

ENGINEERING ORDER

1. ENGINEERING ORDER NO.
(Prefix followed by Dwg. No.)

EO - 01 - 79K36293

2. SHEET **1** OF **4** SHEETS

3. EFFECTIVITY (Facility & Vehicle)

4. DISPOSITION OF OLD PARTS (Check One)

SCRAP REWORK USE NOT APPLICABLE

5. TITLE OF DRAWING

Construct Replacement Life Support Facility

6. REASON FOR CHANGE

1. Removal of wood blocking from roof and replacement with metal.

7. DESCRIPTION OF CHANGE

Revised Specification Section 07220 (79K36294), ROOF AND DECK INSULATION, is attached.

Parts 2.1.1 and 2.1.2 have been revised to clarify thermal resistance values.

Revised Specification Section 07550 (79K36294), MODIFIED BITUMINOUS MEMBRANE ROOFING (Additive Alternate #8), is attached.

The specification has been revised to incorporate text for health and safety procedures.

Remove wood blocking from roof and replace with metal blocking - Drawings:

Drawings A-9 and A-9A, delete note no. 3 of GENERAL NOTES - ROOF DETAILS and replace with the following note:

3. WOOD BLOCKING, NAILERS AND CANTS SHALL NOT BE INSTALLED ON ROOF OR ROOF APPURTENANCES. PROVIDE, AS REQUIRED, 12 GAUGE (UNLESS NOTED OTHERWISE) METAL BLOCKING, NAILERS AND CANTS PER DETAILS OR BY OTHER NONCOMBUSTIBLE MEANS APPROVED BY CONTRACTING OFFICER.

ACTION	QTY.	FIND NO.	MFR. CODE	PART NO.	DESCRIPTION	STOCK SIZE	MATERIAL SPEC.

PARTS LIST

8. **SIGNATURES**

REQUESTER	DATE	DRAFTSMAN	DATE
STRESS	DATE	ENGINEER	DATE
CHECKER	DATE	APPROVED BY	DATE

ENGINEERING ORDER

CONTINUATION SHEET

1. ENGINEERING ORDER NO.
(Prefix followed by Dwg. No.)

EO - 01 - 79K36293

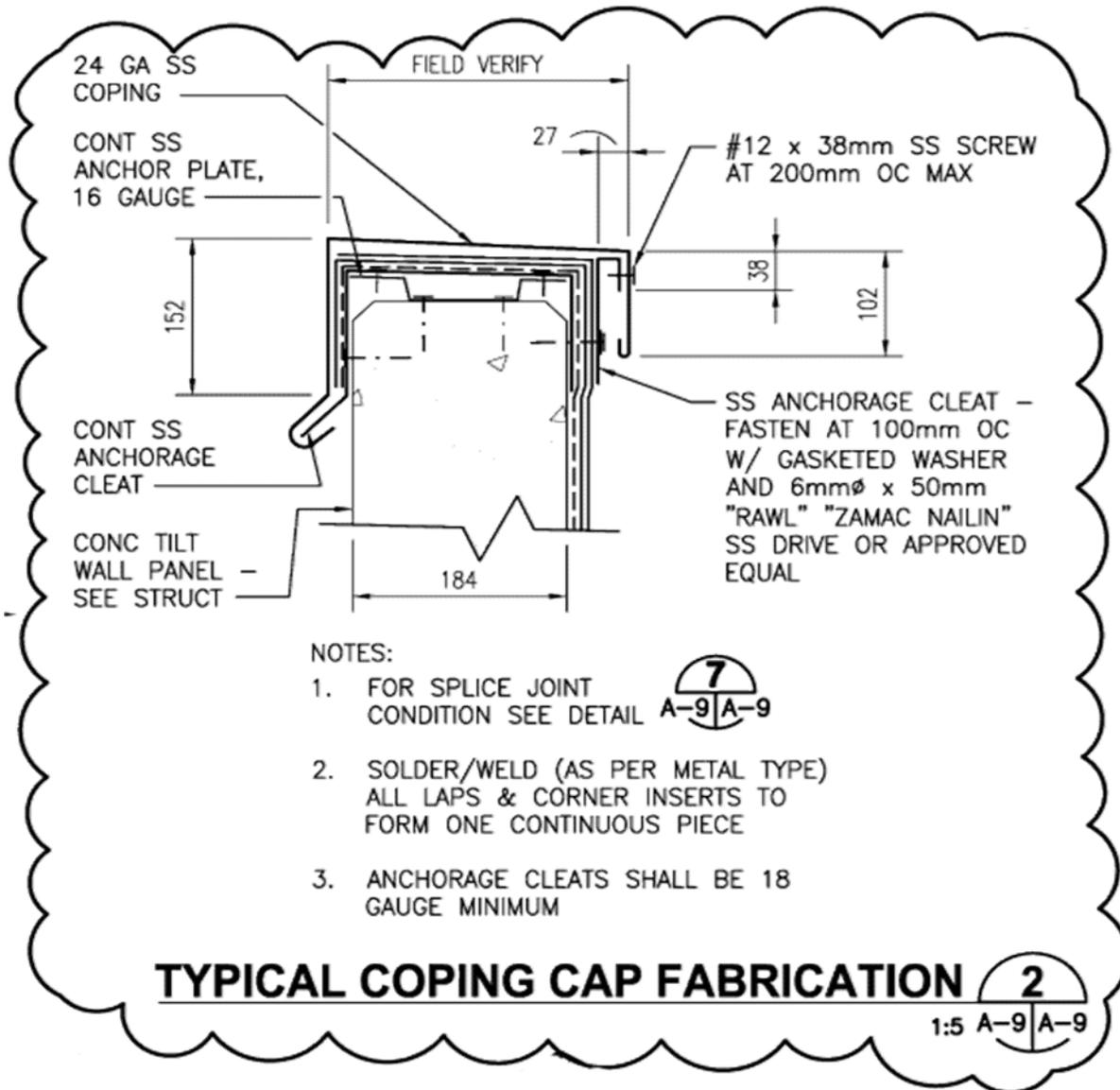
2.

SHEET **2** OF **4** SHEETS

7. DESCRIPTION OF CHANGE (CONTINUATION)

Remove wood blocking from roof and replace with metal blocking - Drawings:

Drawing A-9, revise detail no. 2, TYPICAL COPING CAP FABRICATION. See sketch below (not to scale).



ACTION	QTY.	FIND NO.	MFR. CODE	PART NO.	DESCRIPTION	STOCK SIZE	MATERIAL	SPEC.

