
USACE / NAVFAC / AFCEA UFGS-07416A (August 2004)

Preparing Activity: USACE Superseding
UFGS-07416A (November 2001)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 22 December 2004

Latest change indicated by CHG tags

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07416A

STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

08/04

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 GENERAL REQUIREMENTS
 - 1.3.1 Structural Standing Seam Metal Roof
 - 1.3.2 Qualifications
 - 1.3.2.1 Manufacturer
 - 1.3.2.2 Installer
- 1.4 DESIGN ANALYSIS
 - 1.4.1 Design Criteria
 - 1.4.2 Dead Loads
 - 1.4.3 Live Loads
 - 1.4.3.1 Concentrated Loads
 - 1.4.3.2 Uniform Loads
 - 1.4.4 Roof Snow Loads
 - 1.4.5 Wind Loads
 - 1.4.6 Thermal Loads
 - 1.4.7 Framing Members Supporting the SSSMR System
 - 1.4.8 Roof Panels Design
 - 1.4.9 Accessories and Their Fasteners
- 1.5 PERFORMANCE REQUIREMENTS
- 1.6 DELIVERY AND STORAGE
- 1.7 WARRANTIES
 - 1.7.1 Contractor's Weathertightness Warranty
 - 1.7.2 Manufacturer's Material Warranties.
- 1.8 COORDINATION MEETING

PART 2 PRODUCTS

- 2.1 ROOF PANELS
 - 2.1.1 Steel Panels
 - 2.1.2 Aluminum Panels
- 2.2 CONCEALED ANCHOR CLIPS

- 2.3 ACCESSORIES
 - 2.4 FASTENERS
 - 2.4.1 Screws
 - 2.4.2 Bolts
 - 2.4.3 Structural Blind Fasteners
 - 2.5 SUBPURLINS
 - 2.6 FACTORY COLOR FINISH
 - 2.6.1 Salt Spray Test
 - 2.6.2 Formability Test
 - 2.6.3 Accelerated Weathering, Chalking Resistance and Color Change
 - 2.6.4 Humidity Test
 - 2.6.5 Impact Resistance
 - 2.6.6 Abrasion Resistance Test
 - 2.6.7 Specular Gloss
 - 2.6.8 Pollution Resistance
 - 2.7 INSULATION
 - 2.7.1 Polyisocyanurate Rigid Board Insulation
 - 2.7.2 Blanket Insulation
 - 2.7.3 Glass Mat Gypsum Roof Board
 - 2.8 INSULATION RETAINERS
 - 2.9 SEALANT
 - 2.10 GASKETS AND INSULATING COMPOUNDS
 - 2.11 VAPOR RETARDER
 - 2.11.1 Vapor Retarders as Integral Facing
 - 2.11.2 Vapor Retarders Separate from Insulation
 - 2.11.3 Slip Sheet for Use With Vapor Retarder
 - 2.12 EPDM RUBBER BOOTS
 - 2.13 PREFABRICATED CURBS AND EQUIPMENT SUPPORTS
- PART 3 EXECUTION
- 3.1 INSTALLATION
 - 3.1.1 Field Forming of Panels for Unique Area
 - 3.1.2 Subpurlins
 - 3.1.3 Roof Panel Installation
 - 3.1.4 Concealed Anchor Clips
 - 3.2 INSULATION INSTALLATION
 - 3.2.1 Board Insulation with Blanket Insulation
 - 3.2.2 Blanket Insulation
 - 3.3 PROTECTION OF VAPOR RETARDER FROM ROOF DECK
 - 3.4 VAPOR RETARDER INSTALLATION
 - 3.4.1 Integral Facing on Blanket Insulation
 - 3.4.2 Polyethylene Vapor Retarder
 - 3.5 SLIP SHEET INSTALLATION
 - 3.6 CLEANING AND TOUCH-UP

-- End of Section Table of Contents --

USACE / NAVFAC / AFCESA UFGS-07416A (August 2004)

Preparing Activity: USACE Superseding
UFGS-07416A (November 2001)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 22 December 2004

Latest change indicated by CHG tags

SECTION 07416A

STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
08/04

NOTE: This guide specification covers the requirements for both factory color and mill finish SSSMR systems.

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.

PART 1 GENERAL

NOTE: This guide specification will be used in the preparation of project specifications for SSSMR systems. SSSMR is a system of metal roof panels supported and/or attached by clips fastened directly to the building structure. For non-structural standing seam metal roof systems use Section 07412 NON-STRUCTURAL METAL ROOFING.

This guide specification will be used in conjunction with Section 13120 PREENGINEERED METAL BUILDINGS or Section 13121 METAL BUILDING SYSTEMS (MINOR REQUIREMENTS), when a SSSMR is required for that type of construction.

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.

