SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

1. GENERAL
   * + 1. RELATED DOCUMENTS

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

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
      1. SUMMARY
         1. Section Includes:

Delete “spreader plates, insulation and vapor retarder” in paragraph below if building is not heated. Coordinate with drawings.

Preformed Metal Roofing System: Structural standing seam roof panels with concealed clips and spreader plates installed over rigid insulation, vapor retarder and a structural deck. The system includes related metal flashings and concealed flashings.

Delete the next 2 paragraphs below if no soffits are required. Coordinate with drawings.

Preformed Metal Soffit System: Interlocking, perforated soffit panels secured with concealed fasteners.

Delete Article below if not applicable.

* + - * 1. Products Installed but Not Furnished Under This Section:

The following items will be furnished under HVAC Contract for installation under this Contract:

Edit or add to Products below as required.

Storm Collars for prefabricated chimney.

Mechanical equipment curbs.

* + - 1. DEFINITIONS
         1. Company Field Advisor: An employee of the Company which lists and markets the primary components of the system under their name who is certified in writing by the Company to be technically qualified in design, installation, and servicing of the required products or an employee of an organization certified by the foregoing Company to be technically qualified in design, installation, and servicing of the required products.
         2. Concentrated Loads: Positive downward acting, localized loads.
         3. Uniform Design Loads: Positive downward acting loads and negative upward acting loads specified in this section, including wind uplift and snow loads.
         4. Test Loads: The ultimate uniform test load at which each element of the standing seam roof system fails.
         5. Allowable loads: The ultimate tested load on each element of the roof system divided by the appropriate safety factor for the failure mode being evaluated. Allowable loads may be increased by 1/3 for wind loading only.

For yielding type failure modes such as panel buckling, use a factor of safety of 2.0.

For connection related failure modes such as fastener withdrawal, clip failure, panel disengagement from clip and seam failure, use a factor of safety of 2.5.

For fastener withdrawal use a leverage factor of 2 in addition to a safety factor of 2.5.

* + - * 1. Hydrostatic Joinery: Watertight joints that can withstand a static head of water without leaking. Flashings shall contain hydrostatic joinery, with no joint dependent on exterior sealants for water tightness at panel to panel, flashing to flashing or flashing to panel transitions.
      1. PREINSTALLATION MEETINGS
         1. Preinstallation Conference: Conduct conference at Project site.

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

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

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

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

Review structural loading limitations of **[deck] [purlins and rafters]** during and after roofing.

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

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

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

Review procedures for repair of metal panels damaged after installation.

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

It is recommended to use most of the following submittals requirements as a pre-award item especially items under “Product Data” and “Quality Control”. Review with a member of the Roofing QIT. If pre-award is required add Specification Section 002217 and edit for your project.

* + - 1. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
         2. Manufacturer’s installation instructions shall be provided along with product data.
         3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
         4. Waiver of Submittals: The “Waiver of Certain Submittal Requirements” in Section 013300 does not apply to this Section.
         5. Submittals: Submit product data, samples, the items listed under Quality Control Submittals, and proposed deviations from the Contract Documents, at the same time as one complete package. Partial submittals will not be considered.

Proposed Deviations from the Contract Documents: To be considered for approval, proposed deviations must be submitted with the initial submittal package. Proposed deviations submitted after the initial submittals package is approved will not be considered or approved and may be cause for rejection of the previously approved manufacturer or system.

* + - * 1. Product Data: For each type of product.

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

Contract Documents: Unless approved otherwise, the Contract Documents have precedence over manufacturer’s details and specifications except when a specific detail or condition is not addressed in the Contract Documents.

Manufacturer’s Details: Do not use or submit manufacturer’s details unless there is an omission or proposed deviation from the Contract Documents. In such instances, submit the proposed detail for approval. The proposed detail shall be referenced directly to the related detail on the Contract Drawings.

Manufacturer’s Specifications: When there is a proposed deviation from the Specifications of the Contract Documents, submit the proposed deviation for approval. The proposed deviation shall be referenced directly to the related article in the Contract Specifications.

