and integral full-length cricket.
 - 1. Fabricate curb subframing of nominal [**0.062-inch**]**<Insert dimension>** thick, angle-, C- or Z-shaped, galvanized-steel or stainless steel sheet.
 - 2. Fabricate curb and subframing to withstand indicated loads of size and height indicated.
 - 3. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

Retain first subparagraph below if required. Insert type of rigid insulation if required for specific thermal properties.

- 4. Insulate curbs with [**1-inch**]**<Insert dimension>** thick, rigid insulation.

Retain subparagraph below if required. Insert other features if required.

- 5. Provide treated wood nailers at tops of curbs.

2.6 FABRICATION

- A. Custom-Fabricated Sheet Metal Roofing: Comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions (panel width and seam height), geometry, metal thickness, and other characteristics of installation. Fabricate sheet metal roofing and accessories in shop to greatest extent possible.
- B. Flat-Seam Sheet Metal Roofing: Form flat-seam panels from metal sheets [**20 by 28 inches**]**<Insert dimensions>** with **1/2-inch** notched and folded edges.
- C. Standing-Seam Sheet Metal Roofing: Form standing-seam panels with finished seam height [**of 1 inch**]**[of 1-1/2 inches]****[as indicated]****<Insert dimension>**.
- D. Batten-Seam Sheet Metal Roofing: Form batten-seam panels with edges turned up [**2-1/8 inches**]**[as indicated]****<Insert dimension>** and with **1/2-inch** flange turned toward center of pan.
- E. Horizontal-Seam (Bermuda-Type) Sheet Metal Roofing: Form horizontal-seam (Bermuda-type) panels with upper edges of lower panels turned up and extending **1/2 inch** above continuous horizontal steps in substrate.

Retain first option in "Fabrication Tolerances" Paragraph below for sophisticated or highly finished sheet metal roofing assemblies. Second option has more lenient tolerances suitable for residential roofing.

- F. Fabrication Tolerances: **[Fabricate sheet metal roofing that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.][Fabricate sheet metal roofing that is capable of installation to tolerances specified in MCA's "Metal Roof Installation Manual."]**
- G. Form exposed sheet metal work to fit substrates with little oil canning; free of buckling and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
1. Lay out sheet metal roofing, so transverse seams, if required, are made in direction of flow, with higher panels overlapping lower panels.

Retain first subparagraph below to prevent complicated seam intersections. 12 inches (300 mm) is the minimum recommended in The NRCA Roofing Manual: Metal Panel and SPF Roof Systems.

2. Offset transverse seams from each other **[12 inches]<Insert dimension> inches** minimum.
 3. Fold and cleat eaves and transverse seams in shop.
 4. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements indicated on Drawings and as required for leakproof construction.
- H. Built-in Gutters (Integral Gutters): Fabricate to cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required.
1. Fabricate in minimum **96-inch-** long sections.
 2. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
 3. Fabricate gutters with built-in expansion joints.
- I. Expansion Provisions: Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work.
1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- J. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant in accordance with SMACNA's "Architectural Sheet Metal Manual."

Insert specific list of metals to be separated and protected as required for the Work indicated on Drawings.

- K. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item required. Obtain field

measurements for accurate fit before shop fabrication.

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

Retain first option in "Seams" Subparagraph below for metals being soldered. Soldering requires removal of painted, coated, or lacquered finishes. Retain second option for aluminum, titanium, and metals with painted, coated, or lacquered finishes. If required, retain third option for aluminum and zinc sheets.

2. Seams: Fabricate nonmoving seams with flat-lock seams. **[Tin edges to be seamed, form seams, and solder.][Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.][Rivet joints where necessary for strength.]**
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices of sizes recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

Retain paragraph below to prevent galvanic corrosion between graphite and aluminum or aluminum-zinc alloy-coated steel. See "Metal Considerations" Article in the Evaluations.

- L. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

- A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

Retain one of first two subparagraphs below or delete both if extent is indicated on Drawings.