ALUMINUM ASSOCIATION (AA)

AA ADM1 (2000) Aluminum Design Manual

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 335 (1989) Structural Steel Buildings
Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2002) Minimum Design Loads for Buildings
and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A 463/A 463M (2002a) Steel Sheet, Aluminum-Coated, by
the Hot-Dip Process

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 209 (2004) Aluminum and Aluminum-Alloy Sheet
and Plate

ASTM B 209M (2004) Aluminum and Aluminum-Alloy Sheet
and Plate (Metric)

ASTM C 1177/C 1177M (2004e1) Glass Mat Gypsum Substrate for
Use as Sheathing

ASTM C 1289 (2003) Faced Rigid Cellular
Polyisocyanurate Thermal Insulation Board

ASTM C 518 (2004) Steady-State Thermal Transmission
Properties by Means of the Heat Flow Meter

Apparatus

ASTM C 991	(2003) Flexible Glass Fiber Insulation for Metal Buildings
ASTM D 1308	(2002e1) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
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 2794	(1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(2002) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Specular Gloss
ASTM D 5894	(1996) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610	(2001) Evaluating Degree of Rusting on Painted Steel Surfaces
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 E 96	(2000e1) Water Vapor Transmission of

Materials

ASTM G 154 (2000a) Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

STEEL JOIST INSTITUTE (SJI)

SJI Specs & Tables (August 2002) Standard Specifications and Load Tables for Steel Joists and Joist Girders

1.2 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.] [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

Structural Standing Seam Metal Roof[; G][; G, [_____]]

Metal roofing drawings and specifications and erection drawings; shop coating and finishing specifications; and other data as necessary to clearly describe design, materials, sizes, layouts, standing seam configuration, construction details, provisions for thermal movement, line of panel fixity, fastener sizes and spacings, sealants and erection procedures. Drawings shall reflect the intent of the architectural detailing using the manufacturer's proprietary products and fabricated items as required. The SSSMR system shop drawings shall be provided by the metal roofing manufacturer.

SD-03 Product Data

Design Analysis[; G][; G, [____]]

Design analysis signed by a Registered Professional Engineer employed by the SSSMR manufacturer. The design analysis shall include a list of the design loads, and complete calculations for the support system (when provided by the Contractor), roofing system and its components; valley designs, gutter/downspout calculations, screw pullout test results, and shall indicate how expected thermal movements are accommodated.

Qualifications

Qualifications of the manufacturer and installer.

SD-04 Samples

Accessories

One sample of each type of flashing, trim, closure, thermal spacer block, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof Panels

One piece of each type to be used, 225 mm 9 inches long, full width.

Factory Color Finish

Three 75 by 125 mm 3 by 5 inches samples of each type and color.

Fasteners

Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Insulation

One piece, 300 by 300 mm 12 by 12 inches, of each type and thickness to be used, with a label indicating the rated permeance (if faced) and R-values. The flame spread, and smoke developed

rating shall be shown on the label or provided in a letter of certification.

Gaskets and Insulating Compounds

Two samples of each type to be used and descriptive data.

Sealant

One sample, approximately 0.5 kg 1 pound, and descriptive data.

Concealed Anchor Clips

Two samples of each type used.

Subpurlins

One piece, 225 mm 9 inches long.

EPDM Rubber Boots

One piece of each type.

SD-06 Test Reports

Wind Uplift Resistance[; G][; G, [____]]

The report shall include the following information:

- a. Details of the SSSMR system showing the roof panel cross-section with dimensions and thickness.
- b. Details of the anchor clip, dimensions, and thickness.
- c. Type of fasteners, size, and the number required for each connection.
- d. Purlins/subpurlins size and spacing used in the test.
- e. Description of the seaming operation including equipment used.
- f. Maximum allowable uplift pressures. These pressures are determined from the ultimate load divided by a factor of safety equal to 1.65.
- g. Any additional information required to identify the SSSMR system tested.
- h. Signature and seal of an independent registered engineer who witnessed the test.

SD-07 Certificates

Structural Standing Seam Metal Roof

- a. Certification that the actual thickness of uncoated sheets used in SSSMRS components including roofing panels, subpurlins, and concealed anchor clips complies with specified

requirements.

b. Certification that materials used in the installation are mill certified.

c. Previous certification of SSSMR system tested under the Corps of Engineers' Standard Test Method in lieu of ASTM E 1592 testing.

d. Certification that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than three pieces has been tested and has met the quality standards specified for factory color finish.

e. Certification of installer. Installer certification shall be furnished.

f. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5-year Warranty for Structural Standing Seam Metal Roof (SSSMR) System, a sample copy of which is attached to this section, [and] the 20-year Manufacturer's Material Warranties, [and the manufacturer's 20-year system weathertightness warranty].

Insulation

Certificate attesting that the polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 GENERAL REQUIREMENTS

NOTE: Metal roof panels are capable of spanning the structural supports and resisting snow, dead, live, concentrated, and wind loads without benefit of additional substrate materials. Substrates provided in conjunction with SSSMR systems are not a requirement of this specification and are referred to as roof decks.

For Government designed buildings, the roof framing system must show necessary structural framing members, purlins, or subpurlins to accommodate concealed anchor clip spacing. Concealed anchor clip spacing cannot exceed 760 mm (30 inches) on center in the high wind areas, generally at eaves, rakes, and ridges, and 1.4 m (5'-0") on center for the remainder of the roof. All concealed anchor clips must be attached to the framing system. Clip attachments to metal decks or other substrates are not permitted.

Valleys must be properly designed to ensure that water does not travel up under the offset cleat where the panel terminates. Valley backup plates shall be large enough to carry the valley flashing and the panel terminations. Subpurlins must have

minimum thicknesses and strengths as required by the specifications.

The contract drawings will include loading diagrams/tables showing the design wind uplift pressures for all zones as determined by ASCE 7 or TI 809-01. The contract drawings will also include snow loading diagrams/tables where appropriate. The roof slope will be indicated on the drawings. Roof slopes will be specified in accordance with TI 809-29. SSSMR system must be designed to accommodate effects of ice damming and other conditions in cold climates.