Delete paragraph below if project is not intended for LEED certification.

* + - * 1. Sustainable Design Submittals:

"Product Test Reports" subparagraph below applies to LEED 2009 NC, CI, and CS; LEED v4; IgCC; ASHRAE 189.1; and Green Globes. Coordinate with requirements for adhesives and sealants.

[Product Test Reports](http://www.arcomnet.com/sustainable_design.aspx?topic=6): For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirements.

Retain "Product Data" subparagraph below to require minimum recycled content for LEED 2009 MR Credit 4 - "Recycled Content.

[Product Data](http://www.arcomnet.com/sustainable_design.aspx?topic=7): For recycled content, indicating postconsumer and preconsumer recycled content and cost.

* + - * 1. Shop Drawings:

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

Show the location and spacing of the concealed clips and bearing plates as required to resist the uniform roof design loads.

Show the location and spacing required at; main roof, eaves, rakes, roof ends and corners.

Show the location and spacing of the snow guards.

All shop drawings to be stamped and sealed by an Director’s Representative employed by the metal roof manufacturer and shall be registered in the State of New York.

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

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

Include similar Samples of trim and accessories involving color selection.

Length: 12-inches.

* + - * 1. Quality Control Submittals:

Manufacturer’s Qualifications Data.

Installer’s Qualifications Data.

Company Field Advisor Data.

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

UL Wind Uplift Rating: Statement certifying that the roof system has been tested in conjunction with the type of structural roof deck and roof slope applicable to the project and has achieved a UL 90 Wind Uplift rating.

Acceptable certification: Letter from UL or a copy of the UL classification listing for the roofing system.

Test Report of ASTM E 1592-01: Test report written and signed by a professional Director’s Representative from a recognized independent test laboratory listing the complete documentation and test results. Include a letter certifying that the roof system as tested, meets or exceeds the specified uniform design loads.

Air and Water Infiltration Tests: Statement certifying that the roof system has been tested in accordance with the specified test procedure and that the specified minimum requirements have been achieved.

Summary Report: In addition to the test reports specified above, submit a separate Summary Report as follows:

Failure Mode(s) and Ultimate Test Load(s):

Permanent panel deformation at: + PSF - PSF.

Seam failure at: + PSF - PSF

Panel disengagement from clip: + PSF - PSF.

Clip failure: + PSF - PSF.

Fastener withdrawal: + PSF - PSF.

Allowable loads (including safety factors and a 1/3 increase for negative (-) wind loads):

For yielding type failures: (ultimate test load divided by safety factor of 2) + PSF - PSF.

For connection related failure modes: (ultimate test load divided by safety factor of 2.5) + PSF - PSF.

The allowable loads are ( ) greater than, ( ) less than the design loads.

Maximum allowable clip spacing at:

Zone 1) Main roof = on center.

Zone 2) Ridge, eave, rake = on center.

Zone 3) Roof corners = on center.

Fastener manufacturer’s ultimate fastener withdrawal value for the type of fastener submitted:

Edit below as required.

Steel deck (20 gage) = Lbs.

Allowable fastener load per fastener including factor of safety of 2.5 and a leverage factor of 2 (ultimate load divided by rib spacing, divided by clip spacing, divided by factor of safety, divided by leverage factor):

Edit below as required.

Steel deck (20 gage) = Lbs.

Fixed point calculations: Provide calculations and a written statement certifying that the strength of the fixed point is adequate to resist sliding forces, including snow and panel weight loads.

Field quality-control reports.

* + - * 1. Maintenance Data: For metal panels to include in maintenance manuals.
        2. Contract Closeout Submittals:

Sample Warranties: For special warranties.

* + - 1. CLOSEOUT SUBMITTALS
         1. Maintenance Data:

For metal panels to include in maintenance manuals.

* + - 1. QUALITY ASSURANCE
         1. Manufacturer’s Qualifications:

Actively marketing the proposed concealed clip standing seam metal roofing system for a minimum of 5 years.

The proposed metal roofing system shall have previously been installed on a minimum of 5 roofing projects of comparable scope and complexity to the Work of this Section.

