
USACE / NAVFAC / AFCEA UFGS-07611N (September 1999)

Preparing Activity: NAVFAC Replacing without revision
NFGS of same number and date

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 22 December 2004

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07611N

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09/99

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SECTION 07611N

STEEL STANDING SEAM ROOFING 09/99

NOTE: This guide specification covers the requirements for steel standing seam roofing.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

NOTE: This guide specification is primarily for Structural Standing Seam Metal Roofing Systems (SSMRS), i.e. Self-Supporting Systems designed to span from purlin to purlin at slopes as low as one in 48 1/4 inch per foot versus architectural cladding systems that require continuous support, secondary moisture protection and slopes no less than one in four 3 inches per foot. Structural systems may be used for architectural applications whereas architectural systems cannot be used for structural applications. If an SSMRS system is desired primarily for architectural purposes use Section 07410N METAL ROOF AND WALL PANELS; otherwise use this section.

NOTE: On the drawings, show:

1. Roof slope

2. Supporting structural framework.
3. Intermediate support and attachment details, when applicable.
4. Attachment clip spacing.
5. Flashing support and fastening spacing.
6. Roof venting. (Pay particular attention to preventing infiltration of wind-driven rain.)
7. Sealant and closure locations.
8. Locations for dissimilar metal protection.
9. Details of accessories such as ladders, walkways, antenna mounts, guy wire fastening, ventilation equipment, and lightning rods.
10. Details of flashing at all roof penetrations. On roof plan add note to offset penetrations so center of penetrations coincide with mid-point of panel seams.
11. Design loads including stress diagram.

NOTE: When designing standing seam roofs, consider:

1. Consult with manufacturers early in design stage to obtain current manuals, specific guidance, and structural information regarding roof attachment. Early contact will reduce need for corrections and changes during review process and construction phase. Ensure that system detailed and specified can be provided by three separate manufacturers.
2. Calculate wind uplift forces in accordance with Unified Facilities Criteria (UFC) 1-200-01 Design: General Building Requirements. Submit calculations and stress diagram with design review package.
3. NAVFAC minimum guidelines are one in 24 one-half inch per foot for roof slopes. Provide greater slope if possible. In renovation of existing buildings, adequate slope must often be obtained by imaginative solutions. Prefabricated steel systems, sleepers, and stub walls have been used successfully, but attachment and structural stability of these must be assured. In some existing structures it will be difficult to design strong connections to structural system unless modifications are made to resist wind forces adequately.
4. Flashing presents a particular design problem in preventing wind and water infiltration. High winds

and thermal movement create stresses in flashing which must be resisted by careful detailing of attachment.

While standing seam roofing presents continuous, sealed surface to the elements, flashing transitions are often the cause of serious problems. Overhangs are especially susceptible to high wind forces, and attachment at the edges should be carefully designed. Copious use of sealants and closure pieces molded to conform to the roof panels is imperative.

5. Building may require equipment such as antennae, ladders or lightning rods installed on roof. Access to roof-mounted mechanical equipment is often required. Provide walking surfaces and attachment accessories which do not compromise integrity of roof system. These accessories should provide support without penetrating roofing panels. Usually this is done with clamps attached to standing seam, or specially designed clips. Provide curbs or structural supports for mechanical equipment. Where condensate or other piping will be attached to or come in contact with roofing panels, ensure that the piping and anchorage materials are compatible with roof panel base metal to avoid corrosion from galvanic action. Ensure that condensate or other discharge of liquid onto roof panels will not stain or corrode panel finish and/or base metal.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

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 IRON AND STEEL INSTITUTE (AISI)

AISI SG-973 (1996) Cold-Formed Steel Design Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M (2004) Carbon Structural Steel

ASTM A 366/A 366M (1997e1) Commercial Steel, Sheet, Carbon, (0.15 Maximum Percent Cold-Rolled**

ASTM A 570/A 570M	(1998) Steel, Sheet and Strip, Carbon, Hot-Rolled
ASTM A 607	(1998) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
ASTM A 653/A 653M	(2004a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(2003) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 117	(2002) Operating Salt Spray (Fog) Apparatus
ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(2002e1) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Specular Gloss
ASTM D 714	(2002) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993; R 2001) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	(2001) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 84	(2004) Surface Burning Characteristics of Building Materials
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

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

SMACNA Arch. Manual

(2003, 6th Ed) Architectural Sheet Metal
Manual

1.2 DEFINITIONS

1.2.1 Field-Formed Seam

Seams of panels so configured that when adjacent sheets are installed the seam is sealed utilizing mechanical or hand seamers. Crimped (45 degree bend), roll formed (180 degree bend), double roll formed (2 - 180 degree bends), and roll and lock systems are types of field-formed seam systems.

