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USACE / NAVFAC / AFCEC / NASA | **UFGS-07 60 00 (May 2017)**
Change 2 - 11/18

Preparing Activity: NAVFAC | **Superseding**
UFGS-07 60 00 (August 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 07 60 00

FLASHING AND SHEET METAL
05/17, CHG 2: 11/18

****
NOTE: This guide specification covers the requirements for flashing and sheet metal work including gutters and downspouts, scuppers, splash pans, and sheet metal roofing.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

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NOTE: The specified sheet metal roofing is the type commonly used for on-site fabrication which does not include factory fabricated or preformed metal roofing. Preformed metal roofing is covered in other Division 7 sections. Gravity roof ventilators, roof scuttles, louvers, and similar items are not included in this section. This guide specification requires extensive editing when used with single ply roof systems in order to assure compatibility.
****

****
NOTE: Show details of sheet metalwork on project drawings in accordance with the appropriate details in the Architectural Sheet Metal Manual of the Sheet

Metal and Air Conditioning Contractors National Association (SMACNA) 1793.

Coordinate specifications with the drawings so that drawing details and SMACNA 1793 requirements do not conflict or repeat. Delete references to SMACNA 1793 when requirements are detailed on the drawings.

****

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NOTE: On the drawings, show:

1. Sheet metal roofing assembly, profile, extent, and slope. Specifying metal roofing for low slope (less than 2:12 pitch) roofs is discouraged due to a propensity of metal roofs to leak at lower pitches. Consider other roof assemblies for 2:12 and lower slopes.

2. Roof drain, base, counter open valley, and eave flashings

3. fascia, drip edges, miscellaneous trim.

4. Gutters and downspouts.

5. Expansion joint details - (interior and exterior) at walls, ceilings, floors, roof, and parapets. Provide isometric details for expansion joint intersections.

****

PART 1 GENERAL

****

NOTE: Sheet metal color must be durable and long lasting and resist fading and chalking. Specify products such as coated steel, anodized aluminum, or baked enamel. Painting in the field, other than touch-ups are prohibited. This does not preclude the use of natural materials such as copper or aluminum, however avoid the use of copper where drainage from copper will pass over exposed masonry, stonework, or other metal surfaces.

Galvanized steel is not permitted as an option to other metals specified. Galvanized steel may be specified for temporary structures or where it may be satisfactory due to climatic conditions. Where galvanized steel is specified, make changes to the text as follows:

Paragraph REFERENCES:

ASTM A653/A653M

(Galvanized) by the Hot-Dip Process,

Commercial Quality

Paragraph MATERIALS Add: Galvanized Steel: ASTM A653/A653M, Coating G90.

Paragraph PROTECTION OF ALUMINUM: Require galvanized steel to be treated the same as aluminum, i.e., separated from copper or protected.

Paragraph CONNECTIONS AND JOINTING: Require galvanized steel to be soldered.

Paragraph EXPANSION JOINTS: Expansion joints to be spaced at 12.0 m 40 foot intervals for galvanized steel.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 189.1	(2014) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020)

	Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A308/A308M	(2010) Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process
ASTM A480/A480M	(2020a) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B69	(2020) Standard Specification for Rolled Zinc
ASTM B101	(2012; R 2019) Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C1549	(2016) Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D226/D226M	(2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D4586/D4586M	(2007; E 2012; R 2012) Asphalt Roof Cement, Asbestos-Free
ASTM E408	(2013) Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
ASTM E971	(2011) Standard Practice for Calculation of Photometric Transmittance and Reflectance of Materials to Solar Radiation
ASTM E1918	(2016) Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
ASTM E1980	(2011) Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1	(2014) Performance Standard for Retrofit Drains

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

1.2 GENERAL REQUIREMENTS

Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system. The sheet metal installer is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal modifications required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous, uninterrupted roofing operations.

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification

technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Exposed Sheet Metal Coverings; G[, [_____]]

Gutters; G[, [_____]]

Downspouts; G[, [_____]]

Expansion Joints; G[, [_____]]

Gravel Stops and fascia; G[, [_____]]

Splash Pans; G[, [_____]]

Flashing for Roof Drains; G[, [_____]]

Base Flashing; G[, [_____]]

Counterflashing; G[, [_____]]

Flashing at Roof Penetrations and Equipment Supports; G[, [_____]]

Reglets; G[, [_____]]

Scuppers; G[, [_____]]

Copings; G[, [_____]]

Drip Edges; G[, [_____]]

Conductor Heads; G[, [_____]]

Open Valley Flashing; G[, [_____]]

Eave Flashing; G[, [_____]]

Recycled Content; S

SD-03 Product Data

Cool Roof Data; G[, [_____]]

SD-04 Samples

Finish Samples; G[, [_____]]

SD-08 Manufacturer's Instructions

Instructions for Installation; G[, [_____]]

Quality Control Plan; G[, [_____]]

SD-10 Operation and Maintenance Data

Cleaning and Maintenance; G[, [_____]]

1.4 MISCELLANEOUS REQUIREMENTS

1.4.1 Product Data

Indicate thicknesses, dimensions, fastenings, anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.4.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.4.3 Operation and Maintenance Data

Submit detailed instructions for installation and quality control during installation, cleaning and maintenance, for each type of assembly indicated.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to

the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until installation.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide data for each product with recycled content, identifying percentage of recycled content.

