

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07220

ROOF INSULATION

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 STORAGE OF MATERIALS
- 1.4 FIRE CLASSIFICATION

PART 2 PRODUCTS

- 2.1 BITUMINOUS MATERIALS
 - 2.1.1 Asphalt Bitumen
 - 2.1.2 Asphalt Cement
 - 2.1.3 Asphalt Primer
- 2.2 INSULATION
 - 2.2.1 Cellular Glass
 - 2.2.2 Composite Board Insulation
 - 2.2.3 Expanded-Perlite Insulation Board
 - 2.2.4 Fiberboard
 - 2.2.5 Mineral-Fiber Insulation Board
 - 2.2.6 Polyisocyanurate
 - 2.2.7 Polystyrene
 - 2.2.8 Glass Mat Gypsum Roof Board
- 2.3 NAILS AND FASTENERS
 - 2.3.1 Nails for Fastening Insulation to Flush Mounted Wood Nailers
 - 2.3.2 Fasteners
 - 2.3.3 Metal Disks
- 2.4 VENTING INORGANIC BASE SHEET
- 2.5 GLASS ROOFING FELT
- 2.6 ORGANIC ROOFING FELT
- 2.7 WOOD NAILERS

PART 3 EXECUTION

- 3.1 COORDINATION REQUIREMENTS
- 3.2 ENVIRONMENTAL CONDITIONS
- 3.3 SUBSTRATE PREPARATION
- 3.4 HEATING OF ASPHALT
- 3.5 VAPOR RETARDER
 - 3.5.1 General Application
 - 3.5.2 Edge Requirements
 - 3.5.3 Over Gypsum Insulating Concrete or Lightweight Insulating Concrete
 - 3.5.4 Over Concrete Decks and First Layer of Insulation on Steel Decks
 - 3.5.5 Over Structural Concrete on Non-Venting Support
- 3.6 INSTALLATION OF WOOD NAILERS
- 3.7 APPLICATION OF INSULATION

- 3.7.1 Mechanical Fastening
- 3.7.2 Steel Decks
- 3.7.3 Foam Insulation
- 3.7.4 Installation
- 3.7.5 Protection Requirements
- 3.8 INSPECTION

-- End of Section Table of Contents --

SECTION 07220

ROOF INSULATION

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1 (1999) Particleboard Mat Formed Woods

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208 (1995) Cellulosic Fiber Insulating Board

ASTM C 552 (1991) Cellular Glass Thermal Insulation

ASTM C 578 (1995) Rigid, Cellular Polystyrene Thermal Insulation

ASTM C 726 (1993) Mineral Fiber Roof Insulation Board

ASTM C 728 (1997) Perlite Thermal Insulation Board

ASTM C 1050 (1991) Rigid Cellular Polystyrene-Cellulosic Fiber Composite Roof Insulation

ASTM C 1177/C 1177M (1996) Glass Mat Gypsum Substrate for Use as Sheathing

ASTM C 1289 (1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM D 41 (1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

ASTM D 226 (1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

ASTM D 312 (1995a) Asphalt Used in Roofing

ASTM D 2178 (1997) Asphalt Glass Felt Used in Roofing and Waterproofing

ASTM D 4586 (1993) Asphalt Roof Cement, Asbestos Free

ASTM D 4897 (1998) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing

ASTM F 547 (1977; R 1990) Definitions of Terms
Relating to Nails for Use with Wood and
Wood-Base Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P9513 (1996) Loss Prevention Data for Roofing
Contractors

FM P7825a (1998) Approval Guide Fire Protection

FM P7825c (1998) Approval Guide Building Materials

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (1998) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Instructions

Application of Insulation; FIO.

Insulation manufacturer's recommendations for the application and installation of insulation.

SD-08 Statements

Inspection; GA.

The inspection procedure for insulation installation, prior to start of roof insulation work.

SD-13 Certificates

Insulation; FIO. Glass Roofing Felt; FIO. Organic Roofing Felt; FIO.

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of recovered material. Certificates of compliance for felt materials.

1.3 STORAGE OF MATERIALS

Extruded polystyrene shall be stored in accordance with manufacturer's instructions. Other insulation, base sheet, and felt shall be kept dry at all times, before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer. Wet insulation, wet base sheet or wet felt shall be permanently removed from the site. Felts shall be stacked on end one level high. Felt rolls shall be maintained at a temperature above 10 degrees C 50 degrees F for 24 hours immediately before laying.

1.4 FIRE CLASSIFICATION

Insulation shall have been tested as part of a roof construction assembly of the type used in this project and the construction shall be listed as Fire-Classified in UL Bld Mat Dir or Class I in FM P7825a, except for installation on poured concrete decks or precast concrete roof deck panels.

PART 2 PRODUCTS

2.1 BITUMINOUS MATERIALS

Bituminous materials shall conform to the following requirements:

2.1.1 Asphalt Bitumen

ASTM D 312, Type III or IV. Asphalt flash point, finished blowing temperature, and equiviscous temperature (EVT) shall be indicated on bills of lading or on individual containers.

2.1.2 Asphalt Cement

ASTM D 4586, Type I for horizontal surfaces; Type II for vertical surfaces.

2.1.3 Asphalt Primer

ASTM D 41.

2.2 INSULATION

Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 24 degrees C, 75 degrees F, and the thickness. Minimum thickness shall be as recommended by the manufacturer. Boards shall be marked individually. The thermal resistance of insulation shall be not less than the R-value shown on the drawings. The insulation manufacturing process shall not include chlorofluoro carbons (CFC) or formaldehydes. Insulation and fiberboard shall contain the highest practicable percentage of material which has been recovered or diverted from solid waste (e.g., postconsumer waste), but not including material reused in a manufacturing process. Where two materials have comparable price and performance, the one having the higher recovered material content shall be selected. Insulation shall be one, or a combination of the following materials:

2.2.1 Cellular Glass

ASTM C 552, Type IV.

2.2.2 Composite Board Insulation

ASTM C 726, or ASTM C 1050 or ASTM C 1289 Type III, or ASTM C 1289 Type VI. Perlite, in composite board, may be replaced with ANSI A208.1 wood particle board, 11 mm (7/16 inch) 7/16 inch minimum thickness, provided that the composite board meets specified physical requirements. Composite board with wood particle board shall conform to ASTM C 1289, Type V.

2.2.3 Expanded-Perlite Insulation Board

ASTM C 728 with a minimum recovered material content of 23 percent of the expanded perlite portion of the board.

2.2.4 Fiberboard

ASTM C 208 Type II, Grade 1 or 2, roof insulating board with a minimum recovered material content of 80 percent, treated with sizing, wax or bituminous impregnation. Bituminous impregnation shall be limited to 4 percent by weight when used over steel decks.

2.2.5 Mineral-Fiber Insulation Board

ASTM C 726.

2.2.6 Polyisocyanurate

ASTM C 1289, Type I, or ASTM C 1289 Type II, having minimum recovered material content of 9 percent by weight of the polyisocyanurate portion of the board.

2.2.7 Polystyrene

Polystyrene shall be in accordance with ASTM C 578, Type II, IV, or X.

2.2.8 Glass Mat Gypsum Roof Board

Glass mat gypsum roof board shall be in accordance with ASTM C 1177/C 1177M, flame spread - 0, smoke developed - 0, 3446 kPa 500 psi Class A non-combustible.

2.3 NAILS AND FASTENERS

Nails and fasteners shall conform to the following requirements:

2.3.1 Nails for Fastening Insulation to Flush Mounted Wood Nailers

ASTM F 547 of sufficient length to hold insulation securely in place.

2.3.2 Fasteners

Insulation manufacturer's recommendations except holding power, when driven, shall be not less than 534 N 120 pounds each in steel deck. Fasteners for steel or concrete decks shall conform to FM P7825c for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 4.3 kPa kPa. 90 pounds per square foot.

2.3.3 Metal Disks

Flat and not less than 0.39 mm (30 gauge) 30 gauge thickness. Disks used with nails or fasteners for securing fiberboard insulation shall be minimum 25 mm 1 inch diameter. Disks used with nails or fasteners for securing other board insulation shall be minimum 53 mm 2-1/8 inches in diameter.

2.4 VENTING INORGANIC BASE SHEET

ASTM D 4897, Type II, Non-perforated, with spot mopping holes where specified.

2.5 GLASS ROOFING FELT

ASTM D 2178, Type IV.

2.6 ORGANIC ROOFING FELT

ASTM D 226, Type I.

2.7 WOOD NAILERS

Wood nailers shall conform to Section 06100 ROUGH CARPENTRY, including preservative treatment. Edge nailers shall be not less than nominal 150 mm 6 inches wide and of thickness to finish flush with the top surface of the insulation. Surface mounted nailers shall be a nominal 75 mm 3 inches wide by the full thickness of the insulation.

PART 3 EXECUTION

3.1 COORDINATION REQUIREMENTS

Insulation and roofing membrane shall be finished in one operation up to the line of termination at the end of each day's work. Completed sections shall be waterproofed when more than one day is required to finish the roofing. Phased construction will not be permitted.

3.2 ENVIRONMENTAL CONDITIONS

Air temperature shall be above 4 Degrees C 40 degrees F and there shall be no visible ice, frost, or moisture on the roof deck when the insulation and roofing are installed.

3.3 SUBSTRATE PREPARATION

The substrate construction of any bay or section of the building shall be completed before insulation or vapor retarder work is begun thereon. Insulation or vapor retarder applied directly on lightweight insulating concrete or gypsum shall not be scheduled until the insulating concrete passes the air-dry density test as required by the Task Order. Insulation or vapor retarder applied directly on concrete shall not be scheduled until frothing or bubbling does not occur when hot bitumen is applied to the concrete and until the hot bitumen sticks tightly to the concrete. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Prior to application of vapor retarder or insulation, substrate joints shall be covered with a 100 mm 4 inch strip of roofing felt, embedded in and coated with asphalt cement. Substrate surface shall be smooth, clean, and dry at time of application.

3.4 HEATING OF ASPHALT

Asphalt shall not be heated higher than 42 degrees C 75 degrees F above the EVT or 28 degrees C 50 degrees F below the flash point, or 275 degrees C, 525 degrees F, whichever is lower. EVT and flash point temperatures of asphalt in the kettle shall be conspicuously posted on the kettle. Kettle shall be provided with automatic thermostatic controls and an accurate thermometer. Kettle operators shall be in attendance at all times during heating to ensure that the maximum temperature is not exceeded. Asphalt shall be applied within a range of 14 degrees C 25 degrees F below or above the EVT, or as specified by the manufacturer. Application temperature shall be measured at the mop bucket or mechanical applicator. Asphalt at a temperature below this range shall be returned to the kettle. Flame-heated equipment shall not be placed on the roof.

3.5 VAPOR RETARDER

3.5.1 General Application

Vapor retarder shall consist of two plies of roofing felt, mopped at right angle to the slope, with 150 mm 6 inch end laps staggered at least 300 mm. 12 inches. The full 475 mm 19 inch starter ply and full 900 mm 36 inch wide ply sheets shall be placed, in succession, in hot asphalt immediately behind the applicator. Each ply shall be solid mopped in not less than 0.97 20 nor more than 1.46 kg 30 pounds of asphalt per square meter. square. A squeegee shall be used with glass felts and a broom shall be used with organic felts to embed the felts, eliminate air pockets and obtain adhesion between the plies. Side and end laps shall be completely sealed. Asphalt shall be visible beyond all edges of each ply as it is being installed. Plies shall be laid free of wrinkles, creases or fishmouths. Workers shall not walk on mopped surfaces when the asphalt is sticky. For slopes exceeding 42 mm/m 1/2 inch per foot, each ply shall be nailed 50 mm and 150 mm 2 and 6 inches from the upper edge with nails spaced 300 mm 12 inches on centers and staggered in each row.