1.2.2 Snap Together Seam

Panels so configured that the male and female portions of the seam interlock through the application of foot pressure or tamping with a mallet. Snap-on cap configurations are a type of snap together system.

1.2.3 Pre-Formed

Formed to the final, less field-formed seam, profile and configuration in the factory.

1.2.4 Field-Formed

Formed to the final, less field-formed seam, profile and configuration at the site of work prior to installation.

1.2.5 Roofing System

The roofing system is defined as the assembly of roofing components, including roofing panels, flashing, fasteners, and accessories which, when assembled properly result in a watertight installation.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

- a. Panels shall be continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets shall be in continuous contact from eave to ridge. Individual panels of snap together type systems shall be removable for replacement of damaged material.
- b. There shall be no exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel shall be stainless steel, zinc cast head, or cadmium plated steel screws inserted into predrilled holes. There shall be a minimum of two fasteners per clip. Single fasteners will be allowed when supporting structural members are prepunched or predrilled.
- c. Snap together type systems shall have a capillary break and a positive side lap locking device. Field-formed seam type systems shall be mechanically locked closed by the manufacturer's locking tool. The seam shall include a continuous factory applied sealant

when required by the manufacturer to withstand the wind loads specified.

- d. Roof panel anchor clips shall be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement.

1.3.2 Design Conditions

The system shall be designed to resist positive and negative loads specified herein in accordance with the AISI SG-973. Panels shall support walking loads without permanent distortion or telegraphing of the structural supports.

1.3.2.1 Wind Uplift

NOTE: Determine appropriate pressures that apply to various portions of roof using MIL-HDBK 1002/2 for structural design and wind load information. Use criteria of local building code when their provisions exceed NAVFAC/AF criteria. Insert calculated pressures in table; regardless of calculated value, use 2.25 kPa 45 psf minimum for Class 90 systems.

The design uplift pressures for the roof system shall be computed and applied using a basic wind speed of [_____] kilometers per hour (km/h) miles per hour (mph). Roof system and attachments shall resist the following wind loads, in kilopascals (kPa) pounds per square foot (psf):

	<u>Negative</u>
a. At eaves	[_____]
b. At rakes	[_____]
c. At ridge	[_____]
d. At building corners	[_____]
e. At central areas	[_____]

The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly, and multiplied by the appropriate factor of safety, as follows:

- a. Single fastener in a connection: 3.0
- b. Two or more fasteners in each connection: 2.25

1.3.2.2 Roof Live Loads

NOTE: Refer to MIL-HDBK 1002/2 for additional

requirements.

Loads shall be applied on the horizontal projection of the roof structure. The minimum roof design live load shall be one kPa 20 psf.

1.3.2.3 Thermal Movement

NOTE: Insert design low temperature for the project location as obtained from Joint Services Manual NAVFAC P-89, TM5-785, AFM 88-29, "Engineering Weather Data." Select first bracketed option for unpainted finish and light colors, select second bracketed option for dark colors.

System shall be capable of withstanding thermal movement based on a temperature range of 5 degrees C 10 degrees F below [_____] degrees C F and [60 degrees C 140 degrees F.] [80 degrees C 180 degrees F.]

1.3.2.4 Deflection

Panels shall be capable of supporting design loads between unsupported spans with deflection of not greater than L/180 of the span.

1.3.3 Structural Performance

NOTE: Full scale testing is required to certify the adequacy of the SSMRS. Once a SSMRS is certified for a specific loading condition, that certification may be used for future projects.

The structural performance test methods and requirements of the Standing Seam Roofing Systems (SSRS) shall be in accordance with ASTM E 1592.