A wide variety of roof system configurations, fastening systems, and accessories is available. Details of valley, expansion joints, flashing, underlayments, roof penetrations, curbs, eaves, ridges, intersection and other unique situations of the roof system will be shown on the contract drawings.

The Contractor shall furnish a commercially available roofing system which satisfies all requirements contained herein and has been verified by load testing and independent design analyses to meet the specified design requirements.

1.3.1 Structural Standing Seam Metal Roof

The SSSMR system covered under this specification shall include the entire roofing system; the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with ASTM E 1592. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system.

1.3.2 Qualifications

1.3.2.1 Manufacturer

The SSSMR system shall be the product of a manufacturer who has been in the practice of manufacturing and designing SSSMR systems for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

1.3.2.2 Installer

The installer shall be certified by the SSSMR system manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

1.4 DESIGN ANALYSIS

NOTE: When the SSSMR system is a component of a metal building system, the loading criteria specified in Section 13120 PREENGINEERED METAL BUILDINGS or Section 13121 METAL BUILDING SYSTEMS (MINOR REQUIREMENTS), will apply and these paragraphs will be coordinated accordingly. A reference to the pertinent Section will be made for design conditions, and applicable paragraphs of Section 13120 PREENGINEERED METAL BUILDINGS, or Section 13121 METAL BUILDING SYSTEMS (MINOR REQUIREMENTS) will be edited accordingly.

The design of the SSSMR system shall be provided by the Contractor as a complete system. Members and connections not indicated on the drawings shall be designed by the Contractor. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

1.4.1 Design Criteria

NOTE: Loads and load combinations will be in accordance with ASCE 7. The designer will provide loading diagrams/tables on the contract drawings, plus dimensions of edge, eave, ridge and corner zones.

Design criteria shall be in accordance with ASCE 7.

1.4.2 Dead Loads

The dead load shall be the weight of the SSSMR system. Collateral loads such as sprinklers, mechanical and electrical systems, and ceilings shall not be attached to the panels.

1.4.3 Live Loads

1.4.3.1 Concentrated Loads

The panels and anchor clips shall be capable of supporting a 1335 N 300 pound concentrated load. The concentrated load shall be applied at the panel midspan and will be resisted by a single standing seam metal roof panel assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

1.4.3.2 Uniform Loads

NOTE: The minimum roof live load will be not less than 960 Pa (20 psf).

The panels and concealed anchor clips shall be capable of supporting a minimum uniform live load of [960] [_____] Pa [20] [_____] psf.

1.4.4 Roof Snow Loads

NOTE: Snow load, including unbalanced roof snow loads and drift load will be calculated in accordance with ASCE 7.

The design roof snow loads shall be as shown on the contract drawings.

1.4.5 Wind Loads

NOTE: The internal pressure coefficient for buildings shall be in accordance with ASCE 7. The internal pressures also apply to SSSMR systems above substrates since the panels do not lay directly on the substrate.

The design wind uplift pressure for the roof system shall be as shown on the contract drawings. 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. The safety factor listed below shall be applied to the design force and compared against the ultimate capacity. Prying shall be considered when figuring fastener design loads.

- a. Single fastener in each connection.....3.00
- b. Two or more fasteners in each connection...2.25

1.4.6 Thermal Loads

NOTE: Select appropriate temperature range based on effects of direct sun and general climatic conditions of the project site.

Insulated structures experience greater temperature differences than that of uninsulated structures. For specific projects, giving consideration to the panel color, building location, infrared heating by the sun, and the cooling effect of the roof radiating into the night sky, the designer should use a maximum temperature range of 104 degrees C (220 degrees F) for an insulated building and a maximum temperature range of 71 degrees C (160 degrees F) for an uninsulated building to compensate for the differential movement between the roof panels and the structural framework.

For wood structures, insulated buildings that are temperature sensitive, or in extreme climate areas, a greater temperature range should be considered. Dark roofs in mountain areas may be subject to a temperature range of 116 degrees C (240 degrees F) or more. For lateral expansion the thermal movement

may be assumed to be absorbed in the standing seam rib.

Roof panels shall be free to move in response to the expansion and contraction forces resulting from a total temperature range of [_____] degrees C degrees F during the life of the structure.

1.4.7 Framing Members Supporting the SSSMR System

Any additions/revisions to framing members supporting the SSSMR system to accommodate the manufacturer/fabricator's design shall be the Contractor's responsibility and shall be submitted for review and approval. New or revised framing members and their connections shall be designed in accordance with [AISC 335] [AISI SG-973] [SJI Specs & Tables]. Maximum deflection under applied live load, snow, or wind load shall not exceed 1/180 of the span length.

1.4.8 Roof Panels Design

Steel panels shall be designed in accordance with AISI SG-973. Aluminum panels shall be designed in accordance with AA ADM1. The structural section properties used in the design of the panels shall be determined using the unloaded shape of the roof panels. The calculated panel deflection from concentrated loads shall not exceed 1/180 of the span length. The calculated panel deflection under applied live load, snow, or wind load shall not exceed 1/180 times the span length. Deflections shall be based on panels being continuous across three or more supports. Deflection shall be calculated and measured along the major ribs of the panels.

1.4.9 Accessories and Their Fasteners

Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the roof panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces. There shall be a minimum of two fasteners per clip. Single fasteners with a minimum diameter of 9 mm 3/8 inch will be allowed when the supporting structural members are prepunched or predrilled.