3.5.2 Edge Requirements

At walls, eaves and rakes, the vapor retarder organic felts shall be extended 225 mm, 9 inches, or separate organic felt plies shall be extended 225 mm, 9 inches, with not less than 225 mm 9 inches on the substrate, and the extended portion turned back and mopped in over the top of the vapor retarder. At roof penetrations other than walls, eaves and rakes, the vapor retarder or separate plies shall be extended 225 mm 9 inches to form a lap which shall later be folded back over the edge of the insulation. Asphalt roof cement shall be used under the vapor retarder for at least 225 mm 9 inches from walls, eaves, rakes and other penetrations.

3.5.3 Over Gypsum Insulating Concrete or Lightweight Insulating Concrete

One ply of venting inorganic base sheet shall be laid, without mopping, at right angle to the slope with 100 mm 4 inch side laps and 150 mm 6 inch end laps. Laps shall be bonded with hot asphalt. End laps shall be staggered.

Base sheet shall be nailed 220 mm 9 inches on centers at side laps and in 2 rows 270 mm 11 inches apart down the center of the sheet with nails 450 mm 18 inches on centers and staggered. The 2-ply vapor retarder shall then be applied over the base sheet as specified above.

3.5.4 Over Concrete Decks and First Layer of Insulation on Steel Decks

The 2-ply vapor retarder shall be applied as specified above except that venting inorganic base sheet shall be deleted.

3.5.5 Over Structural Concrete on Non-Venting Support

One ply of venting inorganic base sheet with mopping holes shall be laid dry at right angle to the slope with 100 mm 4 inch side laps and 150 mm 6 inch end laps. The vapor retarder shall then be applied as specified.

3.6 INSTALLATION OF WOOD NAILERS

Nailers shall be secured to cast-in-place deck materials by not less than 9 mm 3/8 inch diameter anchors embedded in the deck not over 1.2 meters 4 feet on centers. Nailers shall be secured to precast deck materials and to steel decks as indicated. Bolt anchors shall have nuts and washers

countersunk, and bolts shall be cut flush with top of nailer. Powder-actuated fasteners, sized and spaced for nailer anchorage equivalent to that specified and indicated, may be used when approved. Surface mounted nailers shall be installed parallel with the roof slope and shall be spaced not over 1.2 meters 4 feet face-to-face, except that where the insulation units are less than 1.2 meters 4 feet in length the nailers shall be spaced to minimize cutting of the insulation.

3.7 APPLICATION OF INSULATION

Insulation shall be laid in two or more layers. Units of insulation shall be laid in courses parallel with the roof slope. End joints shall be staggered. Insulation shall be cut to fit neatly against adjoining surfaces. Joints between insulation boards shall not exceed 6 mm. 1/4 inch.

Joints in successive layers shall be staggered with respect to joints of preceding layer. Where insulation is applied over steel deck, long edge joints shall continuously bear on surfaces of the steel deck. Insulation which can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is waterproofed the same day. Phased construction will not be permitted. Application of impermeable faced insulation shall be performed without damage to the facing.

3.7.1 Mechanical Fastening

On steel decks, or any slope exceeding 42 mm/m, 1/2 inch per foot, the first layer of insulation shall be mechanically fastened. Method of attachment shall be in accordance with recommendations of the insulation manufacturer and requirements specified.

3.7.2 Steel Decks

Uninsulated steel decks shall have insulation applied to span the steel deck flutes and to act as an underlayment for the roof membrane. First layer of insulation on steel deck shall be compatible with mechanical fastening.

3.7.3 Foam Insulation

Polyisocyanurate, or polystyrene foam insulations shall be isolated from built-up roof and modified bitumen membrane by a separate or composite layer of cellular glass, mineral fiber board, perlite board, glass mat gypsum roof board, or fiberboard. Polystyrene shall not be exposed to solvent-base adhesive, coal-tar bitumen or to asphalt which is hotter than 93 degrees C. 200 degrees F.

3.7.4 Installation

Except for the first layer on steel deck, insulation layers shall be laid in solid moppings of hot asphalt applied at a rate of at least 0.97 kg per meter (20 lbs per square). 20 pounds per square. Asphalt shall not be applied further than one panel length ahead of roof insulation being installed. Where roof slopes are greater than 42 mm/m, 1/2 inch per foot, roof insulation shall be held in place by both asphalt mopping and mechanical fasteners. Asphalt primer shall be applied at the rate of 0.4 L/square meter (1 gallon per square) 1 gallon per square over the entire surface to be mopped when the insulation is applied over concrete deck. The edges of insulation boards adjoining vented nailers shall be kept free of asphalt.

3.7.5 Protection Requirements

The insulation shall be kept dry at all times. Insulation boards shall not be kicked into position. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement. Cutoffs shall be removed when work is resumed. Edges of insulation at open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, shall be protected until permanent roofing and flashing is applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces will not be permitted. Smooth, clean board or plank walkways, runways, and platforms shall be used, as necessary to distribute weight to conform to indicated live load limits of roof construction.

3.8 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.
- b. Verification of certification, listing or label compliance with FM P9513.
- c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.
- d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.
- e. Inspection of mechanical fasteners; type, number, length, and spacing.
- f. Coordination with other materials, cants, sleepers, and nailing strips.
- g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.
- h. Installation of cutoffs and proper joining of work on subsequent days.
- i. Continuation of complete roofing system installation to cover insulation installed same day.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07311

ROOFING, STRIP SHINGLES

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY AND STORAGE OF MATERIALS
- 1.4 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Metal Drip Edges
 - 2.1.2 Underlayment
 - 2.1.3 Leak Barrier Underlayment
 - 2.1.4 Ventilators
 - 2.1.4.1 Aluminum Ridge Vents
 - 2.1.4.2 Nailable Plastic Shingle Over Type Ridge Vents
 - 2.1.4.3 Nailable Mesh Shingle Over Type Ridge Vents
 - 2.1.5 Nails
 - 2.1.6 Shingles
- 2.2 COLOR

PART 3 EXECUTION

- 3.1 PREPARATION OF SURFACES
- 3.2 APPLICATION OF ROOFING MATERIALS
 - 3.2.1 Flashings
 - 3.2.2 Metal Drip Edges
 - 3.2.3 Underlayment
 - 3.2.4 Ridge Vents
 - 3.2.5 Shingles

-- End of Section Table of Contents --

SECTION 07311

ROOFING, STRIP SHINGLES

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 225	(1995) Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 1970	(1997) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 3018	(1990; R 1994) Class A Asphalt Shingles Surfaced With Mineral Granules
ASTM D 3161	(1995a) Wind-Resistance of Asphalt Shingles (Fan-Induced Method)
ASTM D 3462	(1997) Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules
ASTM D 4869	(1988; R 1993) Asphalt-Saturated Organic Felt Shingle Underlayment Used in Roofing
ASTM E 108	(1996) Fire Tests of Roof Coverings

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA Asph Shing Roof Mnl	(1996) Asphalt Shingle Roofing Manual
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1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Roofing System; GA.

Manufacturer's catalog data, description of underlayment, shingles,

fasteners, ridge vents, and flashing. Manufacturer's instructions, annotated or supplemented by the Contractor to indicate configuration and method for installing the materials, and for waterproofing of joints where flashings change direction. The number, spacing and orientation of fasteners shall be specified.

SD-14 Samples

Finishes; GA.

Full shingle sample and manufacturer's standard size samples of materials and products requiring color or finish selection.

1.3 DELIVERY AND STORAGE OF MATERIALS

Materials shall be delivered in manufacturer's unopened bundles and containers with the manufacturer's brand and name marked clearly thereon. Shingles shall be stored in accordance with manufacturer's printed instructions. Roll goods shall be stored on end in an upright position or in accordance with manufacturer's recommendations. Immediately before laying, roofing felt shall be stored for 24 hours in an area maintained at a temperature not lower than 10 degrees C. 50 degrees F.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following requirements:

2.1.1 Metal Drip Edges

Metal drip edges shall be minimum 26 gauge galvanized steel or an equivalent non-corrosive non-staining material, as shown.

2.1.2 Underlayment

Organic felt; ASTM D 4869 or ASTM D 226, non perforated Type II, heavy-duty number 30.

2.1.3 Leak Barrier Underlayment

Self-adhering leak barrier or ice dam underlayment shall comply with ASTM D 1970 for sealability around nails.

2.1.4 Ventilators

2.1.4.1 Aluminum Ridge Vents

Ridge vents shall be constructed of prefinished aluminum in minimum 3 m 10 foot long sections and shall be approximately 0.30 m 1 foot wide. Vents shall be designed to prevent infiltration of insects, rain, and snow.

2.1.4.2 Nailable Plastic Shingle Over Type Ridge Vents

Ridge vents shall be constructed of UV stabilized nailable rigid polypropylene material, approximately 0.30 m 1 foot wide and 25 mm 1 inch thick, and shall be in 1.2 m 4 foot long interlocking sections with self-aligning ends or corrugated polyethylene rigid roll or rigid strip ridge vent with aluminum wind deflectors on each side. Vents shall be designed to prevent infiltration of insects, rain, and snow.

2.1.4.3 Nailable Mesh Shingle Over Type Ridge Vents

Ridge vents shall be constructed of UV stabilized nailable polyester mesh material, approximately 0.30 m one foot wide. Vents shall be designed to prevent infiltration of insects, rain, and snow.

2.1.5 Nails

Nails shall be round head 11 or 12 gauge galvanized steel or equivalent corrosion resistant roofing nails. Nail heads shall be 9.5 mm 3/8 inch minimum diameter, with flat and smooth low profile. Shanks shall be barbed or otherwise deformed for added pull-out resistance. Nails shall be long enough to penetrate all layers of roofing materials and achieve secure anchorage into the roof deck. Nails shall extend through the underside of plywood or wood panel roof decks, and shall penetrate at least 19 mm 3/4 inch into wood plank decks.

2.1.6 Shingles

Shingles shall be approximately 333 by 1000 mm 12 by 36 inches in dimension and three-tab strip or architectural designs required by the Task Order. Shingles shall have self-sealing adhesive strips and shall meet a wind velocity rating of 100 km/h 60 mph plus or minus 5 percent in accordance with ASTM D 3161. Shingles shall be manufacturer's standard type for project area. Organic shingles shall comply with ASTM D 225 Type I (uniform or non-uniform thickness) and ASTM E 108 Class C (a high degree of fire protection), and shall weigh as required by the Task Order. Glass felt shingles shall comply with ASTM D 3018 and ASTM D 3462 Type I (self-sealing), ASTM E 108 Class A (a light degree of fire protection), and shall weigh as required by the Task Order.

2.2 COLOR

Shingle color shall be as required by the Task Order.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACES

The construction of any bay or section of roof decking shall be completed before roofing work is started. Roof surfaces shall be smooth, firm, dry, and free from loose boards, large cracks, and projecting ends that might damage the roofing. Vents and other projections through roofs shall be properly flashed and secured in position, and projecting nails shall be driven flush with the deck.