1.4 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G"

designation 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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing; G

Submit roofing drawings to supplement the instructions and diagrams. Drawings shall include design and erection drawings containing an isometric view of the roof showing the design uplift pressures and dimensions of edge, ridge and corner zones; and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation shall be in accordance with the manufacturer's Standard Instructions and details or the SMACNA Arch. Manual. Prior to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

SD-03 Product Data

Roofing panels; G

Attachment clips

Closures

Accessories

Fasteners

Sealants

[Insulation, including joint sealing measures for vapor barrier facing]

Sample warranty certificate; G

Submit for materials to be provided. Submit data sufficient to indicate conformance to specified requirements.

SD-04 Samples

Roofing panel

Submit a 300 mm 12 inch long by full width section of typical panel.

[For color selection, submit 50 by 100 mm 2 by 4 inch metal samples in color, finish and texture [specified] [selected]. [When colors are not indicated, submit samples of not less than six different manufacturer's standard colors for selection.]]

Accessories

Submit each type of accessory item used in the project including, but not limited to each type of anchor clip, closure, fastener, and leg clamp.

Sealants

Intermediate Support Section

Submit full size samples of each intermediate support section, 300 mm 12 inches long.

SD-05 Design Data

Design calculations

SD-06 Test Reports

Field Inspection; G

Submit manufacturer's technical representative's field inspection reports as specified in paragraph entitled "Manufacturer's Field Inspection."

NOTE: This paragraph requires certified test reports for structural and finish tests. If there is reason to require a factory test report for other tests, modify this paragraph accordingly.

Structural performance tests

Finish tests

SD-07 Certificates

Manufacturer's Technical Representative's Qualifications

Statement of Installer's Qualifications

Submit documentation from roofing manufacturer proving the

manufacturer's technical representative meets below specified requirements. Include name, address, telephone number, and experience record.

Submit documentation proving the installer is factory-trained, has the specified experience, and authorized by the manufacturer to install the products specified.

[Coil stock compatibility; G

Provide certification of coil compatibility with roll forming machinery to be used for forming panels without warping, waviness, and rippling not part of panel profile; to be done without damage, abrasion or marking of finish coating.]

SD-08 Manufacturer's Instructions

Installation manual; G

Submit manufacturers printed installation manual, instructions, and standard details.

SD-11 Closeout Submittals

Information card

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

1.5 DESIGN CALCULATIONS

**NOTE: Ensure that appropriate design loads are
specified in paragraph "Wind Uplift."**

Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated. Coordinate calculations with manufacturer's test results. Include calculations for:

Wind load uplift design pressure at roof locations specified in paragraph entitled "Wind Uplift."

Clip spacing and allowable load per clip.

Fastening of clips to structure or intermediate supports.

Intermediate support spacing and framing and fastening to structure when required.

Allowable panel span at anchorage spacing indicated.

Safety factor used in design loading.

Governing code requirements or criteria.

Edge and termination details.

1.6 QUALITY ASSURANCE

1.6.1 Preroofing Conference

NOTE: Consult with the Contracting Officer responsible for construction of the project to determine who should conduct the conference. For SOUTHNAVFACENGCOM administered projects, delete the option of Contractor conducting the conference and delete the last sentence.

After submittals are received and approved but before roofing [and insulation] work, including associated work, is preformed, the [Contracting Officer will] [Contractor shall] hold a preroofing conference to review the following:

- a. The drawings and specifications
- b. Procedure for on site inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system
- c. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing
- d. Safety requirements

The preroofing conference shall be attended by the Contractor and personnel directly responsible for the roofing [and insulation] installation, [[mechanical] [and] [electrical] work], and the roofing manufacturer's technical representative. Conflicts among those attending the preroofing conference shall be resolved and confirmed in writing before roofing work, including associated work, is begun. [Prepare written minutes of the preroofing conference and submit to the Contracting Officer.]

1.6.2 Manufacturer

The SSMRS shall be the product of a metal roofing industry - recognized manufacturer who has been in the practice of manufacturing SSMRS for a period of not less than 5 years and who has been involved in at least 5 projects similar in size and complexity to this project.

1.6.3 Manufacturer's Technical Representative

The representative shall have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place. The manufacturer's representative shall be an employee of the manufacturer with at least 5 years experience in installing the roof system. The representative shall be available to perform field inspections and attend meetings as required herein, and as requested by the Contracting Officer.

1.6.4 Installer's Qualifications

The roofing system installer shall be factory-trained, approved by the

metal roofing system manufacturer to install the system, and shall have a minimum of three years experience as an approved applicator with that manufacturer. The applicator shall have applied five installations of similar size and scope as this project within the previous 3 years.