ENGINEERING ORDER

CONTINUATION SHEET

1. ENGINEERING ORDER NO.
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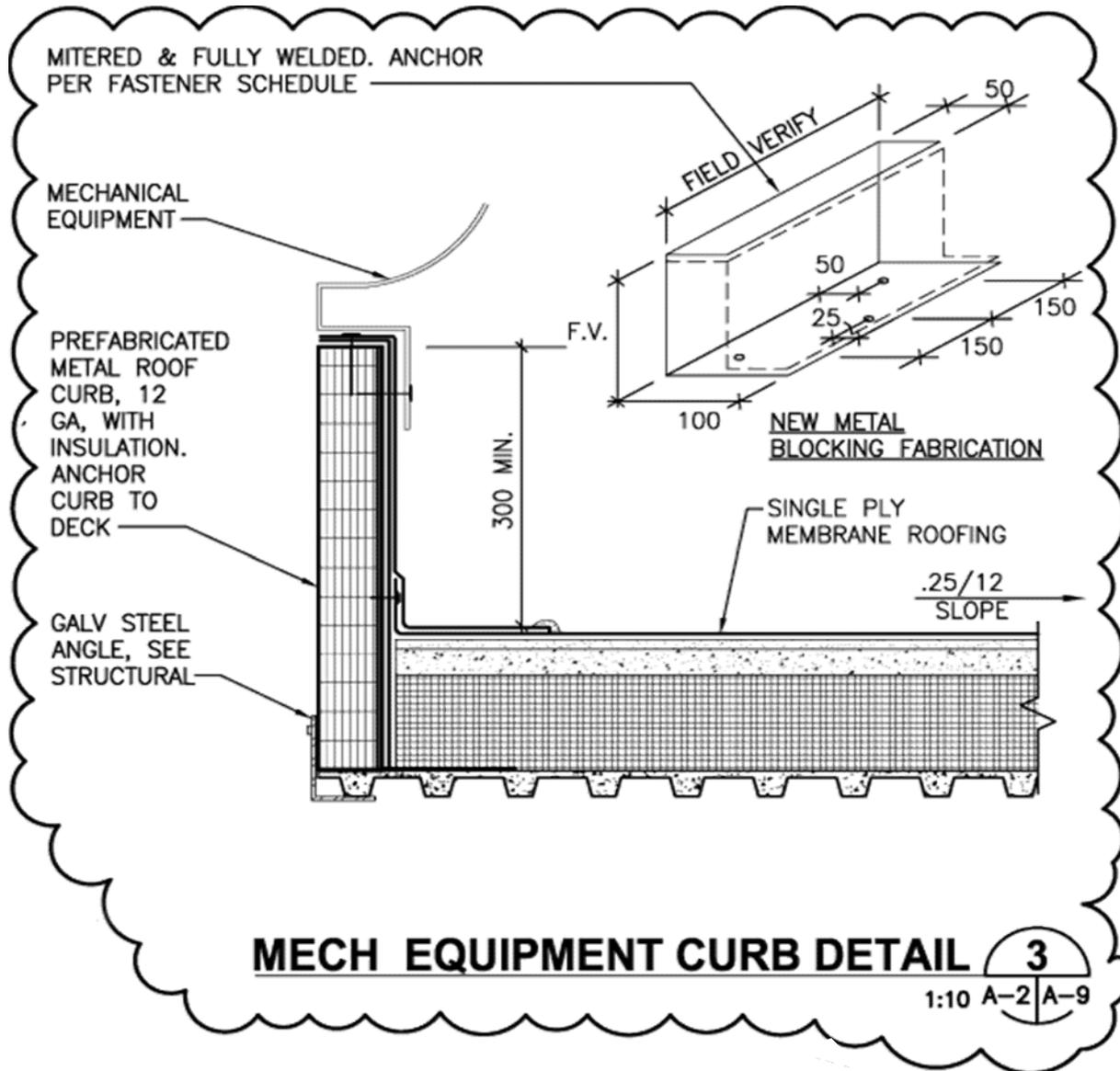
2.

SHEET **3** OF **4** SHEETS

7. DESCRIPTION OF CHANGE (CONTINUATION)

Remove wood blocking from roof and replace with metal blocking - Drawings:

Drawing A-9, revise detail no. 3, MECH EQUIPMENT CURB DETAIL. See sketch below (not to scale).



ACTION	QTY.	FIND NO.	MFR. CODE	PART NO.	DESCRIPTION	STOCK SIZE	MATERIAL	SPEC.

ENGINEERING ORDER

CONTINUATION SHEET

1. ENGINEERING ORDER NO.
(Prefix followed by Dwg. No.)

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2.