2.2 MATERIALS

****

NOTE: Permit use of optional materials to extent that project design, relative costs, local environmental conditions, and commercial availability permit. Relative costs for materials listed in Table I range from 100 as index for stainless steel followed by terne-coated steel, zinc-coated steel, and copper in that order down to approximately 50 for aluminum, based on weights, gages and thicknesses indicated. Specify exposed sheet metal in materials indicated except where additions to buildings require matching of existing and if the appearance of the building would be detrimentally affected by use of a different material. Use aluminum to match existing exposed zinc-alloy or galvanized metal, except in highly corrosive environments such as in and around industrial buildings, coastal areas, and areas that experience high winds or sand abrasion. Where Contractor's choice is limited because of above conditions, revise accordingly. Delete items that do not apply. Weights and thicknesses listed are minimum for items described. If greater weights and thicknesses are justified by unusual local conditions, modify accordingly.

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NOTE: If material is not specified, Contractor will have a choice of aluminum, copper or stainless steel, as listed in SMACNA 1793 and not prohibited herein. If the material is specified, delete all other sheet metal specifications listed in this section.

The minimum thicknesses specified in SMACNA 1793 may be increased and other materials may be used if justified by local conditions.

If galvanized steel is required for temporary facilities, delete "galvanized steel" from the first sentence below.

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NOTE: In humid locations or project locations with Environmental Severity Classifications (ESC) of C3 thru C5, in an atmosphere laden with salt spray, stainless steel is recommended. Where salt spray is not severe, flashings, gutters, and downspouts may be of stainless steel, aluminum alloy (3003-N14), or copper. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). See UFC 1-200-01 for determination of ESC for project locations.

****

Do not use lead, lead-coated metal, or galvanized steel. Use any metal listed by SMACNA 1793 for a particular item, unless otherwise indicated. Provide materials, thicknesses, and configurations in accordance with SMACNA 1793 for each material. Different items need not be of the same metal, except that[if copper is selected for any exposed item, all exposed items must be copper, and that] contact between dissimilar metals must be avoided.

Furnish sheet metal items in 2400 to 3000 mm 8 to 10 foot lengths. Single pieces less than 2400 mm 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 300 mm 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used, except as follows:

2.2.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascia; cap, valley, steeped, base, and eave flashings and related accessories.

2.2.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.2.3 Copper, Sheet and Strip

Provide in accordance with ASTM B370, cold-rolled temper, H 00 (standard).

2.2.4 Lead-Coated Copper Sheet

****

NOTE: Factory-applied color coating on sheet aluminum and galvanized steel may be used on building additions where necessary to match existing galvanized or other exposed painted metal work. This coating may also be used on sheet aluminum and galvanized steel surfaces of new buildings where a

long-life exterior color finish is desired.
****

Provide in accordance with ASTM B101.

2.2.5 Lead Sheet

****
NOTE: In humid locations or project locations with Environmental Severity Classifications (ESC) of C3 thru C5, lead sheet is recommended for plumbing vents and other pipe penetrations through the roof. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). See UFC 1-200-01 for determination of ESC for project locations.
****

Provide in a minimum weight of 19.6 kilograms per square meter 4 pounds per square foot.

2.2.6 Steel Sheet, Zinc-Coated (Galvanized)

****
NOTE: Factory-applied color coating on sheet aluminum and galvanized steel may be used on building additions where necessary to match existing galvanized or other exposed painted metal work. This coating may also be used on sheet aluminum and galvanized steel surfaces of new buildings where a long-life exterior color finish is desired.
****

Provide in accordance with ASTM A653/A653M.

2.2.7 Zinc Sheet and Strip

Provide in accordance with ASTM B69, Type I, a minimum of 0.61 mm 0.024 inch thick.

2.2.8 Stainless Steel

****
NOTE: Factory-applied color coating on sheet aluminum and galvanized steel may be used on building additions where necessary to match existing galvanized or other exposed painted metal work. This coating may also be used on sheet aluminum and galvanized steel surfaces of new buildings where a long-life exterior color finish is desired. Finishes are described in SMACNA Arch Manual. See ASTM A48/A48M for other than standard mill finishes.
****

Provide in accordance with ASTM A480/A480M, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.2.9 Terne-Coated Steel

Provide in accordance with ASTM A308/A308M, a minimum of 350 by 500 mm 14 by 20 inch with minimum of 18 kilogram 40 pound coating per double base box. ASTM A308/A308M.

2.2.10 Aluminum Alloy Sheet and Plate

****
NOTE: Factory-applied color coating on sheet aluminum and galvanized steel may be used on building additions where necessary to match existing galvanized or other exposed painted metal work. This coating may also be used on sheet aluminum and galvanized steel surfaces of new buildings where a long-life exterior color finish is desired.
****

****
NOTE: Do not use less than 0.813 mm 0.032-inch thick material in humid locations or project locations with Environmental Severity Classifications (ESC) of C3 thru C5. In hurricane and typhoon areas, ensure aluminum thickness is not less than 1.651 mm 0.065 inches where exposed to the direct wind. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). See UFC 1-200-01 for determination of ESC for project locations.
****

Provide in accordance with ASTM B209M ASTM B209 [anodized [clear] [color [_____][_____]]] form alloy, and temper appropriate for use. Provide material not less than[0.813 mm 0.032-in][1.651 mm 0.065-in] in thickness.