3.2 APPLICATION OF ROOFING MATERIALS

3.2.1 Flashings

Metal flashings shall conform to Section 07600 SHEET METALWORK, GENERAL. Metal flashings shall be provided at the intersections of roofs and

adjoining walls and at projections through the deck such as chimneys and vent stacks. Valley flashing shall be of the open, closed cut or woven type, in accordance with NRCA Asph Shing Roof Mnl.

3.2.2 Metal Drip Edges

Metal drip edges shall be provided along the eaves and rakes. The metal drip edge shall be applied directly over the underlayment along the rakes and directly on the wood deck at the eaves. Metal drip edges shall extend back from the edge of the deck not less than 75 mm 3 inches and shall be secured with compatible nails spaced not more than 250 mm 10 inches on center along the inner edge.

3.2.3 Underlayment

Before any shingles are applied, two layers of asphalt-saturated-felt underlayment shall be applied to the roof deck sheathing. In areas subject to ice damming, two plies of organic felt set in hot asphalt or asphalt lap cement, or an adhered polymer modified bitumen membrane underlayment shall be applied starting from the eaves to a point 600 mm 24 inches inside the interior wall line.

3.2.4 Ridge Vents

Ridge vents shall be provided along the ridge lines where shown. Ridge vents shall be installed in accordance with the manufacturer's printed instructions.

3.2.5 Shingles

Shingles with the correct recommended exposure shall be applied in accordance with the manufacturer's printed instructions as they appear on the bundle wrapping.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07412

NON-STRUCTURAL METAL ROOFING

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
 - 1.2.1 Non-Structural Metal Roof System
 - 1.2.2 Manufacturer
 - 1.2.3 Installer
- 1.3 DESIGN LOADS
- 1.4 PERFORMANCE REQUIREMENTS
- 1.5 SUBMITTALS
- 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 ACCESSORIES
- 2.3 FASTENERS
- 2.4 FACTORY COLOR FINISH
 - 2.4.1 Cyclic Salt Fog/UV Test
 - 2.4.2 Formability Test
 - 2.4.3 Accelerated Weathering, Chalking Resistance and Color Change
 - 2.4.4 Humidity Test
 - 2.4.5 Impact Resistance
 - 2.4.6 Abrasion Resistance Test
 - 2.4.7 Specular Gloss
 - 2.4.8 Pollution Resistance
- 2.5 UNDERLAYMENTS
 - 2.5.1 Felt Underlayment
 - 2.5.2 Rubberized Underlayment
 - 2.5.3 Slip Sheet
- 2.6 INSULATION
 - 2.6.1 Rigid Board Insulation for Use Above a Roof Deck
 - 2.6.1.1 Polyisocyanurate
 - 2.6.1.2 Mineral Fiber
 - 2.6.1.3 Glass Mat Gypsum Roof Board
 - 2.6.2 Blanket Insulation
- 2.7 INSULATION RETAINERS
- 2.8 SEALANT
- 2.9 GASKETS AND INSULATING COMPOUNDS
- 2.10 VAPOR RETARDER

- 2.10.1 Vapor Retarders as Integral Facing
- 2.10.2 Vapor Retarders Separate from Insulation
- 2.10.3 Slip Sheet for Use With Vapor Retarder

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Roofing
 - 3.1.2 Field Forming of Roof Panels for Unique Areas
 - 3.1.3 Underlayment
- 3.2 INSULATION INSTALLATION
 - 3.2.1 Board Insulation in Warm Climates
 - 3.2.2 Board Insulation in Cool Climates
- 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

-- End of Section Table of Contents --

SECTION 07412

NON-STRUCTURAL METAL ROOFING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M	(1997) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(1997) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 991	(1998) Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings
ASTM C 1177/C 1177M	(1996) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1994) Specular Gloss

ASTM D 610	(1995) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	(1987; R 1998) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1997) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water- Exposure Apparatus
ASTM D 5894	(1996) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet
ASTM E 84	(1998e1) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies
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1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a commercially available roofing system which satisfies the specified design and additional requirements contained herein. The roofing system shall be provided by the Contractor as a complete system, as tested and approved in accordance with UL 580. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

1.2.1 Non-Structural Metal Roof System

The Non-Structural Metal Roof System covered under this specification shall include the entire roofing system; the metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. The system shall be installed on a substrate as required by the Task Order. 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; and items specified in other sections of the specifications that are part of the system.

1.2.2 Manufacturer

The non-structural metal roofing system shall be the product of a manufacturer who has been in the practice of manufacturing metal roofs 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.

1.2.3 Installer

The installer shall be certified by the metal roof 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.

1.3 DESIGN LOADS

Non-structural Metal Roof System assemblies shall be tested as defined in UL 580 and shall be capable of resisting the wind uplift pressures shown on the contract drawings or, as a minimum, shall be approved to resist wind uplift pressures of UL 580, Class 90.

1.4 PERFORMANCE REQUIREMENTS

The metal roofing system supplied shall conform to the roof slope, the underlayment, and uplift pressures shown on the contract drawings. The Contractor shall furnish a commercially available roofing system which satisfies all the specified requirements.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL

PROCEDURES:

SD-04 Drawings

Metal Roofing; GA.

a. Drawings consisting of catalog cuts, flashing details, erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be provided by the metal roofing manufacturer.

b. Drawings showing the UL 580, Class 90 tested roof system assembly.

SD-13 Certificates

Roof Panels; GA. Installation; FIO. Accessories; FIO.

Certificates attesting that the panels and accessories conform to the specified requirements. Certificate for the roof assembly shall certify that the assembly complies with the material and fabrication requirements specified and is suitable for the installation at the indicated design slope. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that at least 3 representative samples of similar material to that which will be provided on this project have been previously tested and have met the quality standards specified for factory color finish.

Insulation; FIO.

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

Installer; GA.

Certification of installer.

Warranties; GA.

At the completion of the project, signed copies of the 5-year Warranty for Non-Structural Metal Roofing System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material and Weathertightness Warranties.

SD-14 Samples

Accessories; FIO.

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

Roof Panels; FIO.

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

Fasteners; GA.

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

Gaskets and Insulating Compounds; GA.

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

Sealant; GA.

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

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 weather tight coverings and kept dry. Material shall not be covered with plastic where such covering will allow sweating and condensation. Plastic may be used as tenting with air circulation allowed. Storage conditions shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The Non-Structural Metal Roofing 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 Non-Structural Metal Roofing 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 roofing covered under this warranty shall include the entire roofing system, including but not limited to, the roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. 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; and items specified in other sections of the specifications that are part of the roof system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to service 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 NON-STRUCTURAL METAL ROOF 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 5 year Contractor's warranty period for the entire roofing system as outlined above.

1.7.2 Manufacturer's Material Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all Non-Structural Metal Roofing System components such as roof panels, 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, fail structurally, or perforate under normal atmospheric conditions at the site. 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 warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing or replacing the defective coated coil material.

c. A roofing system manufacturer's 20 year system weathertightness warranty.

1.8 COORDINATION MEETING

A coordination meeting shall be held within 15 days after task order award for mutual understanding of the metal roofing system contract requirements.

This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing system manufacturer, the roofing supplier, the erector, the designer, 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

Panels shall be steel or aluminum and shall have a mill or factory color finish as required by the Task Order. 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. Sheets longer than 9 m 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide nominal 300 mm 12 inches of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be either square-cut or miter-cut. The ridge cap shall be installed as recommended by the metal roofing manufacturer. Height of corrugations, ribs, or seams, at overlap of adjacent roof sheets shall be the building manufacturer's standard for the indicated roof slope.

2.1.1 Steel Panels

Zinc-coated steel conforming to ASTM A 653/A 653M; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 or 50 coating (as required by the Task Order); or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Uncoated roof panels shall be 0.6 mm 0.024 inch thick minimum. Panels shall be within 95 percent of the nominal thickness. Prior to shipment, mill finish panels shall be treated with a passivating chemical and oiled 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

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 ACCESSORIES

Accessories shall be compatible with the roofing furnished. Flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for roof panels. 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.

2.3 FASTENERS

Fasteners for roof panels shall be zinc-coated steel, aluminum, or nylon capped steel, type and size as recommended by the manufacturer to meet the performance requirements. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the roofing to waterproof the fastener penetration. Washer material shall be compatible with the panels; 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 FACTORY COLOR FINISH

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 as required by the Task Order. The exterior coating shall be a nominal 0.050 mm 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 0.025 mm 1.0 mil thickness. The exterior color finish shall meet the test requirements specified below.

2.4.1 Cyclic Salt Fog/UV Test

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.

2.4.2 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 fracturing to the naked eye.

2.4.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition B or D for the total hours as required by the Task Order. 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 that can be readily removed from the base metal with tape 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.

2.4.4 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.

2.4.5 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 N-meters, 1.5 times the metal thickness in mils, expressed in inch-pounds, with no cracking.

2.4.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 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.

2.4.7 Specular Gloss

Finished roof surfaces shall have a specular gloss value of 10 or less at an angle of 85 degrees or 30 plus or minus at 60 degrees when measured in accordance with ASTM D 523 as required by the Task Order.

2.4.8 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.

2.5 UNDERLAYMENTS

2.5.1 Felt Underlayment

Felt underlayment shall be No. 30 felt in accordance with ASTM D 226, Type II.

2.5.2 Rubberized Underlayment

Rubberized underlayment shall be equal to "Ice and Water Shield" as manufactured by Grace Construction Products, "Winterguard" as manufactured by CertainTeed Corporation, or "Weather Watch Ice and Water Barrier" as manufactured by GAF Building Materials Corporation.

2.5.3 Slip Sheet

Slip Sheet shall be 0.24 kg per square meter 5 pounds per 100 sf rosin sized unsaturated building paper.

2.6 INSULATION

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 and a smoke developed rating, as required by the Task Order, 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.

2.6.1 Rigid Board Insulation for Use Above a Roof Deck

2.6.1.1 Polyisocyanurate

Polyisocyanurate insulation shall conform to ASTM C 1289, Type I, Class 2 (having a minimum recovered material content of 9 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.

2.6.1.2 Mineral Fiber

Insulation shall conform to ASTM C 612.

2.6.1.3 Glass Mat Gypsum Roof Board

Glass mat gypsum roof board for underlayment/overlayment, thermal protection, or insulation protection shall be in accordance with ASTM C 1177/C 1177M.

2.6.2 Blanket Insulation

Blanket insulation shall conform to ASTM C 991.

2.7 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.

2.8 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color 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.

2.9 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.

2.10 VAPOR RETARDER

2.10.1 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 of reinforced foil with a vinyl finish or sheet vinyl; except that unreinforced foil with a natural finish may be used in concealed locations. Facings and finishes shall be factory applied.

2.10.2 Vapor Retarders Separate from Insulation

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.

2.10.3 Slip Sheet for Use With Vapor Retarder

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

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. 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 Roofing

Side laps shall be laid away from the prevailing winds. Side and end lap distances, joint sealing, and fastening and spacing of fasteners shall be in accordance with manufacturer's standard practice. Spacing of exposed fasteners shall present an orderly appearance. Side laps and end laps of roof panels and joints at accessories shall be sealed. Fasteners shall be driven normal to the surface. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weathertight installation. Accessories shall be fastened into substrate, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction.