1.5 PERFORMANCE REQUIREMENTS

NOTE: Testing is required to verify the adequacy of the SSSMR system. External reinforcement of panel seams is not permitted, except when approved by the customer and the designer. Consider the use of closer purlin spacing and/or narrow width panels (305 mm (12 inches)) in order to eliminate the need for external reinforcement. External reinforcement includes clips, and clamps on the ribs or seams.

The SSSMR shall be tested for wind uplift resistance in accordance with ASTM E 1592; SSSMR systems previously tested and approved by the Corps of Engineers' STANDARD TEST METHOD FOR STRUCTURAL PERFORMANCE OF SSMRS BY UNIFORM STATIC AIR PRESSURE DIFFERENCE may be acceptable. Two tests shall be performed. Test 1 shall simulate the edge condition with one end having

crosswise restraint and other end free of crosswise restraint. The maximum span length for the edge condition shall be 750 mm 30 inches. Test 2 shall simulate the interior condition with both ends free of crosswise restraint. The maximum span length for the interior condition shall be 1.5 m 5.0 feet. External reinforcement, such as clamps on the ribs, [may] [shall not] be installed to improve uplift resistance. Bolts through seams shall not be installed.

1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage conditions shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The SSSMR system shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.7.1 Contractor's Weathertightness Warranty

The SSSMR system shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The SSSMR system covered under this warranty shall include the entire roofing system including, but not limited to, the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with ASTM E 1592. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, and skylights; interior or exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of these specifications that are part of the SSSMR system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's required warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM, and shall start upon final acceptance of the facility. It is required that the Contractor provide a separate bond in an amount equal to the installed total roofing system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire SSSMR system as outlined above.

1.7.2 Manufacturer's Material Warranties.

NOTE: The 20-year system weathertightness warranty, required in paragraph c. below, will increase construction cost, and should be used only after consultation with the customer. Remove paragraph c. below, if not required in the project.

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all SSSMR system components such as roof panels, anchor clips and fasteners, flashing, accessories, and trim, fabricated from coil material:

a. A manufacturer's 20 year material warranty warranting that the aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change color in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing with an air-drying version of the specified finish or replacing the defective coated material.

c. A roofing system manufacturer's 20 year, non-prorated, system weathertightness warranty.

1.8 COORDINATION MEETING

A coordination meeting shall be held 30 days prior to the first submittal, for mutual understanding of the Structural Standing Seam Metal Roof (SSSMR) System contract requirements. This meeting shall take place at the building site and shall include representatives from the Contractor, the roof system manufacturer, the roofing supplier, the erector, the SSSMR design engineer of record, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting.

PART 2 PRODUCTS

2.1 ROOF PANELS

NOTE: See TI 809-29 for guidance on roof slope and height of seams.

Panels shall be [steel] [aluminum] and shall have a [factory color] [mill] finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 9 m 30 feet. When length of run exceeds 9 m 30 feet and panel laps are provided, each

sheet in the run shall extend over three or more supports. Sheets longer than 30 m 100 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide not more than 600 mm 24 inches of coverage in place. SSSMR system with roofing panels greater than 300 mm 12 inches in width shall have standing seams rolled during installation by an electrically driven seaming machine. Height of standing seams shall be not less than [_____] mm inches for rolled seam and [_____] mm inches for seams that are not rolled.

2.1.1 Steel Panels

**NOTE: When a factory color finish is specified,
remove last two sentences from this paragraph. AZ
50 coating is allowed for factory-color-finish and
not for mill finish. Remove this paragraph when
steel panels are not used in the project.**

Steel panels shall be zinc-coated steel conforming to ASTM A 653/A 653M; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ [55] [50] coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Zinc, zinc-aluminum alloy or aluminum coated panels shall be 0.584 mm 0.023 inch thick minimum. Panels shall be within 95 percent of reported tested thickness as noted in wind uplift resistance testing required in paragraph PERFORMANCE REQUIREMENTS. Prior to shipment, mill finish panels shall be treated with a passivating chemical to inhibit the formation of oxide corrosion products. Panels that have become wet during shipment and have started to oxidize shall be rejected.

2.1.2 Aluminum Panels

**NOTE: Remove this paragraph when aluminum panels
are not used in the project.**

Alloy conforming to ASTM B 209M ASTM B 209, temper as required for the forming operation, minimum 0.8 mm 0.032 inch thick.

2.2 CONCEALED ANCHOR CLIPS

Concealed anchor clips shall be the same as the tested roofing system. Clip bases shall have factory punched or drilled holes for attachment. Clips shall be made from multiple pieces with the allowance for the total thermal movement required to take place within the clip. Single piece clips may be acceptable when the manufacturer can substantiate that the system can accommodate the thermal cyclic movement under sustained live or snow loads.

2.3 ACCESSORIES

**NOTE: Select either die cast metal closures or
molded closure strips as appropriate.**

Flashing, trim, metal closure strips, caps and similar metal accessories

shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the panels furnished. [Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water.] [Die cast metal closures shall be installed with double bead tape sealant and fasteners that stitch the panel to a 2 mm 16 gage preformed backer plate to ensure a positive compression of the tape sealant.] The use of a continuous angle butted to the panel ends to form a closure will not be allowed.

2.4 FASTENERS

NOTE: Fasteners that are not color coated may be limited to 400-series corrosion resisting steel when justified by atmospheric exposure conditions.