1. Apply from eave to ridge.
 2. Apply on roof not covered by self-adhering sheet underlayment.
 3. Lap horizontal joints not less than **4 inches**.
 4. Lap end joints not less than **12 inches**.
- B. Self-Adhering High-Temperature Sheet Underlayment:
 1. Install self-adhering high-temperature sheet underlayment, wrinkle free.
 2. Prime substrate if recommended by underlayment manufacturer.
 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.

4. Apply in shingle fashion to shed water, with end laps of not less than **6 inches** staggered **24 inches** between courses.
5. Overlap side edges not less than **3-1/2 inches**.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment at the following locations:
 - a. Over entire roof.

Retain first subparagraph above or one or more of eight subparagraphs below. Revise subparagraphs below to suit Project, or delete all subparagraphs if locations are indicated on Drawings. If inserting dimensions, note that many self-adhering high-temperature sheet underlayments are manufactured in 36-inch- (914-mm-) wide rolls.

- b. Roof perimeter for a distance up from eaves of [**24 inches**][**36 inches**]**<Insert dimension>** beyond interior wall line.
- c. Valleys, from lowest to highest point, for a distance on each side of [**18 inches**]**<Insert dimension>**.
- d. Rake edges for a distance of [**18 inches**]**<Insert dimension>**.
- e. Hips and ridges for a distance on each side of [**12 inches**]**<Insert dimension>**.
- f. Roof-to-wall intersections for a distance from wall of [**18 inches**]**<Insert dimension>**.
- g. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of [**18 inches**]**<Insert dimension>**.
- h. Below entire area of integral gutters, up from eaves a minimum of [**36 inches**]**<Insert dimension>** beyond interior wall line, but not less than [**12 inches**]**<Insert dimension>** up from ridge side of gutter.
- i. Directional transitions for a distance of [**12 inches**]**<Insert dimension>** in each direction.

C. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal roofing.

1. Install in shingle fashion to shed water, with lapped joints of not less than **4 inches**.

Retain one of two subparagraphs below or delete both if extent is indicated on Drawings.

2. Apply from eave to ridge.
3. Apply on roof not covered by self-adhering sheet underlayment.

Retain first paragraph below if slip sheet is required. See the Evaluations and sheet metal manufacturer's written recommendations. Delete for zinc sheet metal roofing, which requires a ventilation mat.

D. Install slip sheet, wrinkle free, [**over underlayment**][**directly on substrate**]**<Insert requirement>** before installing sheet metal roofing and related flashing.

1. Install in shingle fashion to shed water, with lapped joints of not less than **4 inches**.

Retain first paragraph below if ventilation mat is required for zinc sheet metal roofing.

- E. Install ventilation mat over underlayment before installing sheet metal roofing and related flashing.
- F. Install flashings to cover **[underlayment][slip sheet][ventilation mat]** in accordance with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

3.2 INSTALLATION, GENERAL

- A. Install sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners [, **solder**], protective coatings, separators, sealants, and other miscellaneous items as required for complete roofing system.
 - 2. Install sheet metal roofing true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of **[solder][welds][sealant]**.
 - 3. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 4. Do not field cut sheet metal roofing by torch.
 - 5. Provide metal closures at **[peaks][rake edges][rake walls][eaves][and]** each side of ridge [**and hip**] caps.
 - 6. Flash and seal sheet metal roofing with closure strips at eaves, rakes, and perimeter of all openings. Fasten with self-tapping screws.
 - 7. Locate and space fastenings in uniform vertical and horizontal alignment. Predrill panels for fasteners.
 - 8. Install ridge [**and hip**] caps as sheet metal roofing work proceeds.
 - 9. Lap metal flashing over sheet metal roofing to direct moisture to run over and off roofing.

Retain subparagraph below to prevent galvanic corrosion between graphite and aluminum or aluminum-zinc alloy-coated steel. See "Metal Considerations" Article in the Evaluations.

- 10. Do not use graphite pencils to mark metal surfaces.