3.1.2 Field Forming of Roof Panels for Unique Areas

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 approved installer. In cold weather conditions, preheating of the steel coils to be field formed shall be performed as necessary just prior to the rolling operations.

3.1.3 Underlayment

Underlayment types shall be installed where shown on the drawings; they shall be installed directly over the substrate. If a roof panel rests directly on the underlayments, a slip sheet shall be installed as a top layer, beneath the metal roofing panels, to prevent adhesion. All underlayments shall be installed so that successive strips overlap the next lower strip in shingle fashion. Underlayments shall be installed in accordance with the manufacturer's written instructions. The underlayments shall ensure that any water that penetrates below the metal roofing panels will drain outside of the building envelope.

3.2 INSULATION INSTALLATION

Insulation shall be installed as indicated and in accordance with manufacturer's instructions. 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 and vapor retarder providing equivalent R-Value and perm rating as remaining insulation.

3.2.1 Board Insulation in Warm Climates

Rigid or semirigid board insulation shall be laid in close contact. 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. Rigid insulation 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, with no less than 1 fastener and bearing plate per 0.37 square meter 1 fastener and bearing plates per 4 square feet of insulation. Layout and joint pattern of insulation and fasteners shall be indicated on the shop drawings.

3.2.2 Board Insulation in Cool Climates

A layer of unfaced blanket insulation shall be placed over the board insulation and held tight against the metal roofing.

3.3 PROTECTION OF VAPOR RETARDER FROM ROOF DECK

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

3.4 VAPOR RETARDER INSTALLATION

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

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

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF 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
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

THE NON-STRUCTURAL METAL ROOF 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 NON-STRUCTURAL METAL ROOFING 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 UL 580. 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 NON-STRUCTURAL METAL ROOFING SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE NON-STRUCTURAL METAL ROOF 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
NON-STRUCTURAL METAL ROOFING SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE NON-STRUCTURAL METAL ROOFING 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 NON-STRUCTURAL METAL ROOF 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 NON-STRUCTURAL METAL ROOFING 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
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

**REPORTS OF LEAKS AND ROOF 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 ROOF 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 NON-STRUCTURAL METAL ROOF 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 --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07413

METAL SIDING

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
 - 1.2.1 Design
 - 1.2.2 Architectural Considerations
- 1.3 SUBMITTALS
- 1.4 DELIVERY AND STORAGE
- 1.5 WARRANTIES

PART 2 PRODUCTS

- 2.1 SIDING
 - 2.1.1 Wall Panels
 - 2.1.2 Steel Panels
 - 2.1.3 Aluminum Panels
 - 2.1.4 Factory Insulated Panels
- 2.2 FACTORY COLOR FINISH
 - 2.2.1 Salt Spray Test
 - 2.2.2 Formability Test
 - 2.2.3 Accelerated Weathering, Chalking Resistance and Color Change
 - 2.2.4 Humidity Test
 - 2.2.5 Impact Resistance
 - 2.2.6 Abrasion Resistance Test
- 2.3 ACCESSORIES
- 2.4 FASTENERS
 - 2.4.1 Screws
 - 2.4.2 End-Welded Studs
 - 2.4.3 Explosive Actuated Fasteners
 - 2.4.4 Blind Rivets
 - 2.4.5 Bolts
- 2.5 INSULATION
- 2.6 VAPOR RETARDER
 - 2.6.1 Vapor Retarders as Integral Facing
 - 2.6.2 Vapor Retarders Separate from Insulation
- 2.7 WALL LINERS
- 2.8 SEALANT
- 2.9 GASKETS AND INSULATING COMPOUNDS

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Siding and Accessories
 - 3.1.1.1 Lap Type Panels with Exposed Fasteners
 - 3.1.1.2 Concealed Fastener Wall Panels

-- End of Section Table of Contents --

SECTION 07413

METAL SIDING

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA Design Manual (1994) Aluminum Design Manual:
Specifications and Guidelines for Aluminum
Structures

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl (1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M (1997) Steel Sheet, Aluminum-Coated, by
the Hot-Dip Process

ASTM A 653/A 653M (1998) Steel Sheet, Zinc-Coated
(Galvanized) or Zinc-Iron Alloy-Coated
(Galvannealed) by the Hot-Dip Process

ASTM A 792/A 792M (1997) Steel Sheet, 55% Aluminum-Zinc
Alloy-Coated by the Hot-Dip Process

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet
and Plate

ASTM B 209M (1995) Aluminum and Aluminum-Alloy Sheet
and Plate (Metric)

ASTM C 518 (1998) Steady-State Heat Flux Measurements
and Thermal Transmission Properties by
Means of the Heat Flow Meter Apparatus

ASTM D 522 (1993a) Mandrel Bend Test of Attached
Organic Coatings

ASTM D 610 (1995) Evaluating Degree of Rusting on
Painted Steel Surfaces

ASTM D 714 (1987; R 1994) Evaluating Degree of
Blistering of Paints

ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1997) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water- Exposure Apparatus
ASTM D 5894	(1996) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV Condensation Cabinet)
ASTM E 84	(1998e1) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures
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1.2 GENERAL REQUIREMENTS

1.2.1 Design

Criteria, loading combinations, and definitions shall be in accordance with ASCE 7. Maximum calculated fiber stress shall not exceed the allowable value in the AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads shall be limited to L/180. Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Members and connections not shown on the drawings shall be designed by the Contractor. Siding panels and accessories shall be the products of the same manufacturer. Steel

siding design shall be in accordance with AISI Cold-Formed Mnl. Aluminum siding design shall be in accordance with AA Design Manual.

1.2.2 Architectural Considerations

Panels profile shall be as shown on the drawings.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Siding; GA.

Drawings consisting of catalog cuts, design and erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be accompanied by engineering design calculations for the siding panels.

SD-13 Certificates

Siding; GA. Installation; FIO. Accessories; FIO.

Certificates attesting that the panels and accessories conform to the requirements specified. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish. Mill certification for structural bolts, siding, and wall liner panels.

Insulation; FIO.

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

SD-14 Samples

Accessories; FIO.

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

Siding; FIO.

One piece of each type and finish (exterior and interior) to be used, 225 mm 9 inches long, full width.

Fasteners; GA.

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 jobsite 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; FIO.

One piece of each type to be used, and descriptive data covering installation.

Gaskets and Insulating Compounds; FIO.

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

Sealant; FIO.

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

Wall Liners; FIO.

One piece, 225 mm 9 inches long, full width.

1.4 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 accommodations for metal siding shall provide good air circulation and protection from surface staining.

1.5 WARRANTIES

The Contractor shall provide a weather tight warranty for the metal siding for a period of 20 years to include siding panel assembly, 10 years against the wear of color finish, and 10 years against the corrosion of fasteners caused by ordinary wear and tear by the elements. The warranties shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

PART 2 PRODUCTS

2.1 SIDING

Panels shall be steel or aluminum and shall have a mill or factory color finish as required by the Task Order. Length of sheets shall be sufficient to cover the entire height of any unbroken wall surface when length of run is 9 m 30 feet or less. When length of run exceeds 9 m, 30 feet, each sheet in the run shall extend over two or more spans. Sheets longer than 9 m 30 feet may be furnished if approved by the Contracting Officer. Width of sheets with overlapping configurations shall provide not less than 600 mm 24 inches of coverage in place, and those with interlocking ribs shall provide not less than 300 mm 12 inches of coverage in place.

2.1.1 Wall Panels

Wall panels shall have edge configurations for overlapping adjacent sheets or interlocking ribs for securing adjacent sheets as required by the Task Order. Wall panels shall be fastened to framework using exposed or concealed fasteners as required by the Task Order.

2.1.2 Steel Panels

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 (as required by the Task Order); or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Uncoated wall panels shall be 0.6 mm 0.024 inch thick minimum. Prior to shipment, mill finish panels shall be treated with a passivating chemical and oiled to inhibit the formation of oxide corrosion products. Panels that have become wet during shipment but have not started to oxidize shall be dried, retreated, and re-oiled.

2.1.3 Aluminum Panels

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

2.1.4 Factory Insulated Panels

Insulated wall panels shall be factory-fabricated units with insulating core between metal face sheets, securely fastened together and uniformly separated with rigid spacers; facing of steel or aluminum of composition and gauge specified for siding; and constructed to eliminate condensation on interior of the panel as required by the Task Order. Panels shall have a factory color or mill finish as required by the Task Order. Insulation shall be compatible with adjoining materials; nonrunning and nonsettling; capable of retaining its R-value for the life of the metal facing sheets; and unaffected by extremes of temperature and humidity. The assembly shall have a flame spread rating not higher than 25 or 75, and smoke developed rating not higher than 50 or 100 when tested in accordance with ASTM E 84 as required by the Task Order. The insulation shall remain odorless, free from mold, and not become a source of food and shelter for insects. Panels shall be not less than 200 mm 8 inches wide and shall be in one piece for unbroken wall heights.

2.2 FACTORY COLOR FINISH

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. The exterior coating shall be a nominal 0.050 mm 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 0.025 mm 1.0 mil thickness. The interior color finish shall consist of the same coating and dry film thickness as the exterior. The exterior color finish shall meet the test requirements specified below.

2.2.1 Salt Spray Test

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, 2.0 to 3.0 mm 1/16 to 1/8 inch failure at scribe, as determined by ASTM D 1654.

2.2.2 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

fracturing to the naked eye.

2.2.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition for the total hours as required by the Task Order. 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 that can be readily removed from the base metal with tape 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 (ΔE) 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.

2.2.4 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.

2.2.5 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 loss of adhesion.

2.2.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 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.

2.3 ACCESSORIES

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 chlorided premolded to match configuration of the panels and shall not absorb or retain water.

2.4 FASTENERS

Fasteners for steel 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 panels shall be aluminum or corrosion resisting steel. Fasteners for attaching wall panels to supports shall provide both tensile and shear strength of not less than 3340 N 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed wall fasteners shall be color finished or provided with plastic color caps to match the panels. Nonpenetrating fastener system for wall panels using concealed

clips shall be manufacturer's standard for the system provided.

2.4.1 Screws

Screws shall be as recommended by the manufacturer.

2.4.2 End-Welded Studs

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

2.4.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank of not less than 3.68 mm 0.145 inch with a shank length of not less than 13 mm 1/2 inch for fastening panels to steel and not less than 25 mm 1 inch for fastening panels to concrete.

2.4.4 Blind Rivets

Blind rivets shall be aluminum with 5 mm 3/16 inch nominal diameter shank or 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.

2.4.5 Bolts

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

2.5 INSULATION

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 and a smoke developed rating, as required by the Task Order, 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.

2.6 VAPOR RETARDER

2.6.1 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 of reinforced foil with a vinyl finish or sheet vinyl; except that unreinforced foil with a natural finish may be used in concealed locations. Facings and finishes shall be factory applied.

2.6.2 Vapor Retarders Separate from Insulation

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.

2.7 WALL LINERS

Wall liners shall be 0.6 mm 0.024 inch thick minimum for aluminum or 0.45 mm 0.018 inch thick minimum for steel with the same composition specified for siding, and formed or patterned to prevent waviness and distortion, and shall extend from floor to a height as required by the Task Order. Matching metal trim shall be provided at base of wall liner, top of wall liner, around openings in walls and over interior and exterior corners. Wall liners shall have the same factory color finish as specified for the wall panels. Colors shall be as indicated.