1.6.5 Single Source

Roofing panels, clips, closures, and other accessories shall be standard products of the same manufacturer; shall be the latest design by the manufacturer; and shall have been designed by the manufacturer to operate as a complete system for the intended use.

1.6.6 Laboratory Tests For Panel Finish

The term "appearance of base metal" refers to the metal coating on steel. Panels shall meet the following test requirements:

- a. Formability Test: When subjected to a 180 degree bend over a 3 mm 1/8 inch diameter mandrel in accordance with ASTM D 522, exterior coating film shall show only slight microchecking and no loss of adhesion.
- b. Accelerated Weathering Test: Withstand a weathering test for a minimum of 2000 hours in accordance with ASTM G 23, Method 1 without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with a penknife blade or similar instrument shall be considered to indicate loss of adhesion.
- c. Chalking Resistance: After the 2000-hour weatherometer test, exterior coating shall not chalk greater than No. 8 rating when measured in accordance with ASTM D 4214 test procedures.
- d. Color Change Test:

NOTE: In general, only colors such as white, beige, and tan will not exceed the 2 NBS units requirement. To allow for heavier pigmented colors, specify color change not to exceed 5 NBS units for a 3000-hour weatherometer test.

After the [2000] [____]-hour weatherometer test, exterior coating color change shall not exceed [2] [____] NBS units when measured in accordance with ASTM D 2244 test procedure.

NOTE: For projects located in high temperature and humidity or corrosive atmospheres or where premium finish would be justified, use:

Salt spray test: Rating of 10, no blisters in field
Rating of 7, 2 mm 1/16 inch edge creep

Abrasion Resistance Test: 100 liters

- e. Salt Spray Test: Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of [8, few blisters] [10, no blisters] in field as determined by ASTM D 714; and an average rating of [6, 3 mm] [7, 2 mm] [6, 1/8 inch] [7, 1/16 inch] failure at scribe, as determined by ASTM D 1654. Rating Schedule No. 1.
- f. Abrasion Resistance Test for Color Coating: When subjected to the falling sand test in accordance with ASTM D 968, coating system shall withstand a minimum of [50] [100] [_____] liters of sand per mil thickness before appearance of base metal.
- g. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage, or corrosion.
- h. Gloss Test: The gloss of the finish shall be 30 plus or minus 5 at an angle of 60 degrees, when measured in accordance with ASTM D 523.

[i. Glare Resistance Test:

NOTE: The requirements for glare resistance should be included only when specifically required by the facility for critical glare areas such as control towers or other structures where glare can be an operational hazard. Refer to MIL-HDBK-1028/1, "Aircraft Maintenance Facilities," for assistance in determining critical glare areas. Delete gloss test above if this paragraph is included.

Surfaces of panels that will be exposed to the exterior shall have a specular reflectance of not more than 10 when measured in accordance with ASTM D 523 at an angle of 85 degrees. Specular reflectance may be obtained with striations or embossing. Requirements specified under "Formability Test" will be waived if necessary to conform to this requirement.]

1.7 WARRANTY

NOTE: This warranty paragraph may be used with this guide specification without special authorization.

Furnish manufacturer's no-dollar-limit materials and workmanship warranty for the roofing system. The warranty period shall be not less than 20 years from the date of Government acceptance of the work. The warranty shall be issued directly to the Government. The warranty shall provide that if within the warranty period the metal roofing system becomes non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the roofing system resulting from defective materials or installed workmanship the repair or replacement of the defective materials and correction of the defective workmanship shall be the responsibility of the roofing system manufacturer. Repairs that

become necessary because of defective materials and workmanship while roofing is under warranty shall be performed within 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time will constitute grounds for having the repairs performed by others and the cost billed to the manufacturer. The Contractor shall also provide a 2 year contractor installation warranty.

1.8 DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle preformed panels, bulk roofing products and other manufactured items in a manner to prevent damage or deformation.

1.8.1 Delivery

Provide adequate packaging to protect materials during shipment. Crated materials shall not be uncrated until ready for use, except for inspection. Immediately upon arrival of materials at the jobsite, inspect materials for damage, dampness, and staining. Damaged or permanently stained materials that cannot be restored to like-new condition shall be replaced with satisfactory material. If materials are wet, remove the moisture and re-stack and protect the panels until used.