Retain "Thermal Movement" Paragraph below to allow thermal movement for panels in a predetermined direction. Delete below for fixed panels.

- B. Thermal Movement: Rigidly fasten metal roof panels to structure at only one location for each panel.
 - 1. Allow remainder of panel to move freely for thermal expansion and contraction.
 - 2. Point of Fixity: Fasten each panel along a single common line of fixing located at **[eave][ridge][center of panel length][locations indicated on Drawings]<Insert location>**.
 - 3. Avoid attaching accessories through roof panels in manner that inhibits thermal movement.
- C. Fasteners: Use fastener sizes that penetrate **[wood blocking or sheathing not less**

than 1-1/4 inches for nails and not less than 3/4 inch for wood screws][substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance]<Insert size requirement>.

- D. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended in SMACNA's "Architectural Sheet Metal Manual."
 - 1. Coat concealed side of [uncoated-aluminum][and][stainless steel] sheet metal roofing with bituminous coating where roofing contacts wood, ferrous metal, or cementitious construction.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Fasciae:
 - 1. Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws.
 - 2. Flash and seal sheet metal roofing with closure strips where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.3 INSTALLATION OF SHEET METAL ROOFING

- A. Install sheet metal roofing system with lines and corners of exposed units true and accurate.
 - 1. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering metal temper and reflectivity.
 - 2. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 3. Fold back sheet metal to form hem on concealed side of exposed edges unless otherwise indicated.
- B. Install cleats to hold sheet metal roofing panels in position.
 - 1. Attach each cleat with at least two fasteners to prevent rotation.
 - 2. Space cleats not more than [12 inches]<Insert dimension> o.c.
 - 3. Bend tabs over fastener head.
 - 4. Provide expansion-type cleats for roof panels that exceed **30 feet** in length.
- C. Seal joints as required for watertight construction. For roofing with 3:12 slopes or less, use cleats at transverse seams.
 - 1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than **1 inch** into sealant.

- b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between **40 and 70 deg F**, set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - e. Do not install sealant-type joints at temperatures below **40 deg F**.
 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
- D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pre-tin edges of sheets with solder to a width of **1-1/2 inches**; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

Retain metals in first two subparagraphs below that are specified in Part 2; revise to suit Project. Soldering requires removal of painted, coated, or lacquered finishes. Although unusual, zinc-coated (galvanized) steel, a type of metallic-coated steel, may be soldered.

2. Do not solder [**metallic-coated steel**][**aluminum**][**and**][**titanium**] sheet.
3. Do not pre-tin zinc-tin alloy-coated copper.
4. Do not use torches for soldering.
5. Heat surfaces to receive solder, and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.
6. Stainless Steel Soldering:
 - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
 - b. Promptly remove acid flux residue from metal after tinning and soldering.
 - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
8. Copper-Clad Stainless Steel Soldering: Tin edges of uncoated sheets, using solder for copper-clad stainless steel.

Retain "Rivets" Paragraph below if required for aluminum or zinc sheet.

- E. Rivets: Rivet joints in [**uncoated aluminum**][**zinc**] where necessary for strength.

Retain one or more roofing types in "Flat-Seam Roofing," "Standing-Seam Roofing," "Batten-Seam Roofing," and "Horizontal-Seam (Bermuda-Type) Roofing" paragraphs below to describe the seaming method(s) required.

- F. Flat-Seam Roofing:
1. Attach flat-seam metal panels to substrate with cleats, starting at eave and working upward toward ridge.
 2. After panels are in place, mallet seams tight and solder.

3. Attach roofing panels with cleats spaced not more than **[24 inches]<Insert dimension>** o.c. Lock and solder panels to base flashing.
4. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at **[12-inch]<Insert dimension>** o.c. spacing. Lock panels to edge flashing and **[solder][apply sealant]**.