2.8 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency.

2.9 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.

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 from each other by means of gaskets or insulating compounds. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, panels 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 Siding and Accessories

Siding shall be applied with the longitudinal configurations in the vertical position. Accessories shall be fastened into framing members, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction.

3.1.1.1 Lap Type Panels with Exposed Fasteners

End laps shall be made over framing members with fasteners into framing members approximately 50 mm 2 inches from the end of the overlapping sheet. Side laps shall be laid away from the prevailing winds. Spacing of fasteners shall present an orderly appearance and shall not exceed: 200 mm 8 inches on center at end laps of siding, 200 mm 8 inches on center at

connection of siding to intermediate supports, and 450 mm 18 inches on center at side laps of siding except when otherwise approved. Side and end laps of siding and joints at accessories shall be sealed. Fasteners shall be installed in straight lines within a tolerance of 13 mm 1/2 inch in the length of a bay. Fasteners shall be driven normal to the surface and to a uniform depth to seat the gasketed washers properly.

3.1.1.2 Concealed Fastener Wall Panels

Panels shall be fastened to framing members with concealed fastening clips or other concealed devices standard with the manufacturer. Spacing of fastening clips and fasteners shall be in accordance with the manufacturer's written instructions. Spacing of fasteners and anchor clips along the panel interlocking ribs shall not exceed 300 mm 12 inches on center except when otherwise approved. Fasteners shall not puncture metal sheets except as approved for flashing, closures, and trim; exposed fasteners shall be installed in straight lines. Interlocking ribs shall be sealed with factory-applied sealant. Joints at accessories shall be sealed.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07510

BUILT-UP ROOFING

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 STORAGE OF MATERIALS

PART 2 PRODUCTS

- 2.1 PRIMER
- 2.2 BITUMEN
 - 2.2.1 Asphalt
 - 2.2.2 Coal-Tar Bitumen
- 2.3 BITUMINOUS CEMENT
- 2.4 CANTS
- 2.5 FELT
 - 2.5.1 Base Sheet
 - 2.5.2 Venting Inorganic Base Sheet
 - 2.5.3 Glass Roofing Felt
 - 2.5.4 Organic Felt Base
 - 2.5.5 Organic Felt
- 2.6 MINERAL-SURFACED ROLL ROOFING
- 2.7 NAILS AND FASTENERS
- 2.8 AGGREGATE SURFACING MATERIALS
- 2.9 WALKWAY SURFACES
 - 2.9.1 Mineral Asphalt Plank
 - 2.9.2 Concrete Slab
- 2.10 WOVEN GLASS FABRIC
- 2.11 INSULATION
- 2.12 Glass Mat Gypsum Roof Board
- 2.12 FLASHINGS

PART 3 EXECUTION

- 3.1 COORDINATION
 - 3.1.1 Insulation
 - 3.1.2 Sheet Metalwork
- 3.2 ENVIRONMENTAL CONDITIONS
- 3.3 PREPARATION REQUIREMENTS
- 3.4 INSTALLATION OF CANTS
- 3.5 CONDITION OF SURFACES
- 3.6 MECHANICAL APPLICATION DEVICES
- 3.7 PRIMING
- 3.8 HEATING OF BITUMEN
- 3.9 BITUMEN STOPS
- 3.10 BITUMEN APPLICATION
- 3.11 APPLICATION OF FELTS

- 3.11.1 On Gypsum, Lightweight Concrete or Insulating Concrete Surfaces
- 3.11.2 On Concrete or Insulation Surfaces
- 3.12 MECHANICAL FASTENING
- 3.13 PROTECTION OF APPLIED ROOFING
- 3.14 FLASHINGS
 - 3.14.1 Base Flashings
 - 3.14.2 Strip Flashings
 - 3.14.3 Valleys and Ridges
- 3.15 WALKWAYS
- 3.16 AGGREGATE SURFACING
- 3.17 GLAZE COAT
- 3.18 ROOF CUT-OUT TESTS
- 3.19 INSPECTION
- 3.20 INFRARED INSPECTION

-- End of Section Table of Contents --

SECTION 07510
BUILT-UP ROOFING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM C 728	(1997) Perlite Thermal Insulation Board
ASTM C 1153	(1997) Location of Wet Insulation in Roofing Systems Using Infrared Imaging
ASTM C 1177/C 1177M	(1996) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 43	(1994) Coal Tar Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 227	(1998) Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 312	(1995a) Asphalt Used in Roofing
ASTM D 450	(1996) Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing
ASTM D 517	(1992) Asphalt Plank
ASTM D 1668	(1997a) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D 1863	(1993; R 1996) Mineral Aggregate Used on Built-Up Roofs
ASTM D 2178	(1997) Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 2626	(1997b) Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing

ASTM D 3617	(1983; R 1994) Sampling and Analysis of New Built-Up Roof Membranes
ASTM D 3909	(1997) Asphalt Roll Roofing (Glass Felt) Surfaced With Mineral Granules
ASTM D 4022	(1994) Coal Tar Roof Cement, Asbestos Containing
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free
ASTM D 4601	(1998) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4897	(1998) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825c	(1998) Approval Guide Building Materials
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1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Inspection; GA.

The inspection procedure for roofing installation, prior to the start of roofing work.

SD-13 Certificates

Bitumen; FIO. Felt; FIO.

Certificates of Compliance for felts and bitumens.

Cants; FIO.

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

1.3 STORAGE OF MATERIALS

Felts, fabrics, and roll roofing shall be kept dry before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer, and stored on end 1 level high. Felt rolls shall be maintained at a temperature above 10 degrees C 50 degrees F for 24 hours immediately before laying. Aggregate shall be kept dry as defined by ASTM D 1863.

PART 2 PRODUCTS

2.1 PRIMER

ASTM D 41 for asphalt roofing systems; ASTM D 43 for coal-tar roofing systems.

2.2 BITUMEN

2.2.1 Asphalt

ASTM D 312, Type III on slopes from 21 mm per m 1/4 inch per foot up to and including 250 mm per m 3 inches per foot; Type IV on slopes above 250 mm per m 3 inches per foot. Bills of lading shall indicate the flash point and equiviscous temperature (EVT) or this information shall be shown on labels for each container of asphalt.

2.2.2 Coal-Tar Bitumen

ASTM D 450, Type III, for 21 mm per m 1/4 inch per foot slope as an option to asphalt.

2.3 BITUMINOUS CEMENT

ASTM D 4586 for use with asphalt roofing systems. ASTM D 4022 for use with coal-tar roofing systems; preference shall be given to cements whose mineral fillers exclude asbestos fibers.

2.4 CANTS

Cants shall be made from treated wood or treated fiberboard not less than 89 mm 3-1/2 inches high or perlite board, as required by the Task Order, cut to reduce change in direction of the membrane to 45 degrees or less. Treated wood shall be of water-borne preservative-treated material as specified in Section 06100ROUGH CARPENTRY. Perlite and fiberboard shall contain the highest practicable percentage of materials which have been recovered or diverted from solid waste (e.g., postconsumer waste), but not including material reused in a manufacturing process. Where two materials have comparable price and performance, the one having the higher recovered material content shall be selected. Fiberboard shall conform to ASTM C 208 with a minimum recovered material content of 80 percent, treated with sizing, wax or bituminous impregnation. Perlite board shall conform to ASTM C 728 with a minimum recovered material content of 23 percent of the expanded perlite portion of the board.

2.5 FELT

2.5.1 Base Sheet

Base sheet shall conform to ASTM D 4601, Type II, with no perforations.

2.5.2 Venting Inorganic Base Sheet

ASTM D 4897, Type II.

2.5.3 Glass Roofing Felt

ASTM D 2178, Type IV or VI, except felts for coal tar systems shall be impregnated with a bituminous resin coating which is compatible with coal tar bitumen.

2.5.4 Organic Felt Base

ASTM D 2626 for use with asphalt roofing system.

2.5.5 Organic Felt

ASTM D 226 for use with asphalt roofing system and ASTM D 227 for use with coal-tar roofing system. Organic felts may be used for bitumen stops, and edge envelopes.

2.6 MINERAL-SURFACED ROLL ROOFING

ASTM D 3909.

2.7 NAILS AND FASTENERS

Nails and fasteners shall be an approved type recommended by the roofing felt manufacturer. Fasteners for steel or concrete deck shall conform to FM P7825c for Class I roof deck construction, to withstand an uplift pressure of 440 kg per square meter. 90 pounds per square foot.

2.8 AGGREGATE SURFACING MATERIALS

Crushed stone, gravel, or crushed slag conforming to ASTM D 1863. Subject to approval, other materials may be used when blended to the grading requirements of ASTM D 1863. Aggregate shall be light-colored and opaque.

2.9 WALKWAY SURFACES

2.9.1 Mineral Asphalt Plank

ASTM D 517, minimum 19.1 mm (3/4 inch) 3/4 inch thick.

2.9.2 Concrete Slab

Precast Concrete 20.7 MPa, 300 x 600 x 63 mm 3000 psi, 12 x 24 x 2-1/2 inches.

2.10 WOVEN GLASS FABRIC

ASTM D 1668, Type I for asphalt roofing systems and Type II for coal-tar roofing systems.

2.11 INSULATION

Insulation shall be fiberboard, composite board, expanded perlite, mineral fiber, or polyisocyanurate, as specified in Section 07220 ROOF INSULATION. Top layer shall be minimum 19 mm 3/4 inch thick fiberboard, mineral fiber or perlite.

2.12 Glass Mat Gypsum Roof Board

Glass mat gypsum roof board shall be in accordance with ASTM C 1177/C 1177M, flame spread - 0, smoke developed - 0, 3446 kpa 500 psi Class A non-combustible. The glass mat gypsum roof board shall be a minimum 6.35 mm 1/4 inch thickness.

2.12 FLASHINGS

Bituminous flashings in accordance with these specifications shall be used throughout unless otherwise specified or indicated.

PART 3 EXECUTION

3.1 COORDINATION

The entire roofing system, excluding flood coat and aggregate surfacing, shall be finished in 1 operation up to the line of termination at end of day's work. Glaze coating may be considered part of the flood coat as specified in paragraph GLAZE COAT. Phased construction will not be permitted.

3.1.1 Insulation

Application of roofing shall immediately follow application of insulation as a continuous operation. Roofing operations shall be coordinated with insulation work so that all roof insulation applied each day is waterproofed the same day. Insulation is specified in Section 07220 ROOF INSULATION.

3.1.2 Sheet Metalwork

Roofing operations shall be coordinated with sheet metalwork so that sheet metal items are installed to permit continuous roof surfacing operations the same day felts are installed. Sheet metalwork is specified in Section 07600 SHEET METALWORK, GENERAL.

3.2 ENVIRONMENTAL CONDITIONS

Air temperature shall be above 4 degrees C 40 degrees F and there shall be no visible ice, frost, or moisture on the roof deck at the time roofing is installed.

3.3 PREPARATION REQUIREMENTS

The substrate construction of a bay or section of the building shall be completed before roofing work is begun thereon. Roofing applied directly on concrete shall not be scheduled until frothing or bubbling does not occur when hot bitumen is applied to the concrete and until the hot bitumen sticks tightly to the concrete. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Nailers, curbs and other items attached to roof surface shall be in place before roofing is begun.