* + - * 1. Installer’s Qualifications:

Licensed or approved by the metal roof system manufacturer.

Actively installing concealed clip metal roofing systems for a minimum of 5 years.

Previously installed and completed a minimum of 5 concealed clip metal roofing projects of comparable scope and complexity to the Work of this Section.

The people supervising the Work of this Section, the job foreman or crew chief, and the workers installing the metal roofing system, must be qualified architectural sheet metal workers and shall have had a minimum 3 years of experience in the installation of concealed clip metal roofing systems.

* + - * 1. Source Limitations: Obtain metal roofing system through one source from a single Manufacturer.

Retain "UL-Certified, Portable Roll-Forming Equipment" paragraph below if portable roll-forming equipment is allowed for on-site roll forming.

* + - * 1. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
        2. Benchmarks: Build benchmarks to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

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

Build benchmark of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 4 feet x 3 feet wide outside corner assembly in conjunction with the siding assembly in full thickness, including attachments[, underlayment,] and accessories.

Permanently fasten the parts in their proper locations.

Do not start permanent construction until the mockup has been approved in writing by the Director’s Representative.

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

Retain subparagraph below if the intention is to make an exception to the default requirement for demolishing and removing mockups.

Maintain the approved benchmark assembly intact until roofing and siding installation is complete and approved, then remove benchmark assembly from site.

Questions regarding the use of the article below should be directed to the Business Unit’s Representative. Coordinate with drawings.

* + - * 1. Roofing Manufacturer’s Company Field Advisor:

The manufacturer of the roofing system, issuing the final system guarantee on this project, must supply a Company Field Advisor, as a technical representative, with the following minimum qualifications:

Documentation of 5 years of field experience on the same type of roofing system.

Documentation of 10 projects where role was a Company Field Advisor; include contact names and phone numbers for each project.

Documentation of attendance at a roof specific instructional seminar within the last two years.

It is mandatory to discuss the use of the paragraph below with the client, the division of construction, and perhaps the specified manufacturers, at project inception, particularly on downstate projects. There is a fee associated with the number of hours for a field advisor to be on a project. Include this additional cost in the project estimate beginning with the program estimate. Edit number of days and hours below depending on size and complexity of project. Six days at 4 hours per day could work as a minimum for a simpler project. Six days or more, at more than 4 hours per day could work for a larger, more complex project. Delete underlines before adding required information.

Secure the services of the Company Field Advisor for a minimum of \_\_\_\_\_\_\_ days at a minimum of \_\_\_\_\_\_\_\_\_ hours per day to inspect the workmanship of the roofing system installer.

Company Field Advisor Duties and Responsibilities:

Become familiar with the Contract Documents and approved submittals prior to the pre-construction conference.

Attend the pre-construction conference and the beginning of the actual membrane installation for the purpose of:

Rendering technical assistance to the Contractor regarding installation procedures of the system.

Familiarizing the Director’s Representative with all aspects of the system including inspection techniques.

Answering questions that might arise.

Edit remaining subparagraphs below to suit project complexity and need. Discuss appropriateness of subparagraphs with Design Project Manager and the Division of Construction.

Attend each bi-weekly meeting.

Be objective, unbiased and impartial in each inspection, recommendation, conversation, action and written report.

Inspect and approve the existing substrate, flashing, blocking, and related materials as being acceptable for the installation of the roofing system.

Ensure proper fastening patterns and fastener sizes of wood blocking, insulation, edge flashing, and related components.

Immediately report non-compliant conditions, if any, to the Director’s Representative.

Provide to the Director’s Representative a written report, submitted prior to leaving the Project Site each day the Company Field Advisor is present. Each daily written report shall contain at a minimum:

Date of report and inspection.

Weather conditions at the start, middle, and end of the work day.

Work performed including Contractor activity, contractor crew size, supervisor’s name, area of activity, and progress and quality of the work as observed.

Discussions with Contractor regarding work anomalies and resolution.

Conditions that are not in compliance with the Contract documents.