1.8.2 Storage

Stack materials on platforms or pallets and cover with tarpaulins or other suitable weathertight covering which prevents water trapping or condensation. Store materials so that water which might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining, such as mud, lime, cement, fresh concrete or chemicals. Protect stored panels from wind damage.

1.8.3 Handling

Handle material carefully to avoid damage to surfaces, edges and ends.

PART 2 PRODUCTS

2.1 ROOFING PANELS

Panels shall have interlocking ribs for securing adjacent sheets. System for securing the roof covering to structural framing members shall be concealed clip fastening system with no fasteners penetrating the panels except at the ridge or eave, rakes, penetrations, and end laps. Backing plates and ends of panels at end laps shall be predrilled or prepunched; factory prepare ends of panels to be lapped by trimming part of seam, die-setting or swaging ends of panels. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope when such slope is 9 meters 30 feet or less. When length of run exceeds 9 meters 30 feet, each sheet in the run shall extend over two or more spans. Sheets longer than 9 meters 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide not less than 300 mm 12 inches of coverage in place. Height of corrugations of adjacent roof sheets shall be not less than [45] [57] [76] mm [1.75] [2.25] [3.0] inches (nominal). Make provisions for expansion and contraction at either ridge or eave, consistent with the type of system to be used. Panels from coil stock shall be formed without warping, waviness or ripples not part of the panel profile and shall be free of damage to the finish coating system.

2.1.1 Material

Zinc-coated steel conforming to ASTM A 653/A 653M, Z275 G90 coating designation or aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 165 AZ 55 coating. Minimum thickness to be 0.6 mm 0.023 inch thick (24 gage) minimum except when mid field of roof is subject to design wind uplift pressures of 3 kPa 60 psf or greater, entire roof system shall have a minimum thickness of 0.8 mm 0.030 inch (22 gage). [Prior to shipment, treat mill finish panels with a passivating chemical and oil to inhibit the formation of oxide corrosion products. Dry, retreat, and re-oil panels that have become wet during shipment or storage but have not started to oxidize.]

2.1.2 Texture

NOTE: Stucco embossing is a mechanical process that imparts some structural strength to the steel and reduces the visual effect of oil-canning. Embossed texture is slightly more expensive than smooth texture but should be considered for use on high visibility projects.

[Stucco embossed.] [Smooth.] [Smooth with raised intermediate ribs for added stiffness.]

2.1.3 Finish

NOTE: Choose finish appropriate for the project. In general, hangars, warehouses, and other utilitarian structures may use unpainted finish to reduce cost. ASTM A 792/A 792M (Galvalume) should be specified only for corrosive environments when unpainted finish is required. Delete paragraph "Laboratory Tests for Panel Finish" and reference to finishes when unpainted finish is specified. Some paint colors are substantially more costly than others, due to scarcity of pigments.

[Unpainted] [Factory color finish].

[2.1.3.1 Factory Color Finish

NOTE: Provide clear edge coating on all metal panels for projects within the salt spray area of the ocean (within 300 feet of the water).

NOTE: Check with the facility regarding color selection. Use only manufacturer's standard colors. Delete this subparagraph if unpainted finish has been selected. Specify 0.050 mm 0.2 mil prime coat if undersides of panels are to be field painted, the

same coating as exterior if undersides of panels are
to be exposed and a premium coating is desired,
otherwise use 0.0125 mm 0.5 milwash coat.

Provide factory applied, thermally cured coating to exterior and interior of metal roof and wall panels and metal accessories. Provide exterior finish top coat of [70 percent resin polyvinylidene fluoride][] with not less than [0.005 mm][0.020 mm][] [0.2 mil][0.8 mil][] dry film thickness. Provide exterior primer [standard with panel manufacturer][] with not less than [0.005 mm][0.020 mm] [0.2 mil][0.8 mil] dry film thickness. Interior finish shall consist of [[0.005 mm][0.2 mil]dry film thickness prime coat][[0.0125 mm][0.5 mil] dry film thickness backer coat][the same coating and dry film thickness as the exterior coating][]. Provide exterior [and interior]coating meeting test requirements specified below. Tests shall have been performed ohn same factory finish and thickness provided. [Provide clear factory edge coating on all factory cut or unfinished edges.]