3.4 INSTALLATION OF CANTS

Cants shall be installed in the angles formed between the roof and walls or other vertical surfaces. Cants shall be laid in a solid coat of bituminous cement just prior to laying the roofing plies. Cants shall be continuous, and shall be installed in lengths as long as practicable. Additional cants are not required at locations where cast-in-place cants are integrally formed with the structural deck or roof fill.

3.5 CONDITION OF SURFACES

Surfaces shall be inspected and approved immediately before application of roofing and flashings. The roofing and flashings shall be applied to a smooth and firm surface free from ice, frost, visible moisture, dirt,

projections, and foreign materials. Prior to application of primer on precast concrete decks, joints shall be covered with a 100 mm 4 inch strip of roofing felt, embedded in and coated with bituminous cement.

3.6 MECHANICAL APPLICATION DEVICES

Mechanical application devices shall be mounted on pneumatic-tired wheels, and shall be designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

3.7 PRIMING

Concrete surfaces to receive bitumen shall be uniformly coated with primer at a rate of not less than 0.4 L per m square (1 gallon per square) 1 gallon per square and allowed to dry. Primer shall be compatible with the bitumen to be used.

3.8 HEATING OF BITUMEN

Asphalt shall not be heated higher than 24 degrees C 75 degrees F above the EVT or 10 degrees C 50 degrees below the flash point or 274 degrees C 525 degrees F (maximum) whichever is lower. EVT and flash point temperatures of asphalt in the kettle shall be conspicuously posted on the kettle. Coal tar bitumen shall not be heated above 218 degrees C 425 degrees F. as recommended by the roofing manufacturer. Heating kettles shall be provided with automatic thermostatic controls and an accurate thermometer. Kettle operators shall be in attendance at all times during the heating to ensure that the maximum temperature specified is not exceeded. Equipment utilizing flame-heat shall not be placed on the roof.

3.9 BITUMEN STOPS

Bitumen stops shall be installed at roof edges, openings and vertical projections before application of roofing plies unless otherwise recommended by the manufacturer's printed instructions. Bitumen stops shall be formed of two 450 mm 18 inch wide strips of organic felt. Two hundred twenty five millimeters Nine inches of the width shall be attached to the roof surface with 225 mm 9 inches extending beyond the edge. The first strip shall be applied in a 225 mm 9 inch wide layer of bituminous roofing cement and nailed 13 mm 1/2 inch from the roof edge at 150 mm 6 inch spacing. The second strip shall be applied to the first in a 225 mm 9 inch wide mopping of bitumen. The free portion of each strip shall be protected from damage throughout the roofing period. After the roofing plies are in place, the free portion of each strip shall be folded back over the roofing membrane and embedded in a continuous coating of bituminous cement and secured with roofing nails spaced 75 mm 3 inches on centers.

3.10 BITUMEN APPLICATION

Asphalt shall be applied within a range of 14 degrees C 25 degrees F below to 14 degrees C 25 degrees F above the EVT. Temperature of coal-tar bitumen at the time it is applied shall be in accordance with the bitumen manufacturer's recommendations. Application temperatures shall be measured at the mop bucket or mechanical applicator. Bitumen at a temperature below the recommended temperature shall be returned to the kettle. Each layer of felt shall be laid in not less than 0.97 kg (20 pounds) 20 pounds nor more than 1.7 kg (35 pounds) 35 pounds of asphalt per square meter or not less than 1.4 kg 30 pounds nor more than 1.7 kg 35 pounds of coal-tar bitumen

per square meter. Where solid moppings are required, the following requirements as evidenced in any one roof cut-out sample shall apply:

- a. Overlapping voids between two or more plies are not acceptable.
- b. The maximum length of any individual void that is encapsulated in bitumen shall be 50 mm. 2 inches.
- c. The total length of all voids encapsulated in bitumen shall not exceed 100 mm 4 inches between any two plies.
- d. Dry voids (the absence of bitumen between plies) are not acceptable.
- e. Voids continuous through the specimen are not acceptable.
- f. Visual interply moisture in voids is not acceptable.

3.11 APPLICATION OF FELTS

Felt plies shall be laid at right angles to the slope of the deck with minimum 150 mm 6 inch end-laps staggered at least 300 mm 12 inches. Felts shall be applied in 900 mm 36 inch widths with 24 17 mm 2/3 inch side laps and starter sheets 300, 600 and 900 mm 12, 24 and 36 inches wide along eaves to maintain 4 full plies including the base sheet when used. The full 900 mm 36 inch width of each ply shall be placed in hot bitumen immediately behind the applicator. A squeegee or broom or follow through tool shall be used to eliminate air pockets and obtain complete adhesion between plies. Bitumen shall be visible beyond all edges of each ply as it is being installed. Plies shall be laid free of wrinkles, creases or fishmouths. Each layer of roofing felt shall be carried up to the top of the cant. Workers shall not walk on mopped surfaces when the bitumen is fluid. For slopes exceeding 42 mm per m 1/2 inch per foot, each felt ply, other than venting base sheet, shall be nailed 50 mm 2 inches and 150 mm 6 inches from upper edge with nails spaced 300 mm 12 inches on centers in each row.

3.11.1 On Gypsum, Lightweight Concrete or Insulating Concrete Surfaces

One ply of venting inorganic base sheet shall be laid, shingle fashion, without mopping and with each sheet lapping 100 mm 4 inches over the previous sheet. Each base sheet shall be nailed or fastened at 225 mm 9 inch intervals along laps and shall also be nailed or fastened at 450 mm 18 inch intervals staggered down the center of the sheet in 2 rows 275 mm 11 inches apart. Three plies of glass roofing felts shall be immediately placed shingle-fashion in solid mopped bitumen over the base sheet as specified. Felts shall be applied in 900 mm 36 inch widths with 24 17 mm 2/3 inch side laps and starter sheets 300, 600 and 900 mm 12, 24 and 36 inches wide along eaves to maintain 3 full plies over the base sheet.

3.11.2 On Concrete or Insulation Surfaces

Four plies of 900 mm 36 inch wide glass roofing felts shall be placed shingle-fashion in solid mopped bitumen.

3.12 MECHANICAL FASTENING

Nails and fasteners for securing roofing shall be flush driven through flat metal disks of not less than 25 mm 1 inch diameter. Metal disks may be

omitted where heads of fasteners are equivalent in size to the 25 mm 1 inch diameter disks. Fasteners, when required, shall be spaced within 20 percent of the indicated spacing dimensions. There shall be no less than the total number of indicated fasteners in any 10 square meter 100 square feet area. Fastener pull-out resistance shall be not less than 180 N 40 pounds each.

3.13 PROTECTION OF APPLIED ROOFING

At end of day's work or whenever precipitation is imminent, the terminated edge of built-up roofing shall be sealed with 2 full width strips of roofing felt set in and coated with bituminous cement. One half-width of the strips shall be extended up and over the finished roofing and the other half-width extended out and onto the bare roof deck. Sealing strips shall be removed before continuing installation of roofing. To facilitate sealing, termination edges may be straightened with pieces of insulation board which shall be removed when work is resumed.

3.14 FLASHINGS

Flashings shall be provided over cants in the angles formed at walls and other vertical surfaces and where required to make the work watertight. Bituminous flashings described below shall be used, except where metal flashings are specified in other sections of the specifications. Flashings shall be provided and installed immediately after the top ply of felt is placed and before the flood coat and aggregate are placed, adjacent to the flashing. Modified bituminous flashing may be used when it is specified in the roofing manufacturer's instructions.

3.14.1 Base Flashings

Base Flashings shall be a 3-ply system using woven glass fabric, laid in roofing cement, with mineral surfaced roll roofing as the outer ply. The top of the base flashing shall be at least 200 mm 8 inches above the roof membrane surface. Mineral surfaced roofing strips shall be cut from the width of the rolls, and shall extend from the reglet or top of curb onto the roof at least 50 mm 2 inches beyond the widest flashing ply. Laps shall be well cemented, and where possible, shall be shingled in a direction down slope or away from the prevailing wind. The top edge of base flashing systems shall be nailed a maximum of 200 mm 8 inches on center.

3.14.2 Strip Flashings

Sheet metal flashings, bitumen stops and gravel stops installed over the roofing top ply shall be strip flashed with 2 layers of roofing felt, 225 mm 9 inches and 300 mm 12 inches wide and successively cemented in place.

3.14.3 Valleys and Ridges

Felt plies shall continue across valleys and ridges and terminate approximately 300 mm 12 inches from the valley or ridge. Exposed lap shall terminate on a line approximately 300 mm 12 inches from, and parallel to the valley or ridge. Two plies of roofing felt 225 mm 9 inch wide bottom ply, and 300 mm 12 inch wide top ply, shall be successively mopped-in over each felt line of termination.

3.15 WALKWAYS

Walkways shall be mineral-surfaced asphalt planks, back-mopped and embedded in the flood coat prior to aggregate surfacing, concrete slab, or metal grid, as required by the Task Order, and shall be located as indicated.

3.16 AGGREGATE SURFACING

After roofing felts have been laid and flashings installed, the roof surface, except for cants, shall be flood-coated uniformly with 2.9 kg 60 pounds of hot asphalt per square meter per square or 3.7 kg per square meter 75 pounds per square of coal-tar bitumen if coal-tar roof system is used. Aggregate surfacing materials shall be spread on the hot bitumen at a rate of 19.5 kg per square meter 400 pounds per square for gravel or 14.6 kg per square meter 300 pounds per square for other approved surfacing aggregate.

3.17 GLAZE COAT

Glaze coating shall be used to waterproof completed sections when more than one day is required to finish the roofing. If there is a probability of rain falling on the felts before the flood coat and aggregate can be applied, a light glaze coat of bitumen 0.49 kg to 0.73 kg per square meter 10 to 15 pounds per square, shall be applied over the exposed felts. The surfacing operation shall be completed within 48 hours after application of the glaze coat. Where glaze coat is used, surface treatment shall be completed as soon as weather conditions permit. Only valleys and low areas that may pond water shall receive glaze coating for fiber glass ply felts in asphalt bitumen systems when more than one days are required to finish the roofing.

3.18 ROOF CUT-OUT TESTS

Roof cut-out samples shall be taken and analyzed in accordance with ASTM D 3617 as directed by the Contracting Officer when there is reason to believe that deficiencies exist in the roofing membrane. When samples indicate deficiencies in the built-up roofing, corrective action shall be taken as directed.

3.19 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roofing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Inspection shall include, but not be limited to, the following:

- a. Environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.
- b. Verification of compliance of materials before, during, and after installation.
- c. Inspection of condition of equipment and accuracy of thermometers and metering devices.
- d. Inspection of flashings, cants and curbs.
- e. Inspection of membrane placement, including edge envelopes, widths of starter sheets, laps, proper use of squeegee, and mechanical fastening.

- f. Inspection of application of bitumen, aggregate, and walkways.
- g. Inspection of embedment of aggregate for required weight and coverage.
- h. Cutout sampling and analysis as directed.