Fasteners for steel roof panels shall be zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum roof panels shall be aluminum or corrosion resisting steel. Fasteners for structural connections shall provide both tensile and shear ultimate strengths of not less than 3340 N 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be sealed or have sealed washers on the exterior side of the roof to waterproof the fastener penetration. Washer material shall be compatible with the roofing; 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. Exposed fasteners for factory color finished panels shall be factory finished to match the color of the panels.

2.4.1 Screws

Screws for attaching anchor devices shall be not less than No. 14. Actual screw pull out test results shall be performed for the actual material gage and yield strength of the structural purlins or subpurlins to which the clip is to be anchored/attached. Other screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

2.4.2 Bolts

Bolts shall be not less than 6 mm 1/4 inch diameter, shouldered or plain shank as required, with locking washers and nuts.

2.4.3 Structural Blind Fasteners

Blind screw-type expandable fasteners shall be not less than 6 mm 1/4 inch diameter. Blind (pop) rivets shall be not less than 7 mm 9/32 inch minimum diameter.

2.5 SUBPURLINS

Cold formed supporting structural members/subpurlins shall have a minimum thickness of 1.5 mm 0.059 inches and a minimum tensile yield strength of 345 MPa 50000 psi. Hot rolled structural members shall have a minimum thickness of 6 mm 0.25 inches and a minimum tensile yield strength of 248 MPa 36000 psi. Subpurlins shall be [galvanized] [shop painted].

2.6 FACTORY COLOR FINISH

NOTE: Factory color finish will be specified except when the buildings are to be used for temporary purposes or where mill finish aluminum panels provide an acceptable appearance. If factory color finish is not required, document the rationale for the decision in the design analysis and remove this paragraph.

The U.S. metal building industry offers a variety of color finishes to protect the metal panels against chemical corrosion and ultraviolet radiation; to provide long life with minimum maintenance plus acceptable weathering and color retention; and to assure chalk, fade, and mar resistance. Some of the most widely used coatings include, but are not limited to, the following:

- a. Polyvinylidene fluoride (PVF2); a nominal 0.025 mm (1 mil) thick coating modified with a proprietary resin for toughness; it may be used in most environments.
- b. Silicone-modified polyester (SMP); a thermoset coating system composed of polyester resin modified by copolymerization with a functional silicone resin intermediate designed for added protection against chemical corrosion and ultraviolet radiation.
- c. Plastisol (PVC); a two-coat system consisting of a polyvinyl-chloride resin dispersed in a plasticizer top-coat over a corrosion-resistant primer; it is a high-performance, thick coating designed for highly aggressive and corrosive environments with excellent resistance to common acids, alkalis, and inorganic compounds.

Most coatings may be ordered extra-thick for buildings in direct contact with salt or chemical laden air or where a premium finish would be justified. The thicker coating provides additional primer and increases the coating's corrosion and abrasion resistance but it requires a special run by the coil coater, at least a 22 degrees C (70 degrees F) environment, and additional delivery time. Appropriate specification requirements must be added if the thick film coatings are to be used.

The high cost of preventing corrosion of galvanized steel panels, together with the fact that cut edges, scratches and penetrations of the panels expose the steel substrate, warrants consideration for the use of solid aluminum which is inherently less susceptible to damaging corrosion.

Roof panels are available in several standard

colors. Standard trim colors are usually more limited. Except where interior surfaces receive a factory color coat, the exposed reverse side of the panels normally are provided with an off-white backer coating. Color other than manufacturer's standard colors will be used only when the extra cost is justified.

The choice of coating for the interior face of panels depends on environmental and aesthetic considerations. Where a corrosive atmosphere is anticipated within the structure, the finish should be PVF2 in a thickness appropriate to the environment. For utilitarian facilities with little likelihood of a detrimental atmosphere, a standard backer coat is appropriate. Backer coat is the manufacturer's standard coating (usually polyester based) applied to the back side of the metal panel. This coating is normally a wash coating and is not controlled for consistent color or gloss. Where interior surfaces are concealed behind insulation, liner panels, etc.; provide only a primer coat. These finishes should not be confused with a wash coat which is used primarily to facilitate the coil forming process and which is not closely controlled for color, gloss or film thickness. The designer's rationale for using any special interior finish should be reflected in the design analysis.

Energy considerations must be included in the choice of standard colors for the roof panels. White or light-colored roofing surfaces are much better at reflecting sunlight than darker surfaces. This keeps roofs 20 to 35 degrees C (35 to 60 degrees F) cooler, which means less heat will be transferred to internal building spaces. Demonstration projects have shown that cooling energy use can be cut by as much as 40 percent when light-colored surfaces are used. Coordinate the use of light-colored roofing material with the user.

Panels shall have a factory applied [polyvinylidene fluoride] [_____] finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated [on the drawings] [in Section 09915 COLOR SCHEDULE]. The exterior coating shall be a nominal [0.025] [0.050] mm [1] [2] mil thickness consisting of a topcoat of not less than 0.018 mm 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than [0.005] [0.025] mm [0.2] [1.0] mil thickness. The interior color finish shall consist of [the same coating and dry film thickness as the exterior] [a nominal 0.025 mm 1 mil thick [PVF2] [_____] finish otherwise the same as the exterior] [a backer coat with a dry film thickness of 0.013 mm 0.5 mil] [a 0.005 mm 0.2 mil thick prime coat]. The exterior color finish shall meet the test requirements specified below.