[2.2.10.1 Alclad

When fabricated of aluminum, fabricate the following items with Alclad 3003, Alclad 3004, or Alclad 3005, clad on [one side][both sides] unless otherwise indicated.

a. Gutters, downspouts, and hangers

b. Gravel stops and fascia

c. Flashing

]2.2.11 Finishes

****
NOTE: If a cool roof is required, there are a number of methods by which to specify requirements; three are indicated below, as contractor options.

NOTE: Low slope (pitches of 2:12 or less) metal roofs are not recommended, however, if specified, cool roof criteria is provided herein.

NOTE: Cool roof colors are not necessarily light colors anymore. This has to do with the arrangement of ions in the finish coating which result in high reflectance and emissivity values. High values indicate finishes best suited to save cooling energy and to reduce heat island effect. Such coatings are readily available from most manufacturers for nominal upcharges; look for 'cool' series colors and product data.

The three paths to cool roofs are described below. Values indicating compliance are generally indicated in manufacturer's product data.

1) Energy Star Certification:
Energy Star sets Initial Solar Reflectance and Initial Emissivity as its criteria for cool roof approval. Low slope roof finishes certified by Energy Star are required to have greater than or equal to 0.65 Initial Solar Reflectance; steep slope roofs (pitches steeper than 2:12)are required to have greater than or equal to 0.25 Initial Solar Reflectance. While Energy Star indicates Initial Emissivity values of certified products, it does not set threshold criteria. A higher emissivity number is more energy efficient. The current list is available at:
https://www.energystar.gov/productfinder/product/certified-roof-products/res

2) ASHRAE 189.1 Compliance:
The American Society for Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) standard 189.1, "Standard for the Design of High Performance Green Buildings" (2011 version) specifies a solar reflective index (SRI) of 78 for low slope cool roofs and 29 for steep slope cool roofs. SRI is a calculation that combines reflectivity and emissivity into a single metric. Newer versions of ASHRAE 189.1 use 3-year aged values, however, many manufacturers have not completed testing of aged values and therefore are not yet able to include it in their product data.

3) ASHRAE 90.1 Compliance:
UFC 3-110-03 Roofing requires that cool roofs meet ASHRAE 90.1 (2010 version) Chapter 5 values for cool roofing. The requirements of this standard are included herein, however, this method does not appear to differentiate roof angle to the sun (slope) and uses only aged values.

****

Provide exposed exterior sheet metal and aluminum with a baked on, factory applied color coating of polyvinylidene fluoride (PVF2) or approved equal fluorocarbon coating. Dry film thickness of coatings must be 0.020 to 0.033 mm 0.8 to 1.3 mils. Color to be selected from [manufacturer's full range of "cool roof" color choices][manufacturer's standard range of color choices][manufacturer's full range of color choices][as indicated on the Drawings]. Field applications of color coatings are prohibited and will

be rejected.

2.2.12 Cool Roof Finishes

Provide cool roof finish coatings and colors in accordance with one of the following methods of analysis:

2.2.12.1 Energy Star Certification

Provide roof finishes having an initial solar reflectance of [0.65 for low slope roofs with a 2:12 pitch or less when tested in accordance with ASTM E1918 and ASTM E1980][0.25 for steep slope roofs with a greater than 2:12 pitch when tested in accordance with ASTM E971][_____] and an initial emissivity of [_____] when tested in accordance with ASTM E408, or as certified by Energy Star for the particular product proposed. Certified Energy Star roof products are listed at https://www.energystar.gov/productfinder/product/certified-roof-products/results

2.2.12.2 ASHRAE 189.1 Compliance

Provide roof finishes having a minimum initial Solar Reflectance Index of [78 for low slope roofs with a 2:12 pitch or less when tested in accordance with ASTM E1918 and ASTM E1980][29 for steep slope roofs with a greater than 2:12 pitch when tested in accordance with ASTM E971][_____], to comply with ASHRAE 189.1.

2.2.12.3 ASHRAE 90.1 Compliance

Provide roof finishes having a minimum 3-year aged solar reflectance of 0.55 when tested in accordance with ASTM C1549 or ASTM E1918, and a minimum 3-year aged thermal emittance of 0.75 when tested in accordance with ASTM E971 or ASTM E408, or, a minimum 3-year aged Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 6.62 W per m2 2.1 BTU per h ft2, to comply with ASHRAE 90.1 - SI ASHRAE 90.1 - IP.

2.2.13 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221MASTM B221.

2.2.14 Solder

Provide in accordance with ASTM B32, 95-5 tin-antimony.

2.2.15 Reglets

2.2.15.1 Polyvinyl Chloride Reglets

Provide in accordance with ASTM D1784, Type II, Grade 1, Class 14333-D, 1.9 mm 0.075 inch minimum thickness.

2.2.15.2 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 6 mm 1/4 inch and a depth of 30 mm 1-1/4 inch, as approved.

2.2.15.2.1 Caulked Reglets

Provide with rounded edges, temporary reinforcing cores, and accessories as required for securing to adjacent construction. Provide built-up mitered corner pieces for inside and outside corners.

2.2.15.2.2 Friction Reglets

Provide with flashing receiving slots not less than 16 mm 5/8 inch deep, 25 mm one inch jointing tongues, and upper and lower anchoring flanges installed at 600 mm 24 inch maximum snap-lock type receiver.

2.2.16 Scuppers

Line interiors of scupper openings with sheet metal. Provide a drip edge at bottom edges with returns of not less than 25 mm one inch against the face of the outside wall at the top and sides. Provide the perimeter of the lining approximately 13 mm 1/2 inch less than the perimeter of the scupper.