Continue documenting non-compliance issues in subsequent reports until the issue has been resolved. Document resolution of non-compliance issues when resolved.

Report to the Director’s Representative in writing failure or refusal of the Contractor to correct unacceptable practices called to the Contractor’s attention.

Confirm, after completion of the roofing work and based on the Company Field Advisor’s inspections and tests, that the Company Field Advisor has observed no applications procedures in conflict with the specifications other than those that may have been previously reported and corrected.

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

007306 Supplementary Conditions - Warranty Extension must be edited by the Specifications Writer, and included in the Project Manual.

* + - * 1. Warranty Extension: The one year period required by Paragraph 9.8 of the General Conditions is extended to 2 years for the Work of this Section. Refer to Supplementary Conditions 007306.
        2. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

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

Structural failures including rupturing, cracking, or puncturing.

Deterioration of metals and other materials beyond normal weathering.

Warranty Period: 2 years from date of Substantial Completion.

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

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

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

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

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

Finish Warranty Period: 20 years from date of Substantial Completion.

Some manufacturers offer a thirty year warranty but most are twenty you will have to check with the manufacturer.

* + - * 1. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

Warranty Period: 20 years from date of Substantial Completion.

1. PRODUCTS
   * + 1. PERFORMANCE REQUIREMENTS

Retain "Recycled Content" paragraph below to specify recycled content if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

USGBC allows a default value of 25 percent to be used for steel without documentation; higher percentages can be claimed if they are supported by appropriate documentation. The Steel Recycling Institute indicates that steel sheet typically has 23 percent postconsumer recycled content and 1.5 percent preconsumer recycled content.

* + - * 1. [Recycled Content](http://www.arcomnet.com/sustainable_design.aspx?topic=30): Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

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

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

Retain one of two paragraphs below to specify "cool-roof" performance if required.

Retain "Solar Reflectance Index" paragraph below if required for LEED-NC, LEED-CS. LEED required roofing materials, for a minimum of 75% of the roof surface to have a solar reflectance index (SRI) equal to or greater than 78 for low-sloped roof (≤ 2:12) and 29 for steep-sloped roof (> 2:12).

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

Three-year, aged Solar Reflectance Index of not less than [78] [29] when calculated according to ASTM E1980.

* + - * 1. Underwriter’s Laboratories (UL) Ratings:

Performance: Class 4 Hail resistant panels.

Flame Resistance: Class “A” roof system.

* + - * 1. Concentrated Roof Loads: The panels shall withstand a 250 pound concentrated load applied to a four square inch area located at the center of the panel and at the center of the maximum span without any sign of permanent panel deformation, rib buckling, or panel sidelap separation.

Inform structural designer of roof design load requirements so that roof support system is adequate.

* + - * 1. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

Uniform Roofing Design Loads:

Edit below as required. See Structural Engineer for information.

Wind Loads: As indicated on Drawings.

Deflection Limits: For wind loads, no greater than 1/180 of the span for positive uniform loads and maximum l/140 for negative uniform loads.

Safety Factor: **<Insert Value>** after any load reduction or material stress increase

Building Category: 1 with an importance factor of <Insert Factor>

Wind Speed: **<Insert Wind Speed>**

Exposure Category: **<Insert Exposure>**

Mean Roof Height: **<Insert height>**

Minimum Building Width: **<Insert width>**

Roof Pitch: **<Insert Value>** inches per 12”

Add appropriate drifting snow factor to positive (+) snow loads specified, in accordance with ASCE 7-02.

The width of the high pressure zones 2 and 3(corners, rakes, eaves, ridges and hips) that may require additional clips to resist the negative (‑) loads specified shall be as shown on the Component and Cladding Chart on Drawing <Insert Drawing Designation> of the Contract Documents.

Delete paragraph below if no soffits are required or edit items below. Coordinate with drawing.

Uniform Soffit Design Loads: The uniform load capacity of the soffit systems shall safely resist a positive and negative load requirement listed in Zone 4 and Zone 5 as shown below.

Edit below as required. Delete underlines before adding required information. See Structural Engineer for information.