2.6.1 Salt Spray Test

NOTE: The results of the salt spray test will vary depending on the thickness of the coating.

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 2016 hours in accordance with ASTM D 5894, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; 10, no rusting, as determined by ASTM D 610; and a rating of 6, over 2.0 to 3.0 mm 1/16 to 1/8 inch failure at scribe, as determined by ASTM D 1654.

2.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 3 mm 1/8 inch diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

2.6.3 Accelerated Weathering, Chalking Resistance and Color Change

NOTE: Low gloss finishes have relatively poor weathering qualities. Delete the last sentence if a low gloss finish is not required by Paragraph Specular Gloss.

A sample of the sheets shall be tested in accordance with ASTM G 154, test condition [UVA-340 lamp, 4h UV at 60 degrees C followed by 4h CON at 50 degrees C] [UVA-340 lamp, 8h UV at 60 degrees C followed by 4h CON at 45 degrees C] for [_____] total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating with an adhesion rating less than 4B when tested in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

2.6.4 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.

2.6.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 13 mm 0.500 inch diameter hemispherical head indenter, equal to 6.7 times the metal thickness in mm, expressed in Newton-meters, 1.5 times the metal thickness in mils, expressed in inch-pounds, with no cracking.

2.6.6 Abrasion Resistance Test

NOTE: The 70 percent polyvinylidene fluoride finish has a minimum abrasion resistance of about 65 liters per 0.025 mm (65 liters/mil) of coating thickness.

The nominal 0.025 mm (1 mil) finish will withstand 50 to 60 liters of sand while the nominal 0.050 mm (2 mil) finish can be expected to withstand 80-100 liters. The results of this test are variable and offer poor repeatability. In shop drawing review, notice the difference between the specified total liters of sand and those reported.

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of [50] [80] liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

2.6.7 Specular Gloss

NOTE: Few manufacturers regularly produce prefinished panels meeting these low gloss requirements and such sheets are available only in limited colors. Standard 70 percent PVF2 finish, for example, has a medium gloss. Low gloss paint formulations result in reduced weathering properties. Identify individual facilities requiring low gloss finish.

For roof of structures at airfields where glare would be objectionable and may be an operational hazard, the specular gloss value should be limited to 10 or less at an angle of 85 degrees.

Finished roof surfaces for [_____] shall have a specular gloss value of [10 or less at an angle of 85 degrees] [30 plus or minus [_____] at 60 degrees] when measured in accordance with ASTM D 523.

2.6.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.7 INSULATION

NOTE: Drawings will show type, R-Value, vapor barrier, extent and location of insulation, including insulation retainer system. Insulation retainer system consists of a grid of bands and cross bands and their connections to hold the insulation neatly in place and against the bottom of the roof panels to ensure condensation does not occur. The insulation retainer system will be detailed on the drawings and specified to allow a

practical installation. On warehouse, shop or other storage type facilities, where esthetics is not essential, insulation baskets or poultry netting and their connections may be shown and specified for the insulation retainer system. The insulation location is dependent upon the use or absence of a separate roof deck. The vapor retarder location is dependent on the climate as noted in paragraph VAPOR RETARDER.

The required R-value for the insulation will be determined and shown at the appropriate details on the drawings. The required R-values for the insulation will never be less than the R-values used in the Energy Budget Analysis. The R-values shown on the drawings should be greater than those used in the design analysis to account for thermal bridges. Provide about a one-third increase (or as local experience has shown, if different) in R-value over what is calculated; that is, if an R-value of 3 is needed in metric (metric units are square meter K/W) (16 in I-P with units of h x square feet x degree F/Btu) use an R-value of 4 (21) in the contract. If an analysis of thermal bridges in the design gives a requirement greater or less than this, it should be used.

Flame spread and smoke development ratings of exposed insulation, to include facing, shall comply with the requirements of MIL-HDBK 1008C. Exposed insulation will be faced, mineral fiber type, only; cellular plastic insulations will not be exposed.

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 24 degrees C 75 degrees F in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. [Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER]. Insulation [, including facings,] shall have a flame spread not in excess of [_____] and a smoke developed rating not in excess of [_____] when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory. Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.7.1 Polyisocyanurate Rigid Board Insulation

NOTE: Detailed information concerning EPA requirements on recycled/recovered materials is available at the following URL's:
<http://www.epa.gov/cpg/products/> and then click on the appropriate item from the list (building.htm for building insulation, for example).
<http://www.epa.gov/cpg/products.htm> (similar results).

<http://www.epa.gov/cpg/pdf/back.pdf> which opens up EPA530-R-98-003 (dated July, 1998, titled BACKGROUND DOCUMENT FOR PROPOSED CPG III AND DRAFT RMAN III).

Using data from listed locations, fill in blank space for required percentage of recycled or recovered material. This is in accordance with the requirements of 40 CFR 247 and Section 01670 which should be included in all projects.

Polyisocyanurate insulation for use above a roof deck shall conform to ASTM C 1289, Type II, (having a minimum recovered material content of [_____] percent by weight of core material in the polyisocyanurate portion). For impermeable faced polyisocyanurate (Ex: aluminum foil), the maximum design R-value per 25 mm 1 inch of insulation used shall be 1.27 7.2. Facings shall be non-asphaltic, glass fiber reinforced.