2.2.17 Conductor Heads

Provide conductor heads and screens in the same material as downspouts. Provide outlet tubes not less than 100 mm 4 inches long.

2.2.18 Splash Pans

Provide splash pans where downspouts discharge onto roof surfaces and at locations indicated. Unless otherwise indicated, provide pans not less than 600 mm long by 450 mm wide 24 inches long by 18 inches wide with metal ribs across bottoms of pans. Provide sides of pans with vertical baffles not less than 25 mm one inch high in the front, and 100 mm 4 inches high in the back.

2.2.19 Copings

Unless otherwise indicated, provide copings in copper sheets, 2400 or 3000 mm 8 or 10 feet long, joined by a 20 mm 3/4 inch locked and soldered seam.

2.2.20 Bituminous Plastic Cement

Provide in accordance with ASTM D4586/D4586M, Type I.

2.2.21 Roofing Felt

****

NOTE: The two types of asphalt-saturated felts are: type I which is commonly called No. 15 asphalt felt, and type II which is commonly called No. 30. These numbers no longer refer to product weights; see ASTM D2526 for more information. Edit paragraph as necessary to fit project requirements.

****

Provide in accordance with ASTM D226/D226M [Type I] [Type II].

2.2.22 Asphalt Primer

Provide in accordance with ASTM D41/D41M.

2.2.23 Fasteners

****

NOTE: In humid locations or project locations with Environmental Severity Classifications (ESC) of C3 thru C5, use stainless steel nails, bolts and fasteners. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). See UFC 1-200-01 for determination of ESC for project locations.

****

Use the same metal as, or a metal compatible with the item fastened.[Use stainless steel fasteners to fasten.] Confirm compatibility of fasteners and items to be fastened to avoid galvanic corrosion due to dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

****

NOTE: On-site fabricated flat copper, zinc, or terne-coated steel metal roofing is not included in text of this guide specification because it is infrequently used. These materials do not require field painting. (However, if terne plate is used, field painting must be specified: one coat of iron oxide paint on underside before application, and on exposed surfaces after application. Exposed surfaces also require finish coat of compatible exterior oil paint over iron oxide paint). If design requires this type of metal roofing, edit subsections below as necessary.

****

3.1.1 Metal Roofing

[3.1.1.1 [Flat Copper,] [Zinc,] [Terne-coated Steel] Roofing

Before applying roofing, cover deck with rosin-sized roofing felt. Lap 50 mm 2 inch at joints and secure in place with roofing nails. Using solder of equal parts tin and lead, solder slowly with well-heated irons to thoroughly heat sheet and completely sweat solder through full width of seam.[Tin edges of copper to be soldered at least 20 mm 3/4 inch before sheets are locked.][Use stainless nails in terne-coated steel]; [in copper, use solid copper or bronze roofing nails][in zinc, use zinc-coated roofing nails.] Where roof decks abut vertical surfaces, turn metal roofing up vertical surfaces about 200 mm 8 inch where practicable; where vertical surfaces are covered with applied materials, turn up roofing behind applied materials. Use standing-seam method for roofs having rise of more than one in four 3 inch per foot, and use flat-seam method when rise is one in four 3 inch per foot or less. Walking not permitted directly on metal roofs; provide approved walkways.

][3.1.1.2 Standing-seam Method

Make standing seams parallel with slope of roof. Fabricate sheets into

long lengths at shop by locking short dimensions together and thoroughly soldering joints thus formed. In applying metal, turn up one edge of course at each side seam at right angles 40 mm 1.5 inch. Then install 50 by 75 mm 2 by 3 inch cleats spaced 300 mm 12 inches apart by fastening one end of each cleat to roof with two 25 mm one inch long nails and folding roof end back over nail heads. Turn end adjoining turned-up side seam up over upstanding edge of course. Turn up adjoining edge of next course 45 mm 1.75 inches and abutting upstanding edges locked, turned over, and flattened against one side of standing seam. Make standing seams straight, rounded neatly at the top edges, and stand about 25 mm one inch above roof deck. All sheets must be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA 1793.

][3.1.1.3 Flat-seam Method

Lay metal so short dimension is parallel to gutter or eave lines and so water will flow over and not into seams. Make seams by turning edges of sheet 20 mm 3/4 inch and lock and solder together. If sheets are laid one at a time, secure to roof deck with cleats, using three cleats to each sheet, two on long side and one on short side. Use cleats 50 mm 2 inches wide, hooked over 20 mm 3/4 inch upturned edges of sheets, and nail to roof deck with two 25 mm one inch long nails. Turn back roof end of cleat over nail heads before next sheet is applied. If desired, sheets may be made into long lengths at shop by locking short dimensions together and soldering seams thus formed. Turn long lengths 20 mm 3/4 inch, and secure each length to roof deck by cleats spaced 300 mm 12 inches apart. Mallet and solder seams after pans are in place. All sheets to be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA 1793.

]3.1.2 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 13 mm 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.3 Nailing

****

NOTE: In humid locations or project locations with Environmental Severity Classifications (ESC) of C4 and C5, include the last sentence in the paragraph below for wind-resistant installations. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE

90.1). See UFC 1-200-01 for determination of ESC for project locations.
****

Confine nailing of sheet metal generally to sheet metal having a maximum width of 450 mm 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 75 mm 3 inch on center and approximately 13 mm 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.[Secure flashing at one-half the normal interval to ensure a wind-resistant installation.]