The Component and Cladding Chart shown on Drawing <Insert Drawing Designation> of the Contract Documents or Design Code: ASCE-7, Method 2 for Components and Cladding.

Retain "Air Infiltration" and "Water Penetration under Static Pressure" paragraphs below for single-skin metal panels that span openings between supports; usually delete for panels mounted on solid substrates.

* + - * 1. Air Infiltration: Air leakage of not more than 0.036 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:

Test-Pressure Difference: 20 lb/sq. ft..

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

Test-Pressure Difference: 20 lbf/sq. ft. when tested for 15 minutes.

Test in "Hydrostatic-Head Resistance" paragraph below is for resistance to hydrostatic pressure from standing water. Retain only for panels capable of watertight (hydrostatic) installation, not for panels used in water-shedding (hydrokinetic) installations that rely on underlayment for watertightness.

* + - * 1. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

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

Add NYS Code Wind Requirements.

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

Uplift Rating: UL 90.

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

Temperature Change (Range): 200 deg F, ambient; 180 deg F, material surfaces.

* + - 1. STANDING-SEAM METAL ROOF PANELS
         1. Provide factory-formed metal roof panels designed to be installed 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.

Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.

Edit below if you do not need stiffening ribs. No stiffening ribs are only recommended when you are using a thicker gauge metal, 22 gauge (0.033-inch) or thicker, or the panel width is very small and the client is made aware of the possibility of “oil canning”.

Snap lock panels are only recommended for roof of 3/12 or more. Use snap lock panels only when no watertightness warranty is required. Do not use snap lock panels on roof assemblies with valley details. Do not use snap lock panels over open framing. Do not use snap lock panels on panel runs over 30 feet in length. Snap lock panels must be continuous from eave to ridge, with no lap joints. Snap lock panels are only allowed over a solid deck with self-adhering ice & water membrane and slip sheet.

* + - * 1. Vertical-Rib, **[Seamed-Joint,][Snap-Lock,]** Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and **[intermediate stiffening ribs symmetrically spaced] [a flat pan]** between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and **[mechanically seaming][snapping]** panels together.

Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 or AZ55 coating designation; structural quality.

Nominal Thickness: 0.028 inch.

Exterior Finish: Two-coat fluoropolymer.

Color: As selected by Director’s Representative from manufacturer's full range.

“Oil Canning”: Excessive oil canning in individual roof panels or throughout the roof area is not permitted, however minor oil canning that is not readily apparent to the eye and does not detract from the aesthetic look of the building is acceptable provided that it only occurs on a minimum number of panels. Acceptance or rejection of individual roof panels or the finished roof based on oil canning will be at the sole discretion of The Director’s Representative.

Clips: [One-piece fixed] [Two-piece floating] to accommodate thermal movement.

Material: **[0.028-inch-] [0.064-inch-]** nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

Joint Type: As standard with manufacturer.

Panel Coverage: 10 inches minimum, 18 inches maximum.

Panel Height: 2.0 inches.

Panel Length: Continuous up to 40 feet with no end laps. Runs over 40 feet may have one end lap.

Delete paragraph below if not required.

Stiffening Ribs: The panels must be formed with stiffening ribs, but the ribs must be small enough to allow the panel to be bent over the roof edge to form a hem with an inside bend of 2T without distorting or cracking the rib or paint finish.

Delete the next paragraph when no soffits are required. Select perforated or solid panels. Use solid panels when the roof is insulated and there is no insulation above the ceiling (warm attic space above the ceiling). Use perforated panels when the insulation is placed above the ceiling and the roof is not insulated (cold attic space).

* + - * 1. Soffit: Perforated or Solid prefinished, 24 gage AZ50 or AZ55 galvalume ASTM A 792 steel panels. Soffit panels shall be manufactured by the roof panel manufacturer. See Drawings for locations of perforated panels.

Panel Width: 12 inches maximum.

Panel Length: As required to run perpendicular to the building wall.

Seam Configuration: Form the panel with a flush joint design and interlocking seams with flanges for concealed fastening.