2.7.2 Blanket Insulation

NOTE: The specified blanket insulation is a flexible mineral fiber insulation for use at temperatures up to 176 degrees C (350 degrees F).

Blanket insulation shall conform to ASTM C 991.

2.7.3 Glass Mat Gypsum Roof Board

Glass mat gypsum roof board for use above the deck or insulation for thermal protection shall have a flame spread - 0, smoke developed - 0, shall be water resistant and have a compressive strength of 3.4 kpa 500 psi. Glass mat gypsum roof board shall conform to ASTM C 1177/C 1177M.

2.8 INSULATION RETAINERS

Insulation retainers shall be type, size, and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

2.9 SEALANT

Sealants shall be elastomeric type containing no oil or asphalt. Exposed sealant shall be [colored to match the applicable building color] [clear] and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

2.10 GASKETS AND INSULATING COMPOUNDS

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

2.11 VAPOR RETARDER

NOTE: The term vapor retarder has been selected to describe the membrane used to reduce moisture vapor transmission. The location of the vapor retarder is determined by the climate and the building type.

The vapor retarder goes on the side of the insulation with the greatest vapor pressure during the course of the year; therefore, it goes on the outside in a climate predominately warm, and on the inside in a climate predominately cool. The designer should determine the most appropriate application/installation of the vapor retarder based on project circumstances and the intended use of the facility. See TM 5-810-1 for humid climate definition.

Detail the use of insulation on the drawings. The four systems are as follows:

- a. Cool climate, no roof deck. The vapor retarder will be a facing on the bottom of blanket insulation.
- b. Warm climate, no roof deck. The vapor retarder will be a facing on the top of blanket insulation with a separate insulation support system. A slip sheet is required. If the integral facing is used to support the insulation, a separate polyethylene vapor retarder must be laid over the insulation.
- c. Cool climate, with a roof deck. The vapor retarder will be a separate membrane directly on top of the roof deck with board insulation over the vapor retarder and an unfaced blanket cushioning between the board insulation and the roofing.
- d. Warm climate, with a roof deck. The vapor retarder will be a facing on the top of a blanket insulation above board insulation. The board insulation sits on the roof deck. A slip sheet is required.

Unreinforced foil as the facing in conditions b. and d. above, should not be used.

2.11.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of [1.15] [_____] ng per Pa-second-square meter [0.02] [_____] perm or less when tested in accordance with ASTM E 96. Facing shall be [white] [black] reinforced polypropylene kraft laminate (PSK). Facings and finishes shall be factory applied.

2.11.2 Vapor Retarders Separate from Insulation

**NOTE: Roof deck should not be assumed to function
as a vapor retarder.**

Vapor retarder material shall be polyethylene sheeting conforming to ASTM D 4397. A single ply of 0.25 mm 10 mil polyethylene sheet; or, at the Contractor's option, a double ply of 0.15 mm 6 mil polyethylene sheet shall be used. A fully compatible polyethylene tape which has equal or better water vapor control characteristics than the vapor retarder material shall be provided. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

2.11.3 Slip Sheet for Use With Vapor Retarder

**NOTE: A slip sheet is required to separate the
roofing panels from the insulation facing where the
facing would be in direct contact with the roofing
panels.**

Slip sheet for use with vapor retarder shall be a 0.24 kg per square meter 5 lb. per 100 square feet rosin-sized, unsaturated building paper.

2.12 EPDM RUBBER BOOTS

Flashing devices around pipe penetrations shall be flexible, one-piece devices molded from weather-resistant EPDM rubber. Rubber boot material shall be as recommended by the manufacturer. The boots shall have base rings made of aluminum or corrosion resisting steel that conform to the contours of the roof panel to form a weather-tight seal.

2.13 PREFABRICATED CURBS AND EQUIPMENT SUPPORTS

Prefabricated curbs and equipment supports shall be of structural quality, hot-dipped galvanized or galvanized sheet steel, factory primed and prepared for painting with mitered and welded joints. Integral base plates and water diverter crickets shall be provided. Minimum height of curb shall be 200 mm 8 inches above finish roof. Curbs shall be constructed to match roof slope and to provide a level top surface for mounting of equipment. Curb flange shall be constructed to match configuration of roof panels. Curb size shall be coordinated, prior to curb fabrication, with the mechanical equipment to be supported. Strength requirements for equipment supports shall be coordinated to include all anticipated loads. Flashings shall not be rigidly attached to underline structure.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Molded closure strips shall be installed wherever roofing sheets terminate in open-end configurations, exclusive of flashings. The closure strip installation shall be weather-tight and sealed. Screws shall be installed with a clutching screw gun, to assure screws are not stripped. Field test shall be conducted on each gun prior to starting installation and periodically thereafter to assure it is

adjusted properly to install particular type and size of screw as recommended by manufacturer's literature. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 Field Forming of Panels for Unique Area

When roofing panels are formed from factory-color-finished steel coils at the project site, the same care and quality control measures that are taken in shop forming of roofing panels shall be observed. Rollformer shall be operated by the metal roofing manufacturer's representative. In cold weather conditions, preheating of the steel coils to be field formed shall be performed as necessary just prior to the rolling operations.

3.1.2 Subpurlins

Unless otherwise shown, subpurlins shall be anchored to the purlins or other structural framing members with bolts or screws. Attachment to the substrate (when provided) or to the panels is not permitted. The subpurlin spacing shall not exceed 750 mm 30 inches on centers at the corner, edge and ridge zones, and 1500 mm 5 foot maximum on centers for the remainder of the roof. Corner, edge, and ridge zones are as defined in ASCE 7.