3.1.4 Cleats

Provide cleats for sheet metal 450 mm 18 inches and over in width. Space cleats evenly not over 300 mm 12 inches on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 50 mm wide by 75 mm long 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. [Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry.]Pre-tin cleats for soldered seams.

3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 1.0 mm 0.040 inches or less in thickness.

3.1.6 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.6.1 Flat-lock Seams

Finish not less than 20 mm 3/4 inch wide.

3.1.6.2 Lap Seams

Finish soldered seams not less than 25 mm one inch wide. Overlap seams not soldered, not less than 75 mm 3 inches.

3.1.6.3 Loose-Lock Expansion Seams

Not less than 75 mm 3 inches wide; provide minimum 25 mm one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 3 mm 1/8 inch thick bed.

3.1.6.4 Standing Seams

Not less than 25 mm one inch high, double locked without solder.

3.1.6.5 Flat Seams

Make seams in the direction of the flow.

3.1.7 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pre-tin edges of sheet metal before soldering is begun. Seal the joints in aluminum sheets of 1.0 mm 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.7.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pre-tinned. Seal the joints in aluminum sheets of 1.0 mm 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.8 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 1.0 mm 0.040 inch. Aluminum 1.0 mm 0.040 inch or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

3.1.8.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2/D1.2M.

3.1.8.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 300 mm 12 inches maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 50 mm 2 inches from the end of the overlapping sheet.

3.1.9 Protection from Contact with Dissimilar Materials

3.1.9.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.9.2 Aluminum

****

NOTE: In humid locations or project locations with Environmental Severity Classifications (ESC) of C3 thru C5, insert the last sentence. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). See UFC 1-200-01 for determination of ESC for project locations.

****

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.[Aluminum may be used over concrete construction, provided that required reglets are of stainless steel and aluminum surface in contact with concrete or masonry is coated with bituminous paint or zinc chromate primer.]

3.1.9.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.9.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.10 Expansion and Contraction

Provide expansion and contraction joints at not more than 9750 mm 32 foot intervals for aluminum and at not more than 12 meter 40 foot intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascia by expansion and contraction joints spaced not more than 3600 mm 12 feet apart.

3.1.11 Base Flashing

****
NOTE: Bracketed first sentence applies only to shingled roofs. Do not include for built-up roofing. Normally, only bituminous base flashing should be specified with built-up roofing. Limit use of metal base flashing to locations where flashing is subject to damage by foot traffic and to runs of 6000 mm 20 feet or less when used with built-up roofing. Flashing for heating, plumbing, and electrical equipment should be specified in the appropriate sections.
****

[Lay the base flashings with each course of the roof covering, shingle fashion, where practicable, where sloped roofs abut chimneys, curbs, walls, or other vertical surfaces.]Extend up vertical surfaces of the flashing not less than 200 mm 8 inches and not less than 100 mm 4 inches under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 150 mm 6 inches. Overlap the flashing strips [or shingles] with the previously laid flashing not less than 75 mm 3 inches. Fasten the strips [or shingles] at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a

minimum of 150 mm 6 inches on center with [large headed aluminum roofing nails] [hex headed, galvanized shielded screws] a minimum of 150 mm 2 inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of [chimneys,] [curbs,] [and similar] vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 115 mm 4.5 inches at the lower side of [dormer walls,] [chimneys,] [and similar] vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

3.1.12 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 230 to 250 mm 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 75 mm 3 inches. Fold the exposed edges of counterflashings 13 mm 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum [200 mm by 200 mm8 inches by 8 inches][200 mm by 250 mm8 inches by 8 inches] or may be of the preformed single piece type. Provide end laps in counterflashings not less than 75 mm 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 3000 mm 10 feet. Form flashings to the required shapes before installation. Factory form corners not less than 300 mm 12 inches from the angle. Secure the flashings in the reglets with lead wedges and space not more than 450 mm 18 inches apart; on[chimneys and][stair/elevator towers] short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 6 mm 1/4 inch and extend not less than 50 mm 2 inches into the walls. Install counterflashing to provide a spring action against base flashing.[Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.]

3.1.13 Metal Reglets

Keep temporary cores in place during installation. Ensure factory fabricated caulked type or friction type, reglets have a minimum opening of 6 mm 1/4 inch and a minimum depth of 30 mm 1-1/4 inch, when installed.

3.1.13.1 Caulked Reglets

Wedge flashing in reglets with lead wedges every 450 mm 18 inches, caulked full and solid with an approved compound.

3.1.13.2 Friction Reglets

Install flashing snap lock receivers at 600 mm by 600 mm 24 inches on center maximum. When flashing has been inserted the full depth of the slot, caulk the slot, lock [with wedges], and fill with sealant.

3.1.14 Polyvinyl Chloride Reglets for Temporary Construction

Rigid polyvinyl chloride reglets may be provided in lieu of metal reglets for temporary construction.

3.1.15 Gravel Stops and fascia

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NOTE: On projects having smooth surfaced roofs, the upstanding leg of the gravel stop may be omitted. Specify in the appropriate roofing section. Coordinate installation requirements for sheet metal gravel stops and fascia with the referenced roofing section.

****

Prefabricate in the shapes and sizes indicated and in lengths not less than 2400 mm 8 feet. Extend flange at least 100 mm 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascia after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascia on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 38 mm 1.5 inch long spaced not more than 75 mm 3 inches on center, in two staggered rows.