G. Standing-Seam Roofing:

1. Attach standing-seam metal panels to substrate with double-fastened cleats spaced at **[12 inches]<Insert dimension>** o.c.
2. Install panels reaching from eave to ridge before moving to adjacent panels.
 - a. Where transverse joints are required, stagger joints in adjacent panels not less than **48 inches**.
3. Before panels are interlocked, apply continuous bead of sealant to top of flange of lower panel.
4. Lock standing seams by folding over twice, so cleat and panel edges are completely engaged.
5. Lock each panel to panel below with **[soldered][sealed]** transverse seam.

Retain one of first two subparagraphs below. Retain first for all areas except those subject to ice dams. Retain second for eaves subject to ice dams if designing according to Figure 6-16 in SMACNA's "Architectural Sheet Metal Manual." Include details on Drawings.

6. Loose-lock panels at eave edges to continuous cleats and flanges at roof edge at gutters.
7. Loose-lock panels at eave edges to continuous edge flashing exposed **24 inches** from roof edge.
 - a. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at **[12-inch]<Insert dimension>** o.c. spacing.
 - b. Lock panels to edge flashing.
8. **[Leave seams upright][Fold over seams]** after locking at ridges and hips.

H. Batten-Seam Roofing:

1. Attach batten-seam metal panels to substrate with cleats, starting at eave and working upward toward ridge.
2. Hold cleats in place with battens, and fold edges of cleats over to hold panels.
3. After panels are in place and before batten cap is installed, apply continuous bead of sealant to top of upturned flanges of each panel.
4. Install batten cap covering batten and panel edges, and fold batten cap and panel together, so batten cap and panel edges are completely engaged in seams.
5. Hook each panel to panel below with **[soldered][sealed]** transverse seam.

Retain first subparagraph below unless battens are narrower at bottom, to provide expansion capability.

6. Splay upturned edges of panels at a slightly obtuse angle, so pan-bottom width is slightly narrower than space between battens, to provide expansion capability.
7. Close batten ends with metal closures. Fold together with panel edges and end of batten cap.

Retain one of two subparagraphs below. Retain first for all areas except those subject to ice dams. Retain second for eaves subject to ice dams if designing according to Figure 6-16 in SMACNA's "Architectural Sheet Metal Manual." Include details on Drawings.

8. Loose-lock panels at eave edges to continuous cleats and flanges at roof edge at gutters.
9. Loose-lock panels at eave edges to continuous-edge flashing exposed **24 inches** from roof edge.
 - a. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at **[12-inch]<Insert dimension>** o.c. spacing.
 - b. Lock panels to edge flashing.

I. Horizontal-Seam (Bermuda-Type) Roofing:

1. Attach horizontal-seam metal panels to substrate with cleats, starting at eave and working upward toward ridge.
2. Attach cleats along continuous horizontal steps in substrate, with cleats at **[8-inch]<Insert dimension>** o.c. spacing.
3. Lock lower edge of each panel to turned-up upper edge of panel below, folding seam over to engage cleat and panel edges.
4. After first fold, mallet seams against substrate, leaving joint slightly angled over lower panel to form drip.
5. Hook end of each panel to adjacent panel with **[soldered][sealed]** cross seam.
6. Hook panel at eave edge to continuous cleat.
7. Join ridges and hips with a standing seam, and **[leave seams upright][fold over seams]** after locking.

J. Built-in Gutters:

1. Anchor back edge of gutter with continuous cleat.
2. Provide expansion joints at locations indicated on Drawings, but not less than **50 feet** on center.
3. Join gutter sections with soldered joints.
 - a. Join sections with lapped joints sealed with sealant where required for expansion.
4. Provide for thermal expansion.
5. Slope gutters to drainage points.
6. Provide end closures and seal watertight with sealant.
7. Install self-adhering, high-temperature sheet underlayment inside built-in gutter as indicated on Drawings.
 - a. Extend self-adhering, high-temperature sheet underlayment to eave drip edges and beneath roof underlayment.

- b. Lap edges **2 inches**.
- c. Lap ends **4 inches**.

3.4 INSTALLATION OF ACCESSORIES

Revise first paragraph below to suit Project.

- A. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion.
 - 1. Coordinate installation with flashings and other components.