]2.2 INTERMEDIATE SUPPORTS

Fabricate panel subgirts, subpurlins, T-bars, Z-bars and tracks from galvanized steel conforming to ASTM A 653/A 653M, Z275 G90, Grade D (1.6 mm thick 16 gage and heavier), Grade A (1.3 mm thick 18 gage and lighter); or steel conforming to ASTM A 36/A 36M, ASTM A 570/A 570M , or ASTM A 607 prime painted with zinc-rich primer. Size, shape, thickness and capacity as required to meet the load[, insulation thickness] and deflection criteria specified.

2.3 ATTACHMENT CLIPS

Fabricate clips from ASTM A 366/A 366M, ASTM A 570/A 570M, or ASTM A 607 steel hot-dip galvanized in accordance with ASTM A 653/A 653M, Z275 G 90, or Series 300 stainless steel. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

2.4 ACCESSORIES

Sheet metal flashings, [gutters,] [downspouts,] trim, moldings, closure strips, pre-formed crickets, caps, equipment curbs, and other similar sheet metal accessories used in conjunction with preformed metal panels shall be of the same material as used for the panels. Provide metal accessories with a factory color finish to match the roofing panels, except that such items which will be concealed after installation may be provided without the finish if they are stainless steel. Metal shall be of a thickness not less than that used for the panels. Thermal spacer blocks and other thermal barriers at concealed clip fasteners shall be as recommended by the manufacturer except that wood spacer blocks are not allowed.

2.4.1 Closures

2.4.1.1 Rib Closures

Corrosion resisting steel, closed-cell or solid-cell synthetic rubber, neoprene or polyvinyl chloride pre-molded to match configuration of rib opening. Material for closures shall not absorb water.

2.4.1.2 Ridge Closures

Metal-clad foam or metal closure with foam secondary closure matching panel configuration for installation on surface of roof panel between panel ribs at ridge and headwall roof panel flashing conditions and terminations. Foam material shall not absorb water.

2.4.2 Fasteners

Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Design the fastening system to withstand the design loads specified. Exposed fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the penetration. Washer material shall be compatible with the covering; have a minimum diameter of 10 mm 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 3 mm 1/8 inch thick.

2.4.2.1 Screws

Not smaller than 4.75 mm No. 14 diameter if self-tapping type and not smaller than 4 mm No. 12 diameter if self-drilling and self-tapping.

2.4.2.2 Bolts

Not smaller than 6 mm 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.4.2.3 Automatic End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not smaller than 5 mm 3/16 inch and cap or nut for holding covering against the shoulder.

2.4.2.4 Explosive Driven Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not smaller than 4 mm 0.145 inch with a shank length of not smaller than 13 mm 1/2 inch for fastening to steel and not smaller than 25 mm one inch for fastening to concrete.

2.4.2.5 Rivets

Blind rivets shall be stainless steel with 3 mm 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

2.4.3 Sealants

Elastomeric type containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant shall be the non-hardening type. Seam sealant shall be factory-applied, non-skinning, non-drying, and shall conform to the roofing manufacturer's recommendations. Silicone-based sealants shall not be used in contact with finished metal panels and components unless approved otherwise by the Contracting Officer.

2.4.4 GASKETS AND INSULATING COMPOUNDS

Nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

[2.5 THERMAL INSULATION

NOTE: Insulation should be included in appropriate section. Most manufacturers recommend batts with minimum thickness of 38 mm 1 1/2 inches for standing seam systems to minimize condensation on underside of roofing sheets and for sound attenuation. Spacer blocks should be required with insulation. 100 mm Four inches (R 25) is the recommended maximum thickness.

Flexible blanket, rigid, or semi-rigid faced with a flexible vapor retarder. Insulation and facing shall have a flame-spread rating of 50 or less in accordance with ASTM E 84. Vapor retarder facing shall have a permeance rating of 0.05 perm or less. Provide a thermal resistance "R" value of [_____] or more. [Exposed insulation shall have a white nondusting and nonshedding finish.] Facings [and finishes] shall be factory-applied.

] 2.6 UNDERLAYMENT FOR WOOD SUBSTRATES

NOTE: Include this article where roof coverings are applied to wood decks.

ASTM D 226, Type I perforated, covered by water-resistant rosin sized building paper.