3.20 INFRARED INSPECTION

Eight months after completion of the roofing system, the roof surface shall be inspected using infrared (IR) imaging as specified in ASTM C 1153. Where the IR inspection indicates wet insulation, sample cuts shall be taken (including a sample from a suspected dry area) and the moisture content of insulation shall be determined. Insulation shall be replaced where moisture content exceeds the following values: wood fiber: 30 percent, glass fiber: 25 percent, perlite board: 25 percent, and polyurethane: 60 percent. Wet insulation, overlying roofing and sample-cut areas shall be replaced as directed.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07600

SHEET METALWORK, GENERAL

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
 - 1.2.1 Coordination
- 1.3 SUBMITTALS
- 1.4 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Accessories
 - 2.1.2 Aluminum Extrusions
 - 2.1.3 Bituminous Cement
 - 2.1.4 Sealant
 - 2.1.5 Fasteners
 - 2.1.6 Felt
 - 2.1.7 Polyvinyl Chloride (PVC) Reglets
 - 2.1.8 Aluminum Alloy Sheet and Plate
 - 2.1.9 Copper
 - 2.1.10 Stainless Steel
 - 2.1.11 Solder
 - 2.1.12 Through-Wall Flashing
 - 2.1.13 Louver Screen

PART 3 EXECUTION

- 3.1 GENERAL
- 3.2 EXPANSION JOINTS
- 3.3 PROTECTION OF ALUMINUM
 - 3.3.1 Paint
 - 3.3.2 Nonabsorptive Tape or Gasket
- 3.4 CONNECTIONS AND JOINTING
 - 3.4.1 Soldering
 - 3.4.2 Riveting
 - 3.4.3 Seaming
- 3.5 CLEATS
- 3.6 GUTTERS AND DOWNSPOUTS
- 3.7 FLASHINGS
 - 3.7.1 Base Flashing
 - 3.7.2 Counter Flashings
 - 3.7.3 Stepped Flashing
 - 3.7.4 Through-Wall Flashing
 - 3.7.4.1 Lintel Flashing
 - 3.7.4.2 Sill Flashing
 - 3.7.5 Valley Flashing

- 3.8 GRAVEL STOPS AND FASCIA
- 3.9 INSTALLATION OF LOUVERS
- 3.10 REGLETS
- 3.11 CONTRACTOR QUALITY CONTROL

-- End of Section Table of Contents --

SECTION 07600

SHEET METALWORK, GENERAL

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 32	(1996) Solder Metal
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 543	(1995) Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 822	(1996) Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Exposure Apparatus
ASTM D 828	(1993) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation-Apparatus
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2822	(1991; R 1997) Asphalt Roof Cement
ASTM D 3656	(1994) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM D 4022	(1994) Coal Tar Roof Cement, Asbestos

Containing

ASTM D 4586 (1993) Asphalt Roof Cement, Asbestos Free
 ASTM E 96 (1995) Water Vapor Transmission of
 Materials

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089 (1990) Recommended Standards and
 Specifications for Insect Wire Screening
 (Wire Fabric)

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION
(SMACNA)

SMACNA-02 (1993; Errata) Architectural Sheet Metal
 Manual

1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction.

1.2.1 Coordination

Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Application of bituminous strip flashing over various sheet metal items is covered in Section 07510 BUILT-UP ROOFING. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Materials; GA.

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Lead, lead-coated metal, and galvanized steel shall not be used. Any metal listed by SMACNA-02 for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA-02. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.

2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

2.1.2 Aluminum Extrusions

ASTM B 221, Alloy 6063, Temper T5.

2.1.3 Bituminous Cement

Type I asphalt cement conforming to ASTM D 2822 or ASTM D 4586. For coal tar roofing; coal tar cement conforming to ASTM D 4022.

2.1.4 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07900 JOINT SEALING.

2.1.5 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.

2.1.6 Felt

ASTM D 226, Type I.

2.1.7 Polyvinyl Chloride (PVC) Reglets

ASTM D 1784, Class 14333D, 1.9 mm 0.075 inch minimum thickness.

2.1.8 Aluminum Alloy Sheet and Plate

ASTM B 209, anodized clear or colored, as required by the Task Order, form, alloy, and temper appropriate for use.

2.1.9 Copper

ASTM B 370, Temper H 00.

2.1.10 Stainless Steel

ASTM A 167, Type 302 or 304; fully annealed, dead soft temper.

2.1.11 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.12 Through-Wall Flashing

- a. Electro-sheet copper not less than 0.14 kg, 5 ounces, factory coated both sides with acid- and alkali-resistant bituminous compound not less than 1.8 kg per square meter 6 ounces per square foot or factory covered both sides with asphalt-saturated cotton fabric, asphalt saturated glass-fiber fabric, or with 18 kg 40 poundreinforced kraft paper bonded with asphalt.
- b. Stainless steel, Type 304, not less than 0.08 mm 0.003 inch thick, completely encased by and permanently bonded on both sides to 23 kg 50 pound high strength bituminized crepe kraft paper, using hot asphalt, heat, and pressure.
- c. Nonreinforced, waterproof, impermeable extruded elastomeric single ply sheeting not less than 0.76 mm 30 mils thick.
- d. 0.09 kg Three ounce copper sheet, with 0.05 mm 2 mils of dense, clear, polyethylene sheet bonded to each side of the copper.
- e. Other through-wall flashing material may be used provided the following performance criteria are met.

(1) No cracking or flaking when bent 180 degrees over a 0.8 mm 1/32 inch mandrel and rebent at the same point over the same mandrel in an opposite direction at 0 degree C. 32 degrees F.

(2) Water vapor permeability not more than 115 ng per Paper second per square meter (2 perms) 2 perms when tested in accordance with ASTM E 96.

(3) Minimum breaking strength of 24 kgf/15 mm 90 pounds per inch width in the weakest direction when tested in accordance with ASTM D 828.

(4) No visible deterioration after being subjected to a 400-hour direct weathering test in accordance with ASTM D 822.

(5) No shrinkage in length or width and less than 5 percent loss of breaking strength after a 10-day immersion, per ASTM D 543, in 5 percent (by weight) solutions, respectively, of sulfuric acid, hydrochloric acid, sodium hydroxide or saturated lime (calcium hydroxide).

2.1.13 Louver Screen

Type I commercial bronze, Type II carbon steel, Type III aluminum alloy insect screening conforming to ISWA IWS 089 or Plastic-coated glass fiber mesh and louver cloth conforming to ASTM D 3656 as required by the Task Order.

PART 3 EXECUTION

3.1 GENERAL

Items such as gutters, downspouts and louvers shall be fabricated in conformance with SMACNA-02 and as indicated. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 13 mm (1/2 inch)

1/2 inch hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes other than built-up roofing.

3.2 EXPANSION JOINTS

Expansion joints shall be provided as indicated. Expansion joints in continuous sheet metal shall be provided at 12.0 meter 40 foot intervals for copper and stainless steel and at 9.6 meter 32 foot intervals for aluminum, except extruded aluminum gravel stops and fasciae which shall have expansion joints at not more than 3.6 meter 12 foot spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

3.3 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods:

3.3.1 Paint

Aluminum surfaces shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in Section 09900 PAINTING, GENERAL.

3.3.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

3.4 CONNECTIONS AND JOINTING

3.4.1 Soldering

Soldering shall apply to copper, and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

3.4.2 Riveting

Joints in aluminum sheets 1.0 mm 0.040 inch or less in thickness shall be mechanically made.

3.4.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 25 mm 1 inch wide. Unsoldered plain-lap seams shall lap not less than 75 mm 3 inches unless otherwise specified. Flat seams shall be made in the direction of

the flow.

3.5 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 3 mm 1/8 inch apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 300 mm 12 inches on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

3.6 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be installed as indicated. Gutters shall be supported as indicated or by cleats spaced not less than 915 mm (36 inches) 36 inches apart. Downspouts shall be rigidly attached to the building. Supports for downspouts shall be spaced according to manufacturer's recommendations.

3.7 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system.

3.7.1 Base Flashing

Metal base flashing shall be coordinated with roofing work. Metal base flashing shall be set in plastic bituminous cement over the roofing membrane, nailed to nailing strip, and secured in place on the roof side with nails spaced not more than 75 mm 3 inches on centers. Metal base flashing shall not be used on built-up roofing.

3.7.2 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over base flashings. Counter flashing shall be installed as required by the Task Order. Where bituminous base flashings are provided, the counter flashing shall extend down as close as practicable to the top of the cant strip. Counter flashing shall be factory formed to provide spring action against the base flashing.

3.7.3 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.7.4 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall not extend further into the masonry backup wall than the first mortar joint. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills.

3.7.4.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less than 50 mm, 2 inches, or shall be applied over top of masonry and precast concrete lintels. Bedjoints of lintels at control joints shall be underlaid with sheet metal bond breaker.

3.7.4.2 Sill Flashing

Sill flashing shall extend the full width of the sill and not less than 100 mm 4 inches beyond ends of sill except at control joint where the flashing shall be terminated at the end of the sill.

3.7.5 Valley Flashing

Valley flashing shall be installed as specified in SMACNA-02 and as indicated.

3.8 GRAVEL STOPS AND FASCIA

Gravel stops and fascia shall be fabricated and installed as indicated and in accordance with SMACNA-02.

3.9 INSTALLATION OF LOUVERS

Louvers shall be rigidly attached to the supporting construction. The installation shall be rain-tight. Louver screen shall be installed as indicated.

3.10 REGLETS

Reglets shall be a factory fabricated product of proven design, complete with fittings and special shapes as required. Open-type reglets shall be filled with fiberboard or other suitable separator to prevent crushing of the slot during installation. Reglet plugs shall be spaced not over 300 mm 12 inches on centers and reglet grooves shall be filled with sealant. Friction or slot-type reglets shall have metal flashings inserted the full depth of slot and shall be lightly punched every 300 mm 12 inches to crimp the reglet and counter flashing together. Polyvinyl chloride reglets shall be sealed with the manufacturer's recommended sealant.

3.11 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification of compliance of materials before, during, and after installation.
- c. Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07720

ROOF VENTILATORS, GRAVITY-TYPE

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DESIGN REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 QUALIFICATION
- 1.5 DELIVERY, STORAGE AND HANDLING
- 1.6 PROJECT/SITE CONDITIONS

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Aluminum Extrusions
 - 2.1.2 Aluminum Sheets
 - 2.1.3 Galvanized Steel Sheets
- 2.2 RIDGE VENTILATORS
- 2.3 STATIONARY VENTILATORS
- 2.4 TURBINE VENTILATORS
 - 2.4.1 Dampers
 - 2.4.2 Rotor Shaft
- 2.5 FABRICATION
- 2.6 CURB BASES
- 2.7 SCREENS
- 2.8 FINISH
 - 2.8.1 Galvanized Steel Finish
 - 2.8.2 Aluminum Finish
 - 2.8.3 Color

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 INSTALLATION
- 3.3 PROTECTION

-- End of Section Table of Contents --

SECTION 07720

ROOF VENTILATORS, GRAVITY-TYPE

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings & Other Structures
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1.2 DESIGN REQUIREMENTS

Ventilators shall be designed for use with the specific type of project roofing system, and shall provide uniform and continuous air flow. Ventilator design shall provide protection against rain and snow, and shall be provided with a continuous weep along the bottom of both sides of wind band. Units shall be self-cleaning by the action of the elements, and shall have provisions for carrying water and normal wind-transported soil matter to the outside. Units shall be designed for windspeeds of not less than 36 meters per second 80 mph in accordance with ASCE 7. Ventilators shall be free of internal obstructions or moving parts which will require maintenance, and shall be complete with type of mounting indicated on drawings.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Roof Ventilators; GA.

Dimensioned drawings indicating location of each type of ventilator including details of construction, gauges of metal, and methods of operation of dampers and controls.

1.4 QUALIFICATION

Manufacturer shall specialize in design and manufacture of the type of roof ventilators specified in this section, and shall have a minimum of 5 years of documented successful experience. Ventilator installer shall be experienced in the installation of ventilator types specified.

1.5 DELIVERY, STORAGE AND HANDLING

Roof ventilators shall be cartoned or crated prior to shipment. Ventilators shall be protected from moisture and damage. Damaged items shall be removed from site.

1.6 PROJECT/SITE CONDITIONS

Rough openings shall be field-measured and recorded on shop drawings prior to fabrication of roof ventilators. Fabrication shall be scheduled with construction schedule.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Extrusions

Aluminum extrusions shall be alloy 6063, temper T5 in compliance with ASTM B 221.

2.1.2 Aluminum Sheets

Aluminum sheets shall be alloy 5005, temper H15 or alloy 3003, temper H14 in compliance with ASTM B 209/ASTM B 209.

2.1.3 Galvanized Steel Sheets

Steel sheets shall be commercial quality, zinc-coated steel (hot-dip galvanized) of quality established by ASTM A 653/A 653M, minimum G90 coating thickness.

2.2 RIDGE VENTILATORS

Roof ridge ventilators shall be fabricated of galvanized steel or aluminum, as required by the Task Order, and shall be assembled to any desired length. Continuous-run ridge ventilators shall be connected with splice plates of type which will telescope together and not require fasteners, soldering or welding. Ventilators shall be provided with manually-operated single-leaf dampers complete with accessories to meet design and performance requirements or UL labeled fire-actuated damper system complete with accessories to meet building code requirements as required by the Task Order. Dampers and airshafts shall be complete with urethane gasketing for extra-tight enclosures. Metal closure strips which match the panel roof rib contours shall be provided to close out weather and provide a secure

seat for ventilators. Insect and Bird screens shall be provided.

2.3 STATIONARY VENTILATORS

Stationary roof ventilators shall be fabricated of galvanized steel or aluminum, as required by the Task Order, with seamless spun conical-shaped weathercap, and shall have straight-through drainage for eliminating the possibility of air-borne debris collecting in the ventilator openings. Insect and Bird screens shall be provided.

2.4 TURBINE VENTILATORS

Turbine ventilators shall be fabricated of galvanized steel, aluminum, corrugated or flat sheets, as required by the Task Order, complete with sensitive ball-bearing action to enable the slightest motion of air to move the rotor head where suction is maintained at low wind velocities. Ventilators shall have 360 degree operating surface to assure access of wind currents regardless of wind velocities. Rotor head shall be anchored to prevent head from lifting or jumping off the rotor in high winds. Rotor crown plate shall be seamless. Bird and Insect screens shall be provided.

2.4.1 Dampers

Turbine ventilators shall be provided with dampers manually-operated with direct pull-chain or rack and pinion, push-button control electric gear motor-operated dampers or thermostat control electric gear motor-operated dampers as required by the Task Order.

2.4.2 Rotor Shaft

Rotor shaft bearings shall be entirely shielded in corrosion-resistant aluminum casing. Bearings shall be pre-lubricated and shall have life-time warranty. Bearings shall be at top and bottom to assure accurate alignment. Shaft and bearings shall be easily replaceable as a unit. Rotor collar shall be rolled and welded.

2.5 FABRICATION

Ventilators shall be fabricated in accordance with approved shop drawings. Welds, soldered seams, rivets and fasteners shall be clean, secure, watertight, and smooth. Edges shall be wired or beaded, where necessary, to ensure rigidity. Joints between sections shall be watertight and shall allow for expansion and contraction. Galvanic action between different metals in direct contact shall be prevented by nonconductive separators.

2.6 CURB BASES

Ventilator bases for curb-mounted installations shall be of size indicated on drawings, and shall be designed specifically for the type of ventilator and roofing system approved for this project. Curb bases shall be factory-formed and flashed for a watertight installation. Curb bases shall be fabricated of material and finish to match the ventilator.

2.7 SCREENS

Screens shall be furnished by ventilator manufacturer as part of ventilator assembly. Screen (with frames) shall be manufactured of material to match ventilators, and shall be designed to be easily removed for cleaning purposes.

2.8 FINISH

2.8.1 Galvanized Steel Finish

Galvanized steel roof ventilators shall be factory-coated with rust-resistant primer and baked-on finish coats of acrylic, finish coats to match metal roof panels, two-coat high-performance coating system or field-painted in accordance with Section 09900 PAINTING, GENERAL.

2.8.2 Aluminum Finish

Aluminum roof ventilators shall be factory-finished to match metal roof finish and color or with two-coat fluoropolymer high-performance coating system as required by the Task Order.

2.8.3 Color

Color shall be as required by the Task Order.

PART 3 EXECUTION

3.1 PREPARATION

Rough openings and other roof conditions shall be prepared in accordance with approved shop drawings and manufacturer's recommendations. Before starting the ventilator work, surrounding roof surfaces shall be protected from damage.

3.2 INSTALLATION

Roof ventilator installation shall be coordinated with roofing work, and shall be installed in accordance with approved shop drawings and manufacturer's published instructions. The ventilator installation shall be watertight and shall be free of vibration noise. Aluminum surfaces shall be protected from direct contact with incompatible materials. Aluminum surfaces which will be in contact with sealant shall not be coated with a protective material. Aluminum shall not be used with copper or with water which flows over copper surfaces. Roof ventilators shall be cleaned in accordance with ventilator manufacturer's recommendations.

3.3 PROTECTION

Exposed ventilator finish surfaces shall be protected against the accumulation of paint, grime, mastic, disfigurement, discoloration and damage for duration of construction activities.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07840

FIRESTOPPING

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 GENERAL REQUIREMENTS
- 1.4 STORAGE AND DELIVERY
- 1.5 INSTALLER QUALIFICATIONS

PART 2 PRODUCTS

- 2.1 FIRESTOPPING MATERIALS
 - 2.1.1 Fire Hazard Classification
 - 2.1.2 Toxicity
 - 2.1.3 Fire Resistance Rating
 - 2.1.3.1 Through-Penetrations
 - 2.1.3.2 Construction Joints and Gaps

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 INSTALLATION
- 3.3 INSPECTION

-- End of Section Table of Contents --

SECTION 07840

FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(1998e1) Surface Burning Characteristics of Building Materials
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 814	(1997) Fire Tests of Through-Penetration Fire Stops

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994; Rev thru Feb 1998) Fire Tests of Through-Penetration Firestops
UL 2079	(1998) Tests for Fire Resistance of Building Joint Systems
UL Fire Resist Dir	(1998) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Firestopping Materials; GA.

Detail drawings including manufacturer's descriptive data, typical details, installation instructions and the fire-test data and/or report as appropriate for the fire resistance rated construction and location. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations or construction joints

are to receive firestopping, drawings shall indicate location and type of application.

SD-13 Certificates

Firestopping Materials; FIO.

Certificates attesting that firestopping material complies with the specified requirements. The label or listing of the Underwriters Laboratories will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing agency equipped to perform such services, stating that the items have been tested and conform to the specified requirements and testing methods.

Installer Qualifications; FIO.

Documentation of training and experience.

Inspection; GA.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof deck.

1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

Installer of firestopping material shall be trained by the manufacturer or the manufacturer's representative, and shall have a minimum of 3 years experience in the installation of firestopping of the type specified.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured products complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resist Dir or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479, except that T Ratings are not required for penetrations smaller than or equal to a 100 mm 4 inch nominal pipe or 0.01 square meter 16 square inches in overall cross sectional area. "F and "T" fire resistance ratings shall be as required by the Task Order

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119 or UL 2079 to meet the required fire resistance rating.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping for filling floor voids 100 mm 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Firestopping shall be provided in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in floors and fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07900

JOINT SEALING

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 ENVIRONMENTAL REQUIREMENTS
- 1.4 DELIVERY AND STORAGE

PART 2 PRODUCTS

- 2.1 BACKING
 - 2.1.1 Rubber
 - 2.1.2 PVC
 - 2.1.3 Synthetic Rubber
 - 2.1.4 Neoprene
- 2.2 BOND-BREAKER
- 2.3 PRIMER
- 2.4 CAULKING
- 2.5 SEALANT
 - 2.5.1 LATEX
 - 2.5.2 ELASTOMERIC
 - 2.5.3 ACOUSTICAL
 - 2.5.4 BUTYL
 - 2.5.5 PREFORMED
- 2.6 SOLVENTS AND CLEANING AGENTS

PART 3 EXECUTION

- 3.1 GENERAL
 - 3.1.1 Surface Preparation
 - 3.1.2 Concrete and Masonry Surfaces
 - 3.1.3 Steel Surfaces
 - 3.1.4 Aluminum Surfaces
 - 3.1.5 Wood Surfaces
- 3.2 APPLICATION
 - 3.2.1 Masking Tape
 - 3.2.2 Backing
 - 3.2.3 Bond-Breaker
 - 3.2.4 Primer
 - 3.2.5 Sealant
- 3.3 CLEANING

-- End of Section Table of Contents --

SECTION 07900

JOINT SEALING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 570	(1995) Oil- and Resin-Base Caulking Compound for Building Construction
ASTM C 734	(1993) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 1085	(1991) Butyl Rubber-Based Solvent-Release Sealants
ASTM C 1184	(1995) Structural Silicone-Sealants
ASTM D 217	(1994) Cone Penetration of Lubricating Grease (IP50/88)
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1565	(1981; R 1990) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Backing; GA. Bond-Breaker; GA.

Sealant; GA.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

SD-13 Certificates

Sealant; FIO.

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 4 to 32 degrees C 40 to 90 degrees F when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 4 and 32 degrees C 40 and 90 degrees F unless otherwise specified by the manufacturer.

PART 2 PRODUCTS

2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type, Class and Grade as required by the Task Order.

2.1.2 PVC

Polyvinyl chloride (PVC) backing shall be ASTM D 1565, Grade as required by the Task Order.

2.1.3 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option and Type, as required by the Task Order, preformed rods or tubes.

2.1.4 Neoprene

Neoprene backing shall be ASTM D 1056, closed or open cell, expanded or regular neoprene cord Type, Class, Grade as required by the Task Order.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.4 CAULKING

Oil- and resin-based caulking shall be ASTM C 570, Type, Use as required by the Task Order.

2.5 SEALANT

2.5.1 LATEX

Latex Sealant shall be ASTM C 834.

2.5.2 ELASTOMERIC

Elastomeric sealants shall conform to ASTM C 920 and the following:

- a. Polysulfide Sealant: Type, Grade, Class, Use; as required by the Task Order.
- b. Polyurethane sealant: Grade, Class, Use; as required by the Task Order.
- c. Silicone sealant: Type, Grade, Class, Use; as required by the Task Order.
- d. Structural silicone sealant: ASTM C 1184, Type, Use; as required by the Task Order.

2.5.3 ACOUSTICAL

Rubber or polymer-based acoustical sealant shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant shall have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and shall remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and shall be non-staining.

2.5.4 BUTYL

Butyl sealant shall be ASTM C 1085.

2.5.5 PREFORMED

Prefomed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 34 to plus 71 degrees C 30 to plus 160 degrees F, the sealant shall be non-bleeding and shall have no loss of adhesion.

2.6 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant.

Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

-- End of Section --