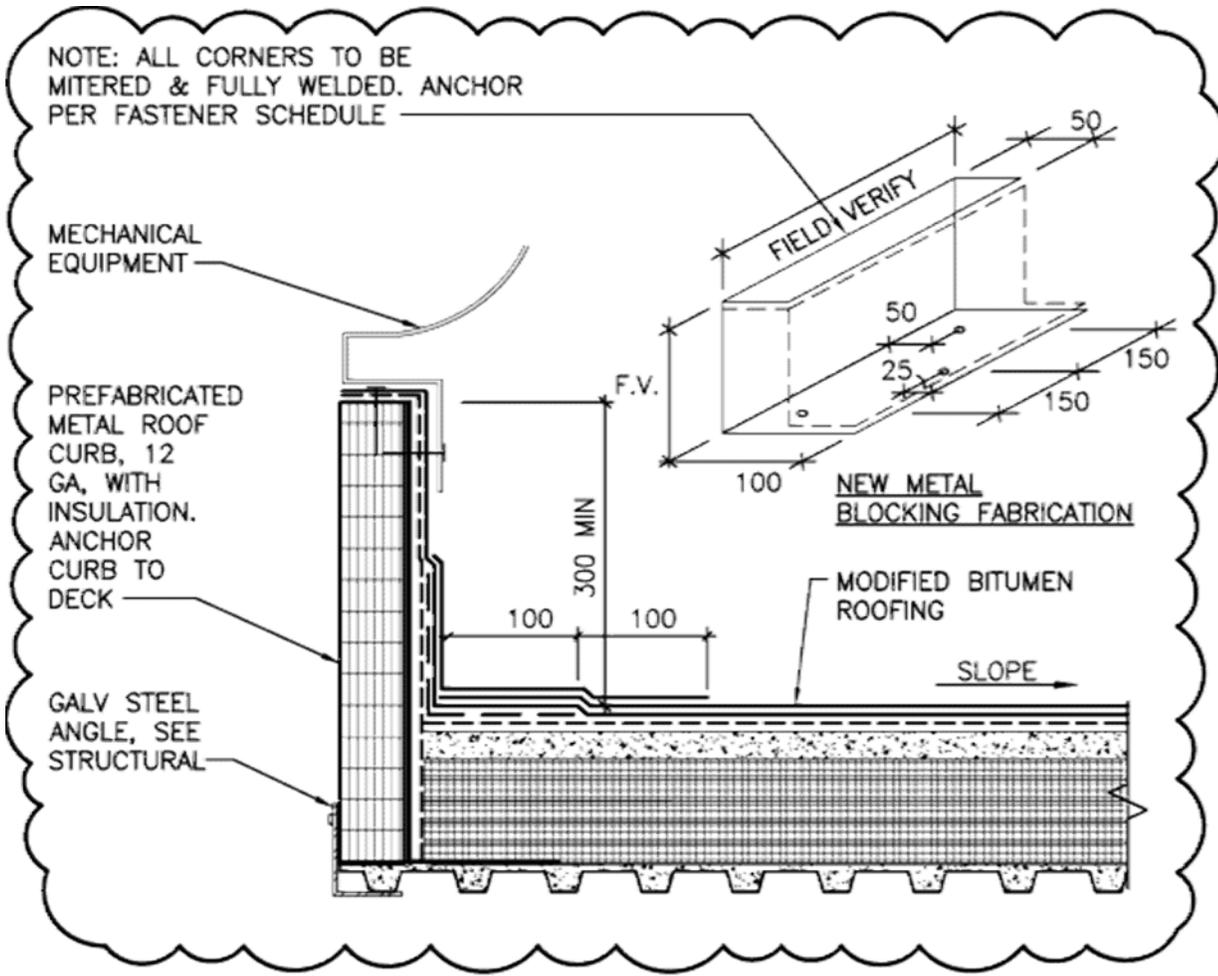
SHEET **4** OF **4**

SHEETS

7. DESCRIPTION OF CHANGE (CONTINUATION)

Remove wood blocking from roof and replace with metal blocking - Drawings:

Drawing A-9A, revise detail no. 3, MECH EQUIP. CURB. See sketch below (not to scale).



MECHANICAL EQUIP. CURB **3**
1:10 A-2A | A-9A

ACTION	QTY.	FIND NO.	MFR. CODE	PART NO.	DESCRIPTION	STOCK SIZE	MATERIAL	SPEC.

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SECTION 07220

ROOF AND DECK INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

Installation of expanded polystyrene rigid board insulation.

Drawings and general provisions of the Contract apply to work specified in this Section.

1.2 RELATED SECTIONS

Section 03342, CELLULAR LIGHTWEIGHT INSULATING CONCRETE

Section 05312, STEEL ROOF DECK

Section 07550, MODIFIED BITUMINOUS MEMBRANE ROOFING

1.3 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ASTM INTERNATIONAL (ASTM)

ASTM C 150	(2002ae1) Standard Specification for Portland Cement
ASTM C 332	(1999) Standard Specification for Lightweight Aggregates for Insulating Concrete
ASTM C 578	(2004) Rigid, Cellular Polystyrene Thermal Insulation
ASTM D 1751	(1999) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-200	(Rev E; Am 2) Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement
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1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Thermal Insulation Materials; G L

Product Data for LEED Credit MR4.1 and MR4.2: Indicate percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.

SD-07 Certificates

Certificates for the following items shall exactly identify each item by the designation that will appear on the packaging for that item. Certificates shall be submitted for all materials that are identified by a referenced specification.

Expanded Polystyrene Roof Insulation; G
Concrete Roof Insulation; G

SD-08 Manufacturer's Instructions

Manufacturer's instructions for the following items shall indicate fastener and adhesive instructions for each type of installation.

Roof Insulation

SD-11 Closeout Submittals

Warranty

1.5 QUALIFICATIONS FOR ROOF AND DECK INSULATION WORK

Roof and deck insulation shall be performed by Contractor personnel certified by the insulation manufacturer to install their products.

Insulating concrete contractor shall be certified in the application of the materials by the aggregate manufacturer.

1.6 DELIVERY AND STORAGE OF MATERIALS

Materials shall be delivered to the project site in their original, unopened packages or containers bearing labels identifying the manufacturer's name, brand name, material, and other information.

Materials shall be stored in their original, unbroken packages or containers in a weathertight and dry area and protected from damage until needed for use.

PART 2 PRODUCTS

2.1 THERMAL INSULATION MATERIALS (OR UNDERLAYMENT)

2.1.1 Rigid Board

Expanded-polystyrene roof insulation, rigid type, having nominal density of 16 kg/m³, and shall conform to ASTM C 578.

Type I with 25 to 35 bonding and venting slots at 64 mm diameter, or approximately 3% open area, and a minimum thermal-resistance value (R) of 24. R value per 25 mm equals 3.85.

Provide insulation products with recycled content. Expanded-polystyrene roof insulation shall contain a minimum content of 9 percent of recovered materials.

2.1.2 Poured Insulation

Lightweight-concrete roof insulation shall have a minimum thermal resistance value (R) of 6 for 50 mm thickness. Aggregates shall conform to ASTM C 332, Group I; portland cement shall conform to ASTM C 150, Type IA or IIIA; water shall be potable. Lightweight-concrete design mix shall be 1 bag (43 kilopascal) of portland cement to 1-1/2 bags (0.2 cubic meter) of aggregate, and with a minimum compressive strength of 860 kilopascal at 28 calendar days.

Expansion-joint filler strips shall be the nonextruding and resilient bituminous type conforming to ASTM D 1751.

Compound shall be cold-applied, two-component, elastomeric polymer, conforming to FS SS-S-200.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Roof insulation shall be installed in accordance with approved descriptive data and as specified in Sections 03342, "Cellular Lightweight Insulating Concrete," and 07550, "Modified Bituminous Roofing Membrane."

Contractor shall verify that all work that penetrates roof decks or that requires men and equipment to traverse a roof deck has been completed prior to underlayment or roof insulation installation.

Contractor shall examine deck surfaces for inadequate anchorage, foreign material, moisture, and unevenness, any condition which would prevent the execution and quality of application of roof system as specified shall be corrected before beginning work. Work shall not proceed until defects are corrected.

Insulation shall be installed only after building construction has progressed to the point that inclement weather will not damage or wet the insulation material.

Starting work designates acceptance of the surfaces by the Contractor.

Insulation material shall be cut and fit as necessary to fully insulate small areas and to accommodate piping, scuttles, skylights, vents, and other construction penetrating the insulation material.

3.2 PREPARATION

3.2.1 Protection of Property

Flame-heated equipment shall be located and used so it will not endanger the structure or other materials on the site or adjacent property. Fire

extinguishers of an appropriate approved type shall be provided and maintained by the Contractor.

Flame-heated equipment shall not be placed on the roof of any structure.

Before starting work, paving and faces of building walls adjacent to hoist and kettles shall be protected and this protection maintained for duration of work.