] 2.7 LINER PANELS

Fabricate liner panels of the same material as roof panels, and formed or patterned to prevent waviness and distortion. Liner panels shall have a factory applied, one mil thick minimum painted coating on the inside face and a prime coat on the liner side.

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces to receive standing seam metal roofing and flashing. Ensure that surfaces are plumb and true, clean, even, smooth, as dry and free from defects and projections which might affect the installation.

3.2 PROTECTION FROM CONTACT WITH DISSIMILAR MATERIALS

3.2.1 Cementitious Materials

Paint metal surfaces which will be in contact with mortar, concrete, or other masonry materials with one coat of alkali-resistant coating such as heavy-bodied bituminous paint.

3.2.2 Contact with Wood

Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

NOTE: Include bracketed sentences where roof coverings are applied directly to wood decks.

Install in accordance with the approved manufacturer's erection instructions, shop drawings, and diagrams. Panels shall be in full and firm contact with attachment clips. Where prefinished panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they shall, after necessary repairs have been made with material of the same color as the weather coating, be approved before being installed. Seal completely openings through panels. Correct defects or errors in the materials. Replace materials which cannot be corrected in an approved manner with nondefective materials. Provide molded closure strips where indicated and where necessary to provide weathertight construction. Use shims as required to ensure attachment clip line is true. Use a spacing gage at each row of panels to ensure that panel width is not stretched or shortened. [Provide one layer of asphalt-saturated felt placed perpendicular to roof slope, covered by one layer of rosin-sized building paper placed parallel to roof slope with side laps down slope and attached with roofing nails. Overlap side and end laps 75 mm 3 inches, offset seams in building paper with seams in felt.]

3.3.1 Roof Panels

Apply roofing panels with the standing seams parallel to the slope of the roof. Provide roofing panels in longest practical lengths from ridge to eaves (top to eaves on shed roofs), with no transverse joints except at the junction of ventilators, curbs, skylights, chimneys, and similar openings. Install flashing to assure positive water drainage away from roof penetrations. Locate panel end laps such that fasteners do not engage supports or otherwise restrain the longitudinal thermal movement of panels.

Form field-formed seam type system seams in the field with an automatic mechanical seamer approved by the manufacturer. Attach panels to the structure with concealed clips incorporated into panel seams. Clip attachment shall allow roof to move independently of the structure, except at fixed points as indicated.

[3.3.2 Insulation Installation

NOTE: For applications where permeability is a critical consideration, sealing of the insulation joints or other methods of providing continuity of the vapor retarder shall be specified. Overall roof construction should be reviewed to assure permeability is consistent with requirements specified for the vapor retarder.

Insulation shall be installed between covering and supporting members to present a neat appearance. Fold and staple [and tape] seams unless approved otherwise by the Contracting Officer.

3.3.2.1 Rigid or Semi-Rigid Insulation

Install in areas where insulation is exposed to view. Fasten securely without loose joints or unsightly sags.

3.3.2.2 Blanket Insulation

May be used in concealed locations. Lap facing at joints and fasten in a manner that will provide tight joints.

3.3.3 Flashings

NOTE: In high winds, metal will vibrate and fatigue at fasteners on "normal" spacings. For this reason, cleated (blind fastened) flashings are not acceptable, and attachment at 150 to 200 mm 6 to 8 inches on center is customary. Flashing should not extend any significant distance more than one inch beyond a support or fastener.

Provide flashing, related closures and accessories as indicated and as necessary to provide a weathertight installation. Install flashing to ensure positive water drainage away from roof penetrations. Flash and seal the roof at the ridge, eaves and rakes, and projections through the roof. Place closure strips, flashing, and sealing material in an approved manner that will assure complete weathertightness. Details of installation which are not indicated shall be in accordance with the SMACNA Arch. Manual, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

3.3.4 Flashing Fasteners

Fastener spacings shall be in accordance with the panel manufacturer's recommendations and as necessary to withstand the design loads indicated. Install fasteners in roof valleys as recommended by the manufacturer of the panels. Install fasteners in straight lines within a tolerance of 13 mm 1/2 inch in the length of a bay. Drive exposed penetrating type fasteners normal to the surface and to a uniform depth to seat gasketed washers properly and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered. Do not drill through sealant tape. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners shall not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels.