Revise first subparagraph below to delete items that are not required.

- 2. Install components required for complete sheet metal roofing assembly, including trim, seam covers, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items.

Retain subparagraph below if accessories specified in referenced Section are to be installed as part of the Work of this Section.

- 3. Install accessories integral to sheet metal roofing that are specified in Section 07 62 00 "Sheet Metal Flashing and Trim" to comply with that Section's requirements.
- B. Flashing and Trim: Comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual."
 - 1. Provide concealed fasteners where possible, and install units true to line, levels, and slopes.
 - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
 - 3. Install flashing and trim as required to seal against weather and to provide finished appearance, including, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 - 4. Install continuous strip of self-adhering underlayment at edge of continuous flashing overlapping self-adhering underlayment, where "continuous seal strip" is indicated in SMACNA's "Architectural Sheet Metal Manual" and on Drawings.
 - 5. Install exposed flashing and trim without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 6. Install sheet metal flashing and trim to fit substrates, and to result in waterproof and weather-resistant performance.
 - 7. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - a. Space expansion joints at maximum of **10 feet** with no joints within **24 inches** of corner or intersection.

Revise two subparagraphs below to suit Project.

- b. Form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, and filled with butyl sealant concealed within joints.
 - c. Use lapped expansion joints only where indicated on Drawings.
- C. Pipe Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended in SMACNA's "Architectural Sheet Metal Manual."
- D. Roof Curbs: Install flashing around bases where curbs meet sheet metal roofing.

3.5 INSTALLATION TOLERANCES

Retain first option in "Installation Tolerances" Paragraph below for sophisticated or highly finished sheet metal roofing assemblies. Second option has more lenient tolerances suitable for residential roofing.

- A. Installation Tolerances: **[Shim and align sheet metal roofing within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.]**~~[Shim and align sheet metal roofing within installed tolerances specified in MCA's "Metal Roof Installation Manual."]~~

3.6 ROOFING SYSTEM INSTALLER'S WARRANTY

Retain this warranty or include another Roofing System Installer's warranty form if required. Coordinate with "Warranty" Article.

- A. WHEREAS _____ of _____, herein called the "Roofing System Installer," has performed roofing and associated Work on the following Project:
 - 1. Owner: **<Insert name of Owner>**.
 - 2. Owner Address: **<Insert address>**.
 - 3. Building Name/Type: **<Insert information>**.
 - 4. Building Address: **<Insert address>**.
 - 5. Area of Work: **<Insert information>**.
 - 6. Acceptance Date: _____.
 - 7. Warranty Period: **[Two][Five]****<Insert number>** years from date of Substantial Completion.
 - 8. Date of Substantial Completion: _____.
- B. AND WHEREAS Roofing System Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said Work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing System Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing System Installer's own cost and expense, make or cause to be made such repairs to or replacements of said Work as are necessary to correct faulty and defective work and

as are necessary to maintain said Work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to Work and other parts of the building, and to building contents, caused by:
 - a. lightning;

Insert required wind speed in first subparagraph below.

- b. peak gust wind speed exceeding <Insert mph>;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the Work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When Work has been damaged by any of foregoing causes, Warranty will be null and void until such damage has been repaired by Roofing System Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing System Installer is responsible for damage to Work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of Work.
4. During Warranty Period, if Owner allows alteration of Work by anyone other than Roofing System Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty will become null and void on date of said alterations, but only to the extent said alterations affect Work covered by this Warranty. If Owner engages Roofing System Installer to perform said alterations, Warranty will not become null and void unless Roofing System Installer, before starting said Work, will have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate Work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty will become null and void on date of said change, but only to the extent said change affects Work covered by this Warranty.
6. Owner will promptly notify Roofing System Installer of observed, known, or suspected leaks, defects, or deterioration and afford reasonable opportunity for Roofing System Installer to inspect Work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing System Installer on said Work and will not operate to restrict or cut off Owner from other remedies

and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty will not operate to relieve Roofing System Installer of responsibility for performance of original Work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 61 00