3.1.15.1 Edge Strip

Hook the lower edge of fascia at least 20 mm 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 150 mm 6 inches maximum on center. Where fastening is made to concrete or masonry, use screws spaced 300 mm 12 inches on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 2 mm 1/16 inch thick compatible spacer or washers.

3.1.15.2 Joints

Leave open the section ends of gravel stops and fascia 6 mm 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 100 mm 4 inches set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascia in accordance with the manufacturer's printed instructions and details.

3.1.16 Metal Drip Edges

Provide a metal drip edge, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 75 mm 3 inches and secure with compatible nails spaced not more than 250 mm 10 inches on center along upper edge.

3.1.17 Gutters

****

NOTE: Where it is local practice to omit gutters because of glaciation and ice damage, eave flashing should be provided in accordance with paragraph EAVE FLASHING.

****

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 20 by 5 mm 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 2400 mm 8 feet. Lap the sections a minimum of 25 mm one inch in the direction of flow or provide with concealed splice plate 150 mm 6 inches minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on[adjustable hangers spaced not more than 750 mm 30 inches on center][as indicated][by continuous cleats][and][or][by cleats spaced not less than 900 mm 36 inches apart]. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from compatible metals.

3.1.18 Downspouts

****

NOTE: For additions to existing buildings, downspouts may be specified to match the design of the existing portion of the building.

****

Space supports for downspouts according to the manufacturer's recommendation for the [wood][masonry] or [steel] substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 3000 mm 10 foot lengths. Provide end joints to telescope not less than 13 mm 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than 25 mm one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 1500 mm 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.18.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.1.19 Flashing for Roof Drains

Provide a 750 mm 30 inches square sheet indicated. Taper insulation to drain from 600 mm 24 inches out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D4586/D4586M. Heavily coat the drain flashing ring with asphalt roof cement. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing are free of wrinkles and folds. Retrofit roof drains must conform to ANSI/SPRI RD-1.

3.1.20 Scuppers

Extend the scupper liner through and project outside of, the wall it penetrates to form a bottom drip edge against the face of the wall. Fold outside edges under 13 mm 1/2 inch on all sides. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement.

3.1.21 Conductor Heads

Set the depth of the top opening equal to two-thirds of the width or the conductor head. Flat-lock solder seams. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 50 mm 2 inches wider than the scupper. Attach conductor heads to the wall with masonry fasteners. Securely fasten screens to heads.

3.1.22 Splash Pans

Install splash pans lapped with horizontal roof flanges not less than 100 mm 4 inches wide to form a continuous surface. Bend the rear flange of the pan to contour of can't strip and extend up 150 mm 6 inches under the side wall covering or to height of base flashing under counterflashing. Bed the pans and roof flanges in plastic bituminous cement and strip-flash as specified.

3.1.23 Open Valley Flashing

Provide valley flashing free of longitudinal seams, of width sufficient to extend not less than 150 mm 6 inches under the roof covering on each side. Provide a 13 mm 1/2 inch fold on each side of the valley flashing. Lap the sheets not less than 150 mm 6 inches in the direction of flow and secure to roofing construction with cleats attached to the fold on each side. Nail the tops of sheets to roof sheathing. Space the cleats not more than 300 mm 12 inches on center. Provide exposed flashing not less than 100 mm 4 inches in width at the top and increase 25 mm one inch in width for each additional 2400 mm 8 feet in length. Where the slope of the valley is one in 2.67 or less 4.5 inches or less per foot, or the intersecting roofs are on different slopes, provide an inverted V-joint, 25 mm one inch high, along the centerline of the valley; and extend the edge of the valley sheets 200 mm 8 inches under the roof covering on each side.

Valley flashing for asphalt shingle roofs is specified in Section 07 31 13 ASPHALT SHINGLES.

3.1.24 Eave Flashing

One piece in width, applied in 2400 to 3000 mm 8 to 10 foot lengths with expansion joints spaced as specified in paragraph EXPANSION AND CONTRACTION. Provide a 20 mm 3/4 inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 250 mm 10 inches on center. Locate the upper edge of flashing not less than 450 mm 18 inches from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with 25 mm one inch flat locked joints with cleats that

are 250 mm 10 inches on center.

3.1.25 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 375 by 455 mm 16 by 18 inches. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.1.26 Expansion Joints

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NOTE: The contract drawings should contain details of building expansion joints at walls, ceiling, floors, roof, and parapets. Include exterior and interior details. Provide isometric detailing for expansion joints intersections.

****

Provide expansion joints for roofs, walls, and floors as [specified] [indicated]. Provide [expansion joints in continuous sheet metal at [12 meter40 foot intervals for copper and stainless steel] [and at 9750 mm 32 foot intervals for aluminum], [aluminum gravel stops and fascia which must have expansion joints at not more than 3600 mm 12 foot spacing]. Provide evenly spaced joints. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing]. Conform to the requirements of Table I.

3.1.26.1 Roof Expansion Joints

Consist of curb with wood nailing members on each side of joint, bituminous base flashing, metal counterflashing, and metal joint cover. Bituminous base flashing is specified in Roofing Section. Provide counterflashing as specified in paragraph COUNTERFLASHING, except as follows: Provide counterflashing with vertical leg of suitable depth to enable forming into a horizontal continuous cleat. Secure the inner edge to the nailing member. Make the outer edge projection not less than 25 mm one inch for flashing on one side of the expansion joint and be less than the width of the expansion joint plus 25 mm one inch for flashing on the other side of the joint. Hook the expansion joint cover over the projecting outer edges of counterflashing. Provide roof joint with a joint cover of the width indicated. Hook and lock one edge of the joint cover over the shorter projecting flange of the continuous cleat, and the other edge hooked over and loose locked with the longer projecting flange. Joints are specified in Table II.

3.1.26.2 Floor and Wall Expansion Joints

Provide U-shape with extended flanges for expansion joints in concrete and masonry walls and in floor slabs.

3.1.27 Flashing at Roof Penetrations and Equipment Supports

****

NOTE: Insert appropriate Section number and title

in the blank below using format in accordance with UFC 1-300-02, Unified Facilities Guide Specifications (UFGS) Format Standard.
****

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck. Goose-necks, rain hoods, power roof ventilators, and [_____] are specified in [_____].

3.1.28 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 75 mm 3 inches on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 50 mm 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 100 mm 4 inches roof flange in bituminous plastic cement and nailed 75 mm 3 inches on center. Extend sleeve a minimum of 200 mm 8 inches above the roof deck and lapped a minimum of 75 mm 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.1.29 Stepped Flashing

Provide stepped flashing where sloping roofs surfaced with shingles abut vertical surfaces. Place separate pieces of base flashing in alternate shingle courses.

3.1.30 Copings

Provide coping with locked and soldered seam. Terminate outer edges in edge strips. Install with sealed [lap joints][cover plate joints][standing seam joints] as indicated.

3.2 PAINTING

Touch ups in the field may be applied only after metal substrates have been cleaned and pretreated in accordance with manufacturer's written instructions and products.

Field-paint sheet metal for separation of dissimilar materials.

[3.2.1 Aluminum Surfaces

Clean with solvent and apply one coat of zinc-molybdate primer and one coat of aluminum paint.

]3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as

approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

[3.5 FIELD QUALITY CONTROL

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NOTE: When justified, and similar requirements are not established for Contractor Quality Control specified in other sections, add the following requirement at the end of paragraph FIELD QUALITY CONTROL:

"A roofing technician responsible directly to the Contractor and experienced in construction of the specified type of roofing system and related work must perform quality control functions and be present on site during roofing installations."

****

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

****

NOTE: Metal gauges listed in the following tables are applicable to light commercial and residential types and uses. Compare metal thickness stated herein with the requirements of SMACNA 1793 and edit these tables using the more stringent requirement of the two. Gauges of metal gutters in the following tables are only applicable to gutters less than 150 mm by 150 mm 6 inches by 6 inches. Use SMACNA 1793 for commercial gutters of larger sizes.

****

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	[Copper kilograms per square meter]	[Aluminum, mm]	[Stainless Steel, mm]	[Terne-Coated Stainless Steel, mm]	[Zinc-Coated Steel, mm]
[Building Expansion Joints]					
[Cover]	4.9	0.81	0.38	0.38	0.6
[Waterstop-bellows or flanged, U-type.]	4.9	-	0.38	0.38	-
[Covering on minor flat, pitched or curved surfaces]	6.125	1.02	0.46	0.46	-
[Downspouts and leaders]	4.9	0.81	0.38	0.38	0.6
[Downspout clips and anchors]	-	1.02 clip 3.175 anchor	-	-	-
[Downspout straps, 50 mm]	14.7 (a)	1.52	1.27	-	-
[Conductor heads]	4.9	0.81	0.38	0.38	-
[Scupper lining]	6.125	0.81	0.38	0.38	-
[Strainers, wire diameter or gage]	4.0 gage	3.66 diameter	2.77 diameter	-	
[Flashings:]					
[Base]	6.125	1.02	0.46	0.46	0.6
[Cap (Counter-flashing)]	4.9	0.81	0.38	0.38	0.5
[Eave]	4.9	-	0.38	0.38	0.6
[Spandrel beam]	3.1	-	0.25	0.25	-
[Bond barrier]	4.9	-	0.38	0.38	-
[Stepped]	4.9	0.81	0.38	0.38	-
[Valley]	4.9	0.81	0.38	0.38	-

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	[Copper kilograms per square meter]	[Aluminum, mm]	[Stainless Steel, mm]	[Terne-Coated Stainless Steel, mm]	[Zinc-Coated Steel, mm]
[Roof drain]	4.9 (b)				
[Pipe vent sleave (d)]					
[Coping]	4.9	-	-	-	-
[Gravel stops and fascia:]					
[Extrusions]	-	1.91	-	-	-
[Sheets, corrugated]	4.9	0.81	0.38	0.38	-
[Sheets, smooth]	6.125	1.27	0.46	0.46	0.6
[Edge strip]	7.35	1.27	0.635	-	-
[Gutters:]					
[Gutter section]	4.9	0.81	0.38	0.38	0.6
[Continuous cleat]	4.9	0.81	0.38	0.38	0.6
[Hangers, dimensions]	25 mm by 3 mm (a)	25 mm by 2 mm (c)	25 mm by 1 mm	-	-
[Joint Cover plates (See Table II)]	4.9	0.81	0.38	0.38	0.6
[Reglets (c)]	3.1	-	0.25	0.25	-
[Splash pans]	4.9	1.02	0.46	0.46	-
(a) Brass.					
(b) May be lead weighing 19.6 kilograms per square meter.					
(c) May be polyvinyl chloride.					
(d) 12.25 kilogram minimum lead sleeve with 100 mm flange. Where lead sleeve is impractical, refer to paragraph SINGLE PIPE VENTS for optional material.					

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	[Copper kilograms per square foot]	[Aluminum, inch]	[Stainless Steel, inch]	[Terne-Coated Stainless Steel, inch]	[Zinc-Coated Steel, U.S. Std. Gage]
[Building Expansion Joints]					
[Cover]	16	.032	.015	.015	24
[Waterstop-bellows or flanged, U-type.]	16	-	.015	.015	-
[Covering on minor flat, pitched or curved surfaces]	20	.040	.018	.018	-
[Downspouts and leaders]	16	.032	.015	.015	24
[Downspout clips and anchors]	-	.040 clip .125 anchor	-	-	-
[Downspout straps, 2-inch]	48 (a)	.060	.050	-	-
[Conductor heads]	16	.032	.015	.015	-
[Scupper lining]	20	.032	.015	.015	-
[Strainers, wire diameter or gage]	No. 9 gage	.144 diameter	.109 diameter	-	
[Flashings:]					
[Base]	20	.040	.018	.018	24
[Cap (Counter-flashing)]	16	.032	.015	.015	26
[Eave]	16	-	.015	.015	24
[Spandrel beam]	10	-	.010	.010	-
[Bond barrier]	16	-	.015	.015	-
[Stepped]	16	.032	.015	.015	-
[Valley]	16	.032	.015	.015	-

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	[Copper kilograms per square foot]	[Aluminum, inch]	[Stainless Steel, inch]	[Terne-Coated Stainless Steel, inch]	[Zinc-Coated Steel, U.S. Std. Gage]
[Roof drain]	16 (b)				
[Pipe vent sleave (d)]					
[Coping]	16	-	-	-	-
[Gravel stops and fascia:]					
[Extrusions]	-	.075	-	-	-
[Sheets, corrugated]	16	.032	.015	.015	-
[Sheets, smooth]	20	.050	.018	.018	24
[Edge strip]	24	.050	.025	-	-
[Gutters:]					
[Gutter section]	16	.032	.015	.015	24
[Continuous cleat]	16	.032	.015	.015	24
[Hangers, dimensions]	1 inch by 1/8 inch (a)	1 inch by .(inch (c)	1 inch by .0 inch	-	-
[Joint Cover plates (See Table II)]	16	.032	.015	.015	24
[Reglets (c)]	10	-	.010	.010	-
[Splash pans]	16	.040	.018	.018	-
(a) Brass.					
(b) May be lead weighing 4 pounds per square foot.					
(c) May be polyvinyl chloride.					

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	[Copper kilograms per square foot]	[Aluminum, inch]	[Stainless Steel, inch]	[Terne-Coated Stainless Steel, inch]	[Zinc-Coated Steel, U.S. Std. Gage]
(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph SINGLE PIPE VENTS for optional material.					

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	30 mm single lock, standing seam, cleated	30 mm single lock, standing	--
Flashings			
Base	25 mm 75 mm lap for expansion joint	25 mm flat locked, soldered; sealed; 75 mm lap for expansion joint	Aluminum manufacturer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound.
Cap-in reglet	75 mm lap	75 mm lap	Seal groove with joint sealing compound.

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Reglets	Butt joint	--	Seal reglet groove with joint sealing compound.
Eave	25 mm flat locked, cleated. 25 mm loose locked, sealed expansion joint, cleated.	25 mm flat locked, locked, cleated 25 mm loose locked, sealed expansion joints, cleated	Same as base flashing.
Stepped	75 mm lap	75 mm lap	--
Valley	150 mm lap cleated	150 mm lap cleated	--
Edge strip	Butt	Butt	--
Gravel stops:			
Extrusions	--	Butt with 13 mm space	Use sheet flashing beneath and a cover plate
Sheet, smooth	Butt with 6 mm space	Butt with 6 mm space	Use sheet flashing backup plate.
Sheet, corrugated	Butt with 6 mm space	Butt with 6 mm space	Use sheet flashing beneath and a cover plate or a combination unit
Gutters	40 mm lap, riveted and soldered	25 mm flat locked riveted and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.
(a) Provide a 75 mm lap elastomeric flashing with manufacturer's recommended sealant.			
(b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant.			

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	1.25 inch single lock, standing seam, cleated	1.25 inch single lock, standing	--
Flashings			
Base	One inch 3 inch lap for expansion joint	One inch flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum manufacturer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound.
Cap-in reglet	3 inch lap	3 inch lap	Seal groove with joint sealing compound.
Reglets	Butt joint	--	Seal reglet groove with joint sealing compound.
Eave	One inch flat locked, cleated. One inch loose locked, sealed expansion joint, cleated.	One inch flat locked, locked, cleated one inch loose locked, sealed expansion joints, cleated	Same as base flashing.
Stepped	3 inch lap	3 inch lap	--
Valley	6 inch lap cleated	6 inch lap cleated	--
Edge strip	Butt	Butt	--
Gravel stops:			

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Extrusions	--	Butt with 1/2 inch space	Use sheet flashing beneath and a cover plate
Sheet, smooth	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing backup plate.
Sheet, corrugated	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing beneath and a cover plate or a combination unit
Gutters	1.5 inch lap, riveted and soldered	One inch flat locked riveted and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.
(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.			
(b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant.			

] -- End of Section --