* + - 1. UNDERLAYMENT MATERIALS

Use article below on all combustible decks, when using a vapor retarder on combustible decks. Underlayment board is also available in ½ inch thickness. ½ inch should be specified for wide fluted metal decks.

* + - * 1. Underlayment Board: 1/4 inch thick gypsum roof board composed of a silicone treated gypsum core with fiberglass facers.

[Products:](http://www.specagent.com/Lookup?ulid=5139) Subject to compliance with requirements, provide the following:

Georgia Pacific

DensDeck.

Approved equivalent.

Retain appropriate paragraphs in this article for metal roof panels applied over sheathing. Self-adhering, high-temperature underlayment may be applied only at eaves, valleys, and other areas vulnerable to leakage, with felt applied over the remainder of the roof; or underlayment may be applied over the entire roof area.

Underlayments listed in "Self-Adhering, High-Temperature Underlayment" paragraph below are suitable for higher temperatures associated with metal roofing. Revise if high-temperature underlayments are not required. Verify, with underlayment manufacturer, acceptability for use on roofs with slopes less than 2:12.

* + - * 1. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.

Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.

Products: Subject to compliance with requirements, provide the following:

Carlisle WIP Products; a brand of Carlisle Construction Materials; WIP 300HT.

Firestone Building Products

Clad-Gard SA.

Approved equivalent.

Retain "Felt Underlayment" paragraph below if not using self-adhering, high-temperature underlayment over the entire roof area.

* + - * 1. Felt Underlayment: ASTM D226, Type II (No. 30), asphalt-saturated organic felts.

Sheet in "Slip Sheet" paragraph below is used to separate metal roof panels from underlayment. Retain if required by manufacturer.

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

Blocking At Eaves and Ridge: 5/4 x pressure treated wood blocking. Blocking shall finish flush with the top of the insulation.

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

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

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

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

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

Bearing Plates: Roof panel manufacturer’s 16 gage galvanized steel plates. Minimum 6 inches square with 2 predrilled fastener holes to mate with holes in clip

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

Use subparagraph below for round projections 1/4 inch to 18 inches in diameter. Do not use on hot pipes.

Round Projections: Premolded EPDM boot with malleable metal collar.

Acceptable Product:

“Dektite” by ITW Buildex, www.itwbuildex.com

Approved equivalent.

Use subparagraph below for venting at ridge when using perforated soffits.

Ridge Vent: Factory fabricated

20 gage AZ55 galvalume steel with 10.8 sq. in. free area per linear foot closure and non-woven modified polyester weather filter.

Acceptable Product:

PreVent Ventilators by Metallic Products Corporation, www.mpvent.com

Approved equivalent.

* + - * 1. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match **[metal roof panels] [roof fascia and rake trim]**.
        2. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
        3. Prefabricated Curbs: Factory fabricated 0.080 thick aluminum, insulated curb designed for application on metal roofing, and custom designed specifically for the intended installation.

Acceptable Products:

FastCurbs, www.fastcurbs.com or

LMCurbs, www.lmcurbs.com.

Approved equivalent.

Fabricate the curbs into one or two piece units with welded corners and seams, and with built in water diverters or crickets on the ridge side of the curb (except for ridge mounted curbs). One-piece units must be used when the curb is installed as the roof panels are being installed. Two-piece units may be used when the curbs will be installed after the roof panels are installed.

The curb shall be designed so that the ridge end of the curb is installed under the roof panels and the sides and low end are installed on top of the roof panels.

Minimum height of curb on ridge side 8 inches.

Minimum base flange width 6 inches.

Finish: Acrylic paint, color to match adjacent roofing panels.

Curb shall be designed and fabricated to match the profile of the roof panel so that the roof panels and the curb nest together.

Include paragraph below for curbs rigidly attached to the structure and that require separate flashing. Coordinate with the mechanical designer.

* + - * 1. Prefabricated Equipment Curbs: Factory fabricated 0.080 thick aluminum, insulated curb designed for application on sloped roofs, and custom designed specifically for the intended installation.

Acceptable Products:

FastCurbs, www.fastcurbs.com or

LMCurbs, www.lmcurbs.com.