3.3.5 Rib and Ridge Closure/Closure Strips

Set closure/closure strips in joint sealant material and apply sealant to mating surfaces prior to adding panel.

3.4 PROTECTION OF APPLIED ROOFING

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.5 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, solder or weld marks and damage to the finish coating.

3.6 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative shall visit the site as necessary during the installation process to assure panels, flashings, and other components are being installed in a satisfactory manner. Manufacturer's technical representative shall perform a field inspection during the first [20] [] squares of roof panel installation and at substantial completion prior to issuance of warranty, as a minimum, and as otherwise requested by the Contracting Officer. Additional inspections shall not exceed one for [100] [] squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. Each inspection visit shall include a review of the entire installation to date.

After each inspection, a report, signed by the manufacturer's technical representative, shall be submitted to the Contracting Officer noting the overall quality of work, deficiencies and any other concerns, and recommended corrective actions in detail. Notify Contracting Officer a minimum of 2 working days prior to site visit by manufacturer's technical representative.

3.7 COMPLETED WORK

Completed work shall be plumb and true without oil canning, dents, ripples, abrasion, rust, staining, or other damage detrimental to the performance or aesthetics of the completed roof assembly.

3.8 INFORMATION CARD

NOTE: Include only the applicable EFD.

For each roof, provide a typewritten card, laminated in plastic and framed for interior display or a photoengraved 0.8 mm thick 0.032 inchthick aluminum card for exterior display. Card to be 220 by 280 mm 8 1/2 by 11 inches minimum and contain the information listed on Form 1 at end of this section. Install card near point of access to roof, or where indicated. Send a photostatic paper copy to [EFACHESNAVFACENGCOM, Code 102, Building 212, Washington Navy Yard, Washington, DC 20374-2121] [LANTNAVFACENGCOM, Code 1613, 1510 Gilbert Street, Norfolk, VA 23511-2699] [NORTHNAVFACENGCOM, Code 103A, 10 Industrial Highway, Mail Stop #82, Lester, PA 19113-2090] [PACNAVFACENGCOM, Code 102, Pearl Harbor, HI 96860-7300]

[SOUTHNAVFACENGCOM, Code 0535, P.O. Box 190010, North Charleston, SC 29419-9010] [SOUTHWESTNAVFACENGCOM, Code 133SB, 1220 Pacific Highway, San Diego, CA 92132-5190].

3.9 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of English unit measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The English and metric units for the measurements shown are as follows:

<u>PRODUCTS</u>	<u>ENGLISH UNITS</u>	<u>METRIC UNITS</u>
a. Steel sheets	0.023 inch 0.030 inch	0.6 mm 0.8 mm
b. Gasket washers	3/8 inch 1/8 inch	10 mm 3 mm
c. Screws	No. 14 No. 12	4.75 mm 4 mm
d. Bolts	1/4 inch	6 mm
e. Studs	3/16 inch	5 mm
f. Fasteners	0.145 inch by 1/2 inch One inch	4 mm by 13 mm 25 mm
g. Rivets	1/8 inch	3 mm

3.10 FORM ONE

FORM 1 - PREFORMED STEEL STANDING SEAM ROOFING SYSTEM COMPONENTS

1. Contract Number:
2. Building Number & Location:
3. NAVFAC Specification Number:
4. Deck/Substrate Type:
5. Slopes of Deck/Roof Structure:
6. Insulation Type & Thickness:
7. Insulation Manufacturer:
8. Vapor Retarder: () Yes () No
9. Vapor Retarder Type:
10. Preformed Steel Standing Seam Roofing Description:
 - a. Manufacturer (Name, Address, & Phone No.):
 - b. Product Name:
 - c. Width:
 - d. Gage:
 - e. Base Metal:
 - f. Method of Attachment:
11. Repair of Color Coating:
 - a. Coating Manufacturer (Name, Address & Phone No.):
 - b. Product Name:
 - c. Surface Preparation:
 - d. Recoating Formula:
 - e. Application Method:
12. Statement of Compliance or Exception: _____

13. Date Roof Completed:
14. Warranty Period: From _____ To _____
15. Roofing Contractor (Name & Address):
16. Prime Contractor (Name & Address):
- Contractor's Signature _____ Date:
- Inspector's Signature _____ Date:
-- End of Section --