3.2.2 Preparation of Surfaces

Condition of surfaces shall be inspected and approved by the roofing contractor and personnel directly responsible for the cellular lightweight concrete and insulation, the Contracting Officer, and representative of the roofing materials manufacturer prior to the start of roof insulation work.

3.3 APPLICATION

3.3.1 General Procedures

Insulation installation shall be continuous, with all operations proceeding together.

Before cessation of work on each working day or when work is interrupted due to rainfall or other causes, the roof shall be sealed against intrusion of water. Insulation shall not be left exposed during rainfall or overnight.

Traffic over partially or completely finished insulation shall be only on planks, or on plywood not less than 16 millimeter thick and 600 millimeter wide.

Materials temporarily stored on the roof shall be distributed to stay within the live-load limits of the roof, which is shown on the drawings. Ample bases shall be provided under equipment to distribute the weight to conform to the live-load limits.

3.3.2 Insulation Application

Insulation shall be installed in accordance with the manufacturer's requirements and as specified below. Method of holddown used by the manufacturer in areas subject to hurricane velocity winds shall be subject to approval prior to installation.

Total nominal thickness shall be installed in 4 layer(s). No more insulation shall be installed at one time than can be protected from wetting or other damage by installation of roofing membranes on the same day or prior to rain or dew.

Joints of insulation board shall be taped, if required by manufacturers of insulation and roofing.

3.4 ACCEPTANCE

Prior to final acceptance, the Contractor shall provide construction (as-built) details and warranty information to the Contracting Officer. Construction details shall include, by building area, the material type, amount, and installation method. An illustration or map of the building may serve this purpose. Data shall have a cover letter/sheet clearly

marked with the system name, date, and the words "As built insulation/material." Forward as-built and warranty information to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database.

-- End of Section --

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SECTION 07550

MODIFIED BITUMINOUS MEMBRANE ROOFING
(Additive Alternate #8)

PART 1 GENERAL

1.1 SECTION INCLUDES

Installation of modified bituminous membrane roofing above cellular lightweight insulating concrete as shown on the drawings.

Drawings and general provisions of the Contract apply to work specified in this section.

1.2 RELATED SECTIONS

Section 03342 CELLULAR LIGHTWEIGHT INSULATING CONCRETE
 Section 05312 STEEL ROOF DECK
 Section 07141 FLUID-APPLIED WATERPROOFING
 Section 07220 ROOF AND DECK INSULATION
 Section 07600 FLASHING AND SHEET METAL
 Section 13100 LIGHTNING PROTECTION SYSTEMS

1.3 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653 M	(2004a) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated or Zinc-Iron Alloy Coated (Galvanized) by the Hot-Dip Process
ASTM A 924/A 924M	(2004) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D 41	(2005) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 226	(1997a) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 312	(2005) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 2170	(2001a) Standard Test Method for Kinematic Viscosity of Asphalts (Bitumens) IP Designation: 319/84 (89)

ASTM D 4402	(1987; R 1995) Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus
ASTM D 4586	(2000) Standard Specification for Asphalt Roof Cement, Asbestos Free
ASTM D 4897	(2001) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM D 6162	(1998) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D 6163	(2000e1) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
ASTM D 6164	(2002) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM E 108	(2004) Standard Test Methods for Fire Tests of Roof Coverings
FM GLOBAL (FM)	
FM AS 4470	(1986; R 1992) Class I Roof Covers
FM P7825	(2004) Approval Guide
MIDWEST ROOFING CONTRACTORS ASSOCIATION (MRCA)	
CERTA	(2003) NRCA/MRCA Certified Roofing Torch Applicator Program
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 241	(2004) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 58	(2004) Storage and Handling of Liquefied Petroleum Gases
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
29 CFR 1910	(2001) Occupational Safety and Health Standards
29 CFR 1910.12	(2004) Construction Work
29 CFR 1926	(2001) Safety and Health Regulations for Construction
29 CFR 1926.16	(2004) Rules of Construction

UNDERWRITERS LABORATORIES (UL)

UL RMSD (2004) Roofing Materials and Systems Directory

UL 790 (2004) Test Methods for Fire Tests of Roof Coverings

1.4 SUBMITTALS

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

SD-03 Product Data

Modified bitumen sheet for roofing and flashings; G
Fiberglass venting base sheet; G
Asphalt; G
Felts; G
Primer; G
Asphalt roof cement; G
Fasteners; G
Sample warranty certificate; G

Submit all data required by Sections 03342 CELLULAR LIGHTWEIGHT INSULATING CONCRETE, and 07220 ROOF AND DECK INSULATION together with requirements of this section. Data shall include written acceptance by the roof membrane manufacturer of the concrete and insulation provided.

SD-07 Certificates

Qualification of manufacturer; G
Qualification of applicator; G
Bill of lading

Certify that the manufacturer of the modified bitumen membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer." Show evidence that products used within this specification are manufactured in the United States. Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator." Submit bill of lading when labels of asphalt containers do not bear the flash point (FP), finished blowing temperature (FBT), and equiviscous temperature (EVT).

SD-11 Closeout Submittals

Warranty
Information sign
Instructions to Government personnel

Submit instructions meeting the requirements of paragraph entitled "Instructions to Government Personnel" and include copies of Material Safety Data Sheets for maintenance/repair materials.

1.5 QUALITY ASSURANCE

1.5.1 Qualification of Manufacturer

Modified bitumen sheet roofing system manufacturer shall have a minimum of 5 years experience in manufacturing modified bitumen roofing products.

1.5.2 Qualification of Applicator

Roofing system applicator shall be approved, authorized, or licensed in writing by the modified bitumen sheet roofing system manufacturer and shall have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator shall supply the names and locations of 5 projects of similar size and scope that he has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.5.3 Fire Safety

Complete roof covering assembly shall:

- a. Have ASTM E 108 Class 1A or UL 790, Class A classification; and
- b. Be listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM P7825.

UL approved components of the roof covering assembly shall bear the UL label.

1.5.4 Wind Uplift

The roof membrane system, including the lightweight insulating concrete assembly, shall meet or exceed an uplift pressure of 390 kg/m². Manufacturer will provide a wind design analysis prepared by a State of Florida Licensed P.E. delineating negative zone pressures and applicable securements. Patterns to comply with zone pressures, wind design analysis will be signed and sealed by a licensed P.E.

1.5.5 Preroofing Conference

After approval of submittals and before performing roofing and insulation work, including associated work, the Contracting Officer will hold a preroofing conference to review the following:

- a. Drawings and specifications;
- b. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, roof insulation, and installation of the roofing in accordance with the roof system warranty, the name of the manufacturer's technical representatives, the frequency of the onsite visits, copies of the roof status reports from the technical representatives to roof manufacturer, and pertinent structural details relating to the roofing system;
- c. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

d. Safety requirements.

Preroofing conference shall be attended by the Contractor and personnel directly responsible for the installation of roofing, fluid-applied waterproofing, cellular lightweight concrete, and insulation, flashing and sheet metal work, Contracting Officer and representative of the roofing materials manufacturer. Before beginning roofing work, confirm in writing the resolution of conflicts among those attending the preroofing conference.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Materials shall be delivered to the site in the manufacturer's original unopened containers and unbroken rolls with labels intact and legible. Original packaging shall not be disturbed until materials are to be applied. Liquid materials shall be used directly from the fully labeled cans in which they were shipped by the manufacturer. Only approved roofing materials may be brought to or stored at the site. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification, the container shall bear the specification number, type, and class, as applicable. Labels or bill of lading for roofing asphalt shall indicate asphalt type, FP, FBT, and EVT, that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with ASTM D 2170 or 75 centipoise when tested in accordance with ASTM D 4402. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.6.2 Storage

Roofing materials shall be stored and protected against moisture absorption. Store felt rolls and roll roofing on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 10 degrees C for at least 24 hours before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof and yet provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

Not more than a 1-day supply of insulation or felts shall be stored on the roof at any time. This 1-day supply shall be stacked on pallets and completely covered with plastic sheet whenever work is interrupted or when there is precipitation of any kind. Plastic sheeting shall be securely fastened to the pallets so as to be completely weathertight. Materials not so protected shall be permanently removed from the site.

Materials temporarily stored on the roof shall be distributed to stay within the indicated live-load limits of the roof construction which is shown on the drawings. Ample bases shall be provided under equipment to distribute the weight to conform to these live-load limits. Storage locations shall be approved.

1.6.3 Handling

Select and operate material handling equipment so as not to damage applied roofing. Prevent damage to edges and ends of roll materials.

1.7 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 4 degrees C, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Provide manufacturer's printed directions for installation during cold weather conditions.

1.8 HOT-MOPPED ASPHALT APPLIED MODIFIED BITUMEN MEMBRANE SAFETY

1.8.1 Property Protection

Take all precautions necessary to prevent ignition of combustible materials during hot-mopped asphalt application of roofing. Immediately call the fire department if a fire commences. Review all fire safety procedures as outlined at the pre-roofing conference.

Install materials using the techniques recommended by CERTA NRCA/MRCA Certified Roofing Torch Applicator Program available from the National Roofing Contractors Association (NRCA) and the Midwest Roofing Contractors Association (MRCA) as endorsed by the Asphalt Roofing Manufacturers Association (ARMA) and the United Union of Roofers, Waterproofers and Allied Workers. Application procedures must comply with NFPA 241, OSHA 29 CFR 1910 and 29 CFR 1910.12, 29 CFR 1926.16, 29 CFR 1926 Subpart F.

Do not store flammable liquids on the roof.

No Asphalt/Tar Kettles are allowed on roofs. Locate kettles and supply LP-Gas Cylinders safely and secured per NFPA 241 outside of the building's perimeter a minimum of 6.096 m from the structure and any combustible materials.

Maintain a minimum separation of 6.096 m between LP-Gas Cylinders and kettle. Provide protective fire retardant blanket barrier or shield between any building structure to a minimum height of 2.44 meters and a clear surround distance of 2.44 m if operations force placement of kettle within a distance of 6.096 m. Do not obstruct or place kettles or Cylinder storage within 3.048 m of exits, means of egress, gates, roadways, entrances. Locate kettles downwind and away from any building air intakes.

Provide a minimum of two portable fully charged 9.072 kg CO2 fire extinguishers no closer than 1.524 m and no further than 7.62 m of horizontal travel distance from each kettle at all times while kettle is in operation, in easily accessible and identifiable locations.

Comply with the following safety procedures:

- a. Fuel containers, burners, and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating must comply with the requirements of NFPA 58.
- b. Fuel containers having capacities greater than one pound must be located a minimum of 3.048 m clear distance from the burner flame.

- c. All LP-Gas Cylinders must be clearly labeled "Flammable Gas", and secured to prevent accidental tip-over.
- d. Check all pressure regulators and hoses prior to use for proper functioning and integrity.
- e. Turn off fuel supply at LP Gas Cylinder when kettle is not in use.
- f. Equip all kettles with a functioning temperature measuring device to ensure no heating in excess of 10 degrees C below the flash point.
- g. Provide covers, lid, or top which are close fitting, constructed of minimum No.14 manufacturer's gauge steel, and can be gravity closed on all kettles.
- h. Clean all roofing mops and rags free of excess asphalt and store safely away from all combustible materials. Store discarded roofing mops and rags in a non-combustible container and remove from site each day.
- i. Position all pump lines handling hot asphalt securely and equip all pump lines with a shut-off valve on each with a coupler which may be opened when lines are full. Do not subject pump lines to pressures in excess of safe and recommended NRCA and ARMA working pressures. Station an operator near the equipment to cut off flow and care for other emergencies while conducting heating, pumping and application operations.
- j. Asphalt/tar bucket used by roofers or workers in similar trades must be constructed of minimum No. 24 gauge or heavier sheet steel and have a metal bail of no less than 6.35 mm diameter material. The bail is to be fastened to offset ears or equivalent which have been riveted, welded, or otherwise safely and securely attached to the bucket. Soldered bail sockets are prohibited. Position workers and other employees to avoid being struck by bucket or other roofing materials, which may accidentally fall while being hoisted, lowered, or used in the roofing operation. Provide safety barriers and caution signs at all roof holes.
- k. Do not use flammable liquids with a flash point below 37.8 degrees C (gasoline and similar products) for cleaning purposes.

Do not use solid fuel or Class I liquids as fuel for roofing asphalt/tar kettles. Provide a minimum of one employee fully knowledgeable of kettle operations and hazards to maintain constant surveillance during kettle operation within a minimum distance of 7.62 m of the kettle.

Check all fire extinguishers prior to commencement of work, and upon completion of the day's work, to ensure fullness and operability.

Project supervisor must make daily inspections with the facility manager of all conditions and operations which could present hazards during hot-mopped applications and issue directives to address all such concerns and items of the work and existing conditions.

Identify and protect all combustible roof components, possible fire traps, and hidden hazards. Seal off voids or openings in the substrate with

non-combustible materials prior to installing hot-mopped applied materials in the area. Install protective fire retardant blankets and shields at building walls, eaves, parapets and equipments curbs constructed of combustible materials within 0.9144 meter radius of the area of hot-mopped kettle prior to commencement of the work.

When working around intakes and openings, temporarily disconnect and block to prevent fumes from kettle from being drawn into the opening.

1.8.2 Fire Watch

All personnel on the roof during hot-mopped application must be properly trained to use a fire extinguisher. Provide a fire watch for a minimum of two hours after completion of hot-mopped kettle operations at the end of each work shift. Maintain the fire watch for additional time required to ensure no potential ignition conditions exist. Utilize heat sensing meters to scan for hot spots in the work. Provide a minimum duration fire watch of two hours conducted by personnel properly trained to survey the underside of the roof deck (where possible) and the topside of possible smoldering elements.

Do not leave the rooftop unattended during breaks in work during a work shift. Walk and scan all areas of application checking for hot spots, fumes, or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift.

1.8.3 Wind Conditions

When sustained wind gusts of 24 kilometers per hour or greater are present, notify the safety officer and cease roofing installation until wind conditions lower and authorization from the safety officer to proceed is received.

1.9 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that flashing and counter flashing are installed as the work progresses.

1.10 WARRANTY

Furnish the modified bitumen sheet roofing system manufacturer's "no-dollar-limit" warranty for the roofing system, metal flashings, and accessories, including written acceptance of cellular lightweight insulating concrete deck. The warranty shall run directly to the Government. In no event shall the warranty period be less than 20 years from the date of the Government's acceptance of the work, notwithstanding roofing applicator's or manufacturer's unpaid invoices for installation, supplies, or service. The warranty shall state that:

- a. When within the warranty period the roofing system becomes nonwatertight, splits, tears, blisters, or separates at the seams or shows any other evidence of excessive weathering, because of defective materials or workmanship, the repair or replacement of defective materials and correction of defective workmanship shall be the responsibility of the manufacturer;
- b. When the manufacturer or the manufacturer's approved applicator

fail to perform repairs within 72 hours of notification, emergency repairs performed by others will not void the warranty; and

- c. Damage to the roofing system caused by sustained winds having a velocity of 161 km/h or less is covered by the warranty.

PART 2 PRODUCTS

2.1 DESCRIPTION OF ROOFING SYSTEM

2.1.1 SBS Modified Sheet on Nailable Substrate

Substrate: Insulating cellular lightweight concrete over metal deck	
Components:	Quantity:
Asphalt Primer Type III or IV Asphalt Ventilating Base Sheet (VB) ASTM	3 liters/10 sq. meters Spot-mop 1 ply
Asphalt Primer Type III or IV Asphalt Base Sheet (GB) Type III or IV Asphalt SBS Modified Base Sheet (MB) Type III or IV Asphalt SBS Modified Bitumen Cap Sheet (RSS)	3 liters/10 sq. meters 12.5 kg/10 sq. meters 1 ply 12.5 kg/10 sq. meters 1 ply 12.5 kg/10 sq. meters 1 ply

2.2 MATERIALS

2.2.1 Asphalt

ASTM D 312, Type III or IV.

2.2.2 Modified Bitumen Sheet, Felts

Designation	Use	Felt	Impregnant	Coating	Specification
GB	Base Sheet (Ventilating)	Glass	Asphalt	Asphalt	ASTM D 4897,
MB	SBS Modified Base Sheet and Base Flashing Sheet	Fiber-glass	SBS Modified Bitumen	SBS Modified Bitumen	ASTM D 6163, Type II or Type III, Grade S, 100 mils thick minimum and 3.71 kg/m ²
MB	Field SBS Modified Interply	Fiber-glass/Poly-ester	SBS Modified Bitumen	SBS Modified Bitumen	ASTM D 6162, Type II or III, Grade S, 110 mils thick minimum, and 3.71 kg/m ²

Designation	Use	Felt	Impregnant	Coating	Specification
MB	Self-adhered sheet to encapsulate metal blocking and any combustible materials	Poly-ester	SBS Modified Bitumen	Smooth	ASTM D 6164, Type I, Grade S, 120 mils minimum and 4.64 kg/m ²
RSS	SBS Bitumen Cap Sheet	Poly-ester	SBS Modified Bitumen	SBS Modified Granules	ASTM D 6164, Type II, Grade G 114 mils thick, at selvage and avg. thickness of 160 mils min., weighing 4.88 kg/m ² minimum.
RSS	SBS Flashing Cap Sheet	Poly-ester	SBS Modified Bitumen	SBS Modified Granules	ASTM D 6164, Type II, Grade G 114 mils thick, at selvage and avg. thickness of 160 mils min., weighing 4.88 kg/m ² minimum.

2.2.3 Top Surfacing

Protect modified bitumen roofing system from direct exposure to the weather with one of the following surfacings as recommended by the modified bitumen roofing system manufacturer.

2.2.3.1 Mineral Roofing Granules

Factory applied, requiring no further coating.

2.2.4 Primer

ASTM D 41.

2.2.5 Asphalt Roof Cement

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

2.2.6 Fasteners

Provide noncorrosive fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM AS 4470. For felts, provide fasteners driven through metal discs, or one piece composite fasteners with heads not less than 25 mm in diameter or 25 mm square with rounded or 45 degree tapered corners.

2.2.6.1 Masonry or Concrete Walls and Vertical Surfaces

Provide hardened steel nails with flat heads, diamond shaped points, and mechanically deformed shanks not less than 25 mm long for securing felts, modified bitumen sheets, and metal Items to masonry or concrete walls and vertical surfaces. Use power-driven fasteners only when approved in writing.

2.2.7 Metal Discs (Tin Caps)

Flat noncorrosive fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM AS 4470; not less than 75 mm in diameter, when using screw type fasteners. Discs shall be formed to prevent dishing or cupping.

2.2.8 Roof Vents

Roof vents shall be of 0.85 millimeter galvanized steel conforming to ASTM A 653/A 653 M and ASTM A 924/A 924M, G165 Coating Designation. Roof vents shall be cylindrical, not less than 150 millimeter in diameter and 200 millimeter high. A conical weather cap, cone-base diameter 300 millimeter and cone height 150 millimeter, shall be securely fastened to the top of each roof vent by galvanized strap brackets. At roof end of the vent, a 300 millimeter flashing flange shall be securely brazed to the vent cylinder approximately 10 millimeter from the end.

2.2.9 Cellular Lightweight Insulating Concrete Below Modified Bitumen Membrane System

Cellular lightweight insulating concrete shall be compatible with the membrane as recommended in modified bitumen manufacturer's printed instructions and as specified in Sections 03342 CELLULAR LIGHTWEIGHT INSULATING CONCRETE and 07220 ROOF AND DECK INSULATION.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Ensure that the following conditions exist prior to application of the roofing materials:

- a. Drains, curbs, cants, expansion joints, and, roof penetrating components are in place.
- b. Surfaces are rigid, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.
- c. The plane of the substrate does not vary more than 6.35 mm within an area 3 by 3 meters when checked with a 3 meter straight edge placed anywhere on the substrate.
- d. Substrate is sloped as indicated to provide positive drainage. No ponding water will be permitted.
- e. Walls and vertical surfaces are constructed to receive counter flashing, and will permit nailing of the base flashing materials.
- f. Wood blocking is prohibited. Formed metal blocking is fastened in

place at openings and intersections with vertical surfaces for securing of felts, edging strips, gravel stops, and roof fixtures. Surface-applied blocking is the same thickness as the roof insulation.

- g. Protect all combustible materials and surfaces which may contain concealed combustible or flammable materials. All fire extinguishing equipment has been placed as specified.
- h. Verify all Fire Watch personnel assignments.

Contractor shall not proceed with the roofing application until defects have been corrected.

Starting work designates acceptance of the surfaces by the Contractor.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoist and kettles prior to starting the work. Lap protective coverings not less than 150 mm, secure against wind, and vent to prevent collection of moisture on covered surfaces. This protection shall be maintained for the duration of work.

3.2.1.2 Flame-Heated Equipment

Do not place flame-heated equipment on roof. Provide and maintain a fire extinguisher adjacent to flame-heated equipment and on the roof.

3.2.1.3 Open Flame Application Equipment

Torches and other open flame equipment shall not be used.

3.2.1.4 Electric-Heated Equipment

Provide adequate electrical service as required by manufacturer of electrical equipment to ensure against damage to equipment and property and to ensure proper application of roofing materials.

3.2.2 Priming of Surfaces

Prime surfaces at the rate of 2.84 liters per 9.29 sq. meters or as recommended by modified bitumen sheet manufacturer's printed instructions and allow to dry.

3.2.2.1 Priming of Concrete and Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive base sheet and roofing materials uniformly with asphalt primer. Allow primer to dry prior to application of base sheet, roofing, and flashing.

3.2.2.2 Priming of Metal Surfaces

Prime flanges of metal edging strips, prior to stripping into roofing

system in accordance with modified bitumen manufacturer's printed instructions and allow to dry.

3.2.3 Heating of Asphalt

Break up solid asphalt on a surface free of dirt and debris. Heat asphalt in kettle designed to prevent contact of flame with surfaces in contact with the asphalt. Kettles shall have visible thermometer and thermostatic controls set to the temperature limits specified herein. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus one degree C, to check temperatures of the asphalt frequently. When temperatures exceed maximums specified, remove asphalt from the site. Do not permit cutting back, adulterating, or fluxing of asphalt.

3.3 APPLICATION

Apply roofing materials as specified herein unless specified or recommended otherwise by manufacturer's printed application instructions and approved by the Contracting Officer. Keep roofing materials dry before and during application. Do not permit phased construction. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt. Modified Bitumen Base Sheet shall not remain exposed prior to application of the Modified Bitumen Cap Sheet unless approved by the Contracting Officer and supported by the manufacturer's standard written application instructions.

3.3.1 General Procedures

Roofing installation shall be continuous, with all operations proceeding together. Base sheet and specified plies of felt shall follow shingle-fashion as a single composite operation.

Roofing shall not be applied when ambient temperature is below 10 degrees C.

Interval between the base sheet application and succeeding plies shall not exceed 48 hours.

Before cessation of work on each working day or when work is interrupted due to rainfall or other causes, the roof shall be sealed against intrusion of water. Base sheet shall be brought to the edge of the insulation, dams shall be installed, and exposed felts shall be effectively glazed. Insulation or unglazed felts shall not be left exposed during rainfall or overnight.

Traffic over partially or completely finished roofing shall be only on planks or on plywood not less than 16 millimeter thick and 600 millimeter wide.

Bitumen quantities specified for laminating insulation, for attaching base sheets, for laminating successive plies of felts, or for flood coating shall be regarded as square-meter by square-meter minimums, not as averages for areas.

Debris shall be removed from the roof at the end of each work day.

3.3.2 Bitumen Stops

Provide bitumen stops at roof edges, openings, and vertical projections before hot mopped application of the roofing membrane (base sheet and modified bitumen). Do not provide sheet metal bitumen stops. Form bitumen stops of two 450 mm wide strips of organic felt conforming to ASTM D 226. ply felts. Attach 225 mm of the width to the roof surface and extend 225 mm beyond the edge. Apply first strip in a 225 mm wide layer of asphalt roof cement and, where nailers are provided, nail on 150 mm spacing 13 mm from the edge. Apply second strip in a 225 mm wide mopping of asphalt. Protect the free portion of each strip from damage throughout the roofing period. After the roofing plies are in place, fold the free portion of each strip over the roofing membrane and embed in a continuous coating of asphalt roof cement and secure with fasteners 75 mm o.c.

3.3.3 Ventilating Base Sheets

Apply ventilating base sheets in accordance with manufacturer's printed application instructions.

3.3.4 Modified Base Sheets

Apply base sheets in shingle fashion in hot mopping of asphalt. Apply sheets with side laps at a minimum of 50 mm unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 150 mm and staggered a minimum of 900 mm. Apply sheets at right angles to the roof slope so that the direction of water flow is over and not against the laps. Extend sheets approximately 50 mm above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim felt to a neat fit around vent pipes, roof drains, and other projections through the roof. Application shall be free of ridges, wrinkles, and buckles.

3.3.5 Hot-Mopping of Modified Interply Base Sheets

Provide hot asphalt for embedding of modified bitumen base sheet, to the substrate. Apply base sheets immediately following application of hot asphalt. Do not work ahead with asphalt. Asphalt shall be completely fluid, with mop temperatures within the specified EVT range, at the instant base sheets come into contact with asphalt. Application of bitumen between plies shall be such as to provide full, continuous, uniform coverage and complete penetration of asphalt into the sheet above and below. Embed sheets in asphalt. As sheets are being rolled into hot asphalt, immediately and thoroughly squeegee, roll, or broom down to eliminate trapped air and to provide tight, smooth laminations without wrinkles, buckles, kinks, and fish mouths. Completed system shall be free of air pockets and blisters.

3.3.5.1 Temperature Limitations for Asphalt

Heat and apply asphalt at the temperatures specified below unless specified otherwise by manufacturer's printed application instructions. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its FBT. Do not heat asphalt between 260 and 274 degrees C for longer than four consecutive hours. Do not heat asphalt to the equiviscous temperature (EVT). Before heating and application of asphalt refer to the asphalt manufacturer's label or bill of lading for FP, FBT, and EVT of the asphalt used.

3.3.6 Modified Bitumen Sheets

Sheets shall be watertight and visually free of pinholes, particles of foreign matter, undispersed raw material, or other manufacturing defects that might affect serviceability. Edges of seams shall be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles.

3.3.6.1 SBS Modified Bitumen CAP Sheet

Solid mop CAP sheet with hot asphalt at the rate of 2.84 liters per 9.29 sq. meters and embed one layer of roofing membrane into hot asphalt. Roll modified bitumen roofing membrane into place with a flow of hot asphalt out of side and end laps. Side laps shall be 101 mm and end laps shall be 152 mm. Stagger end laps a minimum of 914 mm. Back mop end laps. Apply roofing in a continuous application. Start installation at the low point of the roof and progress to the high point. Provide tight, smooth laminations without wrinkles, ridges, buckles, kinks, and fishmouths. Completed system shall be free of air pockets, blisters, ridges, fishmouths, and open laps.

3.3.7 SBS Modified Bitumen Flashing System

Apply a 2-ply modified bitumen sheet flashing system in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, in accordance with membrane manufacturer's printed application instructions and where necessary to make the work watertight. Metal flashing collars and cap flashings are specified under Section 07600 FLASHING AND SHEET METAL. Do not set metal flashing in hot asphalt.

Encapsulate any combustible material. Install self-adhered sheet to encapsulate formed metal blocking to receive metal coping. Encapsulate formed metal blocking with self-adhered SBS sheet. Install sheet to lap vertical face minimum of 152 mm below joint to roof face, minimum 51 mm below joint to exposed (finished) building face.

3.3.7.1 Flashing at Roof Drain

Roof drains are specified on drawings. Flashing for roof drains, are specified under Section 07600 FLASHING AND SHEET METAL. Extend base sheet and modified bitumen sheets to edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Securely clamp base sheet, modified bitumen sheets, and metal roof drain flashing and strip flashing in the flashing clamping ring. Secure clamps so that sheets and metal flashing are free from wrinkles and folds.

3.3.8 Roof Walkways

Install asphalt plank roof walkways, where indicated, for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Install manufacturer's walkway materials as listed on plans.

3.3.9 Lightning Protection

Coordinate lightning protection installation at roof parapet and roof ridge with lightning protection plans.

Utilize manufacturer's lightning protection adhesive to secure metal hold-down clips.

Roofing manufacturer shall ensure installation of adhesive and flashing of lightning protection system components are in accordance with roofing warranty.

3.3.10 Fire Watch

Provide fire watch during roofing application and continue for two hours after completion of application. Provide at least two 10 liter containers of water and two CO2 extinguishers for use during the fire watch.

3.3.11 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.3.12 Protection of Applied Roofing Against Moisture Absorption

At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system as follows.

3.3.12.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system with two full width strips of roofing felt set in and coated with asphalt roof cement. One-half width of the strips shall extend up and over the finished roofing and the other half-width extended out onto the bare deck unless recommended otherwise in membrane manufacturer's printed application instructions. Seal off flutes in metal decking along the cutoff edge. Pull membrane free or cut to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.3.12.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Temporary flashings shall consist of one ply of ply felt applied in a trowel coat of asphalt roof cement applied to a primed surface, and finished with a surface coat of asphalt roof cement. Remove temporary flashing before applying permanent flashing.

3.3.12.3 Temporary Walkways, Runways, and Platforms

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

3.4 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.4.1 Test for Surface Dryness

Before application of base sheets and starting work on the area to be roofed, perform test for surface dryness in accordance with the following:

- a. Foaming: When poured on the surface to which felts are to be applied, one pint of asphalt when heated in the range of 176 to 204 degrees C, shall not foam upon contact.
- b. Strippability: After asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from the surface, do not consider the surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been tested by the method above and found dry.

3.4.2 Instructions to Government Personnel

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the modified bitumen membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.5 INFORMATION SIGN

For each roof, furnish a photoengraved 0.8 mm thick aluminum card for exterior display. Card shall be 220 by 280 mm minimum and shall contain the information listed on Form 1 located at end of this section. Install card near point of access to roof.

FORM 1, ROOFING SYSTEM DESCRIPTION

1. Location _____ 2. Bldg. Name _____

3. Bldg. No. _____ 4. Roof Area (SF) _____ 5. Contract No. _____

6. New Construction: () Yes () No 7. Deck Slope: _____

8. Type of Deck:
 () Metal () Wood Plank or Plywood
 () Cast-In-Place Concrete () Other _____
 () Precast/Prestressed Concrete

9. Type of Insulation Board:
 () Polyisocyanurate/Composite () Polyisocyanurate Foam
 () Polystyrene/Composite () Polystyrene
 () Perlite () Mineral Fiber
 () Other _____

10. Insulation Manufacturer: _____

11. Insulation Thickness: _____

12. Vapor Treatment: Total coverage () Yes () No
 () No Vapor Retarder () Bituminous Vapor Retarder
 () One Way Roof Vents () Laminated Kraft Paper
 () Other _____

13. Vapor Treatment Manufacturer(s): _____

14. Roofing Type:
 () Built-Up (Asphalt) () PIB () TPA
 () Built-Up (Coal-Tar) () Modified Bitumen () EPDM
 () Metal () CSPE () PVC
 () Shingles () Other _____

15. Roofing Manufacturer: _____

16. Roofing Installer/Warrantor: _____

17. Roofing Application Method:
 () Bitumen () Fully Adhered () Loose-Laid
 () Mechanically Fastened () Torched Ballasted
 () Mechanically Fastened/Fully Adhered () Other _____

18. Warranty Period: From _____ To _____

19. Warranty Serial Number: _____

20. Date Roofing Completed: _____ 21. Inspector: _____

22. Prime Contractor Name/Address: _____

Signature: _____ Date: _____

INSTRUCTIONS FOR FORM 1 (Do Not Post)

1. Location: Name of activity as shown on contract.
2. Bldg. Name: As shown on contract or as provided by Contracting Officer.
3. Bldg. Number: As provided by Contracting Officer.
4. Roof Area: Area in square meters of roof for which deck insulation, membrane, etc. are the same. A separate form is required if any part of roof system is different over other areas of the roof.
5. Contract Number: As shown on the contract.
7. Show deck slope.
8. Deck: Check appropriate block.
9. Type of Insulation Board: Check appropriate block.
11. Show minimum thickness of installed insulation.
12. Vapor Treatment: Check appropriate blocks.
13. Show vapor treatment system manufacturer's name.
14. Roofing Type: Check appropriate block.
15. Show roofing manufacturer's name.
16. Roofing Installer's or Contractor's name.
17. Roofing Application Method: Check appropriate block.
18. Warranty Period: Insert start and end dates.
20. Show date roofing was accepted by the Contracting Officer. Warranty period begins on this date.
21. Show Government Inspector's name.
22. Prime Contractor Name/Address/Signature: Must be signed and dated by an official of Contracting firm.