Approved equivalent.

Fabricate the curbs into one-piece units with welded corners and seams.

Minimum height of curb on ridge side 8 inches.

Specify prefabricated flashing when curb is rigidly attached to the structure.

* + - * 1. Prefabricated Curb Flashing:

Factory fabricated flashing, 0.080 thick aluminum, designed for application on metal roofing and custom designed specifically for the intended installation.

Acceptable Products:

FastCurbs, www.fastcurbs.com or

LMCurbs, www.lmcurbs.com.

Approved equivalent.

Fabricate the flashing into one or two piece units with welded corners and seams, and with built in water diverters or crickets on the ridge side of the curb (except for ridge mounted curbs). One-piece units must be used when the flashing is installed as the roof panels are being installed. Two-piece units may be used when the flashing will be installed after the roof panels are installed.

The flashing shall be designed so that the ridge end of the flashing is installed under the roof panels and the sides and low end are installed on top of the roof panels.

Minimum height of flashing on ridge side 8 inches.

Minimum base flange width 6 inches.

Finish: Acrylic paint, color to match adjacent roofing panels.

Flashing shall be designed and fabricated to match the profile of the roof panel so that the roof panels and the flashing nest together.

* + - * 1. Panel Fasteners: Self-tapping screws designed to withstand design loads.
        2. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

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

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

Type 3 Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311. Refer to Section 079200.

If using article below show the number of ‘engineered’ rows of snow fence on the drawings or indicate the snow load requirements of the snow fence.

* + - * 1. Mechanically Attached Snow Guards: Aluminum, non-penetrating clamps devices which are secured to the standing seams of metal roofs utilizing stainless steel round point set screws to clamp them in place. Use no glue or sealants to attach.

Products:

Metal Roof Innovations, Ltd.;ColorGard S-5.

Snow Gem; Sno Barricade.

Approved equivalent.

* + - * 1. Foam Closures: Factory precut closed cell foam meeting ASTM D1056, matching roofing panel profile when used at ridge, rakes, head, jambs, bottoms and tops of siding panels.
      1. FABRICATION
         1. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

Retain "On-Site Fabrication" paragraph below to permit use of on-site, portable roll-forming equipment.

* + - * 1. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
        2. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

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

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

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

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

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

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

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

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

* + - 1. FINISHES
         1. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
         2. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
         3. Steel Panels and Accessories:

Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.

Finish in "Concealed Finish" subparagraph below is frequently used as a factory finish for interior surfaces.

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 0.5 mil.

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

Retain one or both subparagraphs below.

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

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.

Retain subparagraph below with subparagraph above for systems that depend on air- or water-resistive barriers to prevent air infiltration or water penetration.

Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

* + - * 1. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
        2. Proceed with installation only after unsatisfactory conditions have been corrected.
      1. PREPARATION
         1. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
      2. INSTALLATION OF UNDERLAYMENT
         1. Install underlayment board over combustible decks.

Use subparagraph below with steel decks.

* + - * 1. Installing Underlayment Board On Steel Decks:

Install the underlayment with the long joints running in a continuous straight line with end joints staggered. Butt edges and ends snugly so there are no gaps between the boards. Discard boards with broken corners or boards that are warped.

Install the underlayment with the long edges running in the same direction as the flutes of the steel deck with the long joints bearing on the solid surface of the deck.

Secure each piece of underlayment with one fastener in each corner of each board. Place the fastener one foot in from each edge.

Retain this article for metal roof panels applied over solid roof sheathing.

Retain "Self-Adhering Sheet Underlayment" or "Felt Underlayment" paragraph below or retain both if required.

* + - * 1. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

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

Apply over the entire roof surface.

Apply over the roof area indicated below:

Revise subparagraphs below to suit Project or delete if indicated on Drawings. If inserting dimensions, note that many self-adhering sheet underlayments are manufactured in 36-inch- (914-mm-) wide rolls.

Roof perimeter for a distance up from eaves of 36 inches beyond interior wall line.