3.1.3 Roof Panel Installation

Roof panels shall be installed with the standing seams in the direction of the roof slope. The side seam connections for installed panels shall be completed at the end of each day's work. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weather-tight installation. End laps of panels shall be provided in accordance with the manufacturer's instructions. Closures, flashings, EPDM rubber boots, roof curbs, and related accessories shall be installed according to the manufacturer's drawings. Fasteners shall not puncture roofing sheets except as provided for in the manufacturer's instructions for erection and installation. Expansion joints for the standing seam roof system shall be installed at locations indicated on the contract drawings and other locations indicated on the manufacturer's drawings.

3.1.4 Concealed Anchor Clips

Concealed anchor clips shall be fastened directly to the structural framing members. Attachment to the substrate (when provided) or to the metal deck is not permitted. The maximum distance, parallel to the seams, between clips shall be 750 mm 30 inches on center at the corner, edge, and ridge zones, and 1500 mm 5 feet maximum on centers for the remainder of the roof.

3.2 INSULATION INSTALLATION

NOTE: Choose one paragraph and delete the other.
Use rigid or semirigid board insulation with a roof deck. Use blanket insulation without a roof deck.
A maximum of 100 mm (4 inches) of batt insulation may be compressed at purlins. Thermal blocks should be shown where required for thermal efficiency.

When thermal blocks are shown, a maximum of 50 mm (2 inches) of batt insulation may be compressed at purlins.

Insulation shall be continuous over entire roof surface. Where expansion joints, terminations, and other connections are made, the cavity shall be filled with batt insulation with vapor retarder providing equivalent R-value and perm rating as remaining insulation. Insulation shall be installed as indicated and in accordance with manufacturer's instructions.

3.2.1 Board Insulation with Blanket Insulation

Rigid or semirigid board insulation shall be laid in close contact. Board shall be attached to the metal roof deck with bearing plates and fasteners, as recommended by the insulation manufacturer, so that the insulation joints are held tight against each other, and shall have a minimum of 1 fastener per 0.37 square meters 1 fastener per 4 square feet. Layout and joint pattern of insulation and fasteners shall be indicated on the shop drawings. If more than one layer of insulation is required, joints in the second layer shall be offset from joints in the first layer. A layer of blanket insulation shall be placed over the rigid or semirigid board insulation to be compressed against the underside of the metal roofing to reduce thermal bridging, dampen noise, and prevent roofing flutter. This layer of blanket insulation shall be compressed a minimum of 50 percent.

3.2.2 Blanket Insulation

Blanket insulation shall be installed between and parallel to the purlins with tabs of a facer lapping on the top face of the purlins. Thermal blocks shall be provided over purlins, between clips. A second layer of unfaced insulation shall be added between purlins to provide full R-value. Blanket insulation shall be supported by an integral facing or other commercially available support system.

3.3 PROTECTION OF VAPOR RETARDER FROM ROOF DECK

NOTE: Delete this paragraph if the vapor retarder will not be in direct contact with the roof deck.

A cloth industrial duct tape shall be applied over the seams of metal roof decks, at penetration edges, and at surface areas exhibiting sharp burrs or similar protrusions. For other types of roof decks, cloth industrial duct tape shall be applied over irregularities which could potentially puncture polyethylene membrane.

3.4 VAPOR RETARDER INSTALLATION

NOTE: Choose one paragraph and delete the other.

3.4.1 Integral Facing on Blanket Insulation

Integral facing on blanket insulation shall have the facing lapped and sealed with a compatible tape to provide a vapor tight membrane.

3.4.2 Polyethylene Vapor Retarder

The polyethylene vapor retarder membrane shall be installed over the entire surface. A fully compatible polyethylene tape shall be used to seal the edges of the sheets to provide a vapor tight membrane. Sheet edges shall be lapped not less than 150 mm 6 inches. Sufficient material shall be provided to avoid inducing stresses in the sheets due to stretching or binding. All tears or punctures that are visible in the finished surface at any time during the construction process shall be sealed with polyethylene tape.

3.5 SLIP SHEET INSTALLATION

**NOTE: Delete this paragraph if no blanket
insulation facing will be compressed against metal
roofing.**

A slip sheet shall be laid over the blanket insulation facing to prevent the vinyl facing from adhering to the metal roofing.

3.6 CLEANING AND TOUCH-UP

Exposed SSSMR systems shall be cleaned at completion of installation. Debris that could cause discoloration and harm to the panels, flashings, closures and other accessories shall be removed. Grease and oil films, excess sealants, and handling marks shall be removed and the work shall be scrubbed clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Factory color finished surfaces shall be touched up with the manufacturer's recommended touch up paint.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

FACILITY DESCRIPTION _____

BUILDING NUMBER: _____

CORPS OF ENGINEERS CONTRACT NUMBER: _____

CONTRACTOR

CONTRACTOR: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

OWNER

OWNER: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

CONSTRUCTION AGENT

CONSTRUCTION AGENT: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

THE SSSMR SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE SSSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH ASTM E 1592. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE SSSMR SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE SSSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

(Company President)

(Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE SSSMR SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE SSSMR SYSTEM DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
6. THIS WARRANTY APPLIES TO THE SSSMR SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

★★

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

**REPORTS OF LEAKS AND SSSMR SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE SSSMR SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --