

SECTION 07 60 00

FLASHING AND SHEET METAL  
05/17

PART 1 GENERAL

1.1 REFERENCES

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.

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS A 6021	(2011) Liquid-applied Compounds for Waterproofing Membrane Coatings of Buildings
JIS G 3302	(2022) Hot Dip Zinc Coated Steel Sheet and Strip
JIS H 3100	(2018) Copper and Copper Alloy Sheets, Plates and Strips
JIS G 4305	(2015) Cold-Rolled Stainless Steel Plate, Sheet and Strip (Amendment 1)
JIS H 4000	(2017) Aluminium and Aluminium Alloy Sheets, Strips and Plates (Amendment 1)
JIS H 4040	(2015) Aluminum and Aluminum Alloy Bars and Wires
JIS K 2208	(2009) Asphalt Emulsion
JIS K 5602	(2008) Determination of Reflectance of Solar Radiation by Paint Film
JIS K 5675	(2008) High Solar Reflectance Paint for Roof
JIS K 6720	(2008) Plastics-Vinyl Chloride Homopolymers and Copolymers (PVC)
JIS Z 3282	(2017) Solder-Chemical Composition and Shape
JIS Z 3604	(2016) Inert Gas Arc Welding Standard for Aluminum

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. 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[, [\_\_\_\_\_]]

Scuppers; G[, [\_\_\_\_\_]]

Copings; G[, [\_\_\_\_\_]]

Drip Edges; G[, [\_\_\_\_\_]]

Conductor Heads; G[, [\_\_\_\_\_]]

Open Valley Flashing; G[, [\_\_\_\_\_]]

Eave Flashing; 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

Do not use lead, lead-coated metal, or galvanized steel. 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 lengths. Single pieces less than 2400 mm 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 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 JIS H 3100, cold-rolled temper (standard).

#### 2.2.4 Lead Sheet

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

#### 2.2.5 Steel Sheet, Zinc-Coated (Galvanized)

Provide in accordance with JIS G 3302.

#### 2.2.6 Zinc Sheet and Strip

Provide a minimum of 0.61 mm thick.

#### 2.2.7 Stainless Steel

Provide in accordance with JIS G 4305, SUS302, 304 or SUS304, 2D Finish, fully annealed, dead-soft temper.

#### 2.2.8 Terne-Coated Steel

Provide a minimum of 350 by 500 mm with minimum of 18 kilogram coating per double base box.

#### 2.2.9 Aluminum Alloy Sheet and Plate

Provide in accordance with JIS H 4000 [anodized [clear] [color [\_\_\_\_][\_\_\_\_]]] form alloy, and temper appropriate for use. Provide material not less than[ 0.813 mm][ 1.651 mm] in thickness.

##### [2.2.9.1 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

##### ]2.2.10 Finishes

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. 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.

#### 2.2.11 Cool Roof Finishes

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

##### 2.2.11.1 JIS K 5602 and JIS K 5675

Provide roof finishes having minimum initial solar reflectance of [40][50] when tested in accordance with JIS K 5602 and JIS K 5675.

#### 2.2.12 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

JIS H 4040.

#### 2.2.13 Solder

Provide in accordance with JIS Z 3282, 95-5 tin-antimony.

#### 2.2.14 Reglets

##### 2.2.14.1 Polyvinyl Chloride Reglets

Provide in accordance with JIS K 6720, 1.9 mm minimum thickness.

##### 2.2.14.2 Metal Reglets

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

###### 2.2.14.2.1 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.

###### 2.2.14.2.2 Friction Reglets

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

#### 2.2.15 Scuppers

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

#### 2.2.16 Conductor Heads

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

#### 2.2.17 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 with metal ribs across bottoms of pans. Provide sides of pans with vertical baffles not less than 25 mm high in the front, and 100 mm high in the back.

#### 2.2.18 Copings

Unless otherwise indicated, provide copings in copper sheets, 2400 or 3000 mm long, joined by a 20 mm locked and soldered seam.

#### 2.2.19 Bituminous Plastic Cement

Provide in accordance with JIS A 6021.

#### 2.2.20 Roofing Felt

Provide in accordance with A6005 [Asphalt Felt] or [Asphalt Roofing].

#### 2.2.21 Asphalt Primer

Provide in accordance with JIS K 2208.

#### 2.2.22 Fasteners

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

##### 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 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 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 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, and use flat-seam method when rise is one in four 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. Then install 50 by 75 mm cleats spaced 300 mm apart by fastening one end of each cleat to roof with two 25 mm 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 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 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.

#### ] [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 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 wide, hooked over 20 mm upturned edges of sheets, and nail to roof deck with two 25 mm 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, and secure each length to roof deck by cleats spaced 300 mm 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.

#### ] 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 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. 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

Confine nailing of sheet metal generally to sheet metal having a maximum width of 450 mm. Confine nailing of flashing to one edge only. Space nails evenly not over 75 mm on center and approximately 13 mm 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 and over in width. Space cleats evenly not over 300 mm on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 50 mm wide by 75 mm 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 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 wide.

#### 3.1.6.2 Lap Seams

Finish soldered seams not less than 25 mm wide. Overlap seams not soldered, not less than 75 mm.

#### 3.1.6.3 Loose-Lock Expansion Seams

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

#### 3.1.6.4 Standing Seams

Not less than 25 mm 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 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 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. Aluminum 1.0 mm 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 JIS Z 3604.

#### 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 maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 50 mm 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

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 intervals for aluminum and at not more than 12 meter 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 apart.

#### 3.1.11 Base Flashing

[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 and not less than 100 mm 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. Overlap the flashing strips [or shingles] with the previously laid flashing not less than 75 mm. 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 on center with [large headed aluminum roofing nails] [hex headed, galvanized shielded screws] a minimum of 150 mm 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 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 above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 75 mm. Fold the exposed edges of counterflashings 13 mm. Where stepped counterflashings are required, they may be installed in short lengths a minimum [200 mm by 200 mm][200 mm by 250 mm] or may be of the preformed single piece type. Provide end laps in counterflashings not less than 75 mm and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 3000 mm. Form flashings to the required shapes before installation. Factory form corners not less than 300 mm from the angle. Secure the flashings in the reglets with lead wedges and space not more than 450 mm 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 and extend not less than 50 mm 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 and a minimum depth of 30 mm, when installed.

#### 3.1.13.1 Caulked Reglets

Wedge flashing in reglets with lead wedges every 450 mm, 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 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

Prefabricate in the shapes and sizes indicated and in lengths not less than 2400 mm. Extend flange at least 100 mm 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 long spaced not more than 75 mm on center, in two staggered rows.

##### 3.1.15.1 Edge Strip

Hook the lower edge of fascia at least 20 mm 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 maximum on center. Where fastening is made to concrete or masonry, use screws spaced 300 mm 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 thick compatible spacer or washers.

##### 3.1.15.2 Joints

Leave open the section ends of gravel stops and fascia 6 mm and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 100 mm 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 and secure with compatible nails spaced not more than 250 mm on center along upper edge.

### 3.1.17 Gutters

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 of material compatible with gutter. Fabricate gutters in sections not less than 2400 mm. Lap the sections a minimum of 25 mm in the direction of flow or provide with concealed splice plate 150 mm 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 on center] [as indicated] [by continuous cleats] [and] [or] [by cleats spaced not less than 900 mm 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

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 lengths. Provide end joints to telescope not less than 13 mm 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 away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 1500 mm 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 square sheet indicated. Taper insulation to drain from 600 mm out. Set flashing on finished felts in a full bed of asphalt roof cement. 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.

### 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 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 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 wide to form a continuous surface. Bend the rear flange of the pan to contour of can't strip and extend up 150 mm 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 under the roof covering on each side. Provide a 13 mm fold on each side of the valley flashing. Lap the sheets not less than 150 mm 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 on center. Provide exposed flashing not less than 100 mm in width at the top and increase 25 mm in width for each additional 2400 mm in length. Where the slope of the valley is one in 2.67 or less, or the intersecting roofs are on different slopes, provide an inverted V-joint, 25 mm high, along the centerline of the valley; and extend the edge of the valley sheets 200 mm 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 lengths with expansion joints spaced as specified in paragraph EXPANSION AND CONTRACTION. Provide a 20 mm continuous fold in the upper edge of the sheet to engage cleats spaced not more than 250 mm on center. Locate the upper edge of flashing not less than 450 mm 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 flat locked joints with cleats that are 250 mm 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. 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

Provide expansion joints for roofs, walls, and floors as [specified] [indicated]. Provide [expansion joints in continuous sheet metal at [12 meter intervals for copper and stainless steel] [and at 9750 mm intervals for aluminum], [aluminum gravel stops and fascia which must have expansion joints at not more than 3600 mm 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 for flashing on one side of the expansion joint and be less than the width of the expansion joint plus 25 mm 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

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 on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 50 mm. 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 roof flange in bituminous plastic cement and nailed 75 mm on center. Extend sleeve a minimum of 200 mm above the roof deck and lapped a minimum of 75 mm 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

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.

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	-
[Roof drain]	4.9 (b)				



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]
[Pipe vent sleeve (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 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.
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:			

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 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.			

] -- End of Section --