Valleys, from lowest point to highest point, for a distance on each side of 18 inches. Overlap ends of sheets not less than 6 inches.

Rake edges for a distance of 18 inches.

Hips and ridges for a distance on each side of 12 inches.

Roof-to-wall intersections for a distance from wall of 18 inches.

Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches.

* + - * 1. Felt Underlayment: Apply at locations indicated below, in shingle fashion to shed water, and with lapped joints of not less than 2 inches.

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

Apply over the entire roof surface.

Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches, in shingle fashion to shed water.

Retain "Slip Sheet" paragraph below if required.

* + - * 1. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
        2. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."
      1. INSTALLATION OF STANDING SEAM METAL ROOF PANELS
         1. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

Shim or otherwise plumb substrates receiving metal panels.

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

Install screw fasteners in predrilled holes.

Locate and space fastenings in uniform vertical and horizontal alignment.

Install flashing and trim as metal panel work proceeds.

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

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

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

* + - * 1. Fasteners:

Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

* + - * 1. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
        2. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
        3. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

Install clips to supports with self-tapping fasteners.

Install pressure plates at locations indicated in manufacturer's written installation instructions.

Retain "Snap Joint" or "Seamed Joint" subparagraph below; coordinate with products selected in Part 2.

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

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

Retain "Watertight Installation" subparagraph below for hydrostatic (watertight) panel installation; delete if not required.

Watertight Installation:

Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.

Provide sealant or tape between panels and protruding equipment, vents, and accessories.

At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

* + - * 1. Installing Soffit Panels:

Install the panels perpendicular to the building wall. Install the panels free of buckles or distortion.

Fasten the panels with concealed fasteners as recommended by the panel manufacturer, and as indicated.

Install flashings and trim for soffit panels as indicated and specified, unless approved otherwise by the Director’s Representative.

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

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

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

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

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

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

Retain one of two subparagraphs below.

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

Connect downspouts to underground drainage system indicated.

* + - * 1. Roof Curbs: Install flashing around bases where they meet metal roof panels.

Use paragraph below for self-flashing curbs to support light weight equipment. These curbs are fastened directly to the roof panels.

* + - * 1. Installing Preformed Curbs:

Install the curb so that the back flange (high side) extends beneath the roof panels and the front and side flanges extend over the roof panels.

Apply 2-1/2 inch wide preformed sealant tape between the curb flanges and the roof panels. Set the tape 1/4 inch back from the edges.

Fasten the curb 3 inches on center to the metal roof panels with fasteners 3 inches on center. Do not fasten the curb to the structural deck or to the structural members.

Use paragraph below for flashing heavy curbs that are secured to structural framing. Retain paragraph below with “Installing Hot Stack Flashing” paragraph below.

* + - * 1. Installing Curb Flashing:

Install 4-piece curb flashing so that the back flange (high side) extends beneath the roof panels and the front and side flanges extend over the roof panels.

Fabricate the flashing with a min. of 1 inch clearance all around the curb. Join each of flashing with a folded lock seam filled with butyl sealant.

Apply 2 1/2” wide preformed sealant tape between all overlapping flanges and between the flashing flanges and the roof panels. Set the tape 1/4” back from the edges.

Fasten the flashing to the metal roof panels with fasteners 3 inches on center.

Include “Installing Preformed Curbs” paragraph above when using paragraph below.

* + - * 1. Installing Hot Stack Flashing

Install preformed curb around the hot stack.

Cut hole in curb cover with 1-inch clearance around the stack.

Install preformed chimney flashing on the curb cover set on 2-inch wide tape sealant. Secure chimney flashing with molly type fasteners 3 inches on center.

* + - * 1. Installing Snow Guards: Install snow guards in accordance with the manufacturer’s recommendations.
        2. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.
      1. ERECTION TOLERANCES
         1. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
      2. FIELD QUALITY CONTROL

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a company field advisor per Section 014216 to test and inspect metal roof panel installation, including accessories. Report results in writing.
        2. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
        3. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
        4. Prepare test and inspection reports.
      1. CLEANING AND PROTECTION
         1. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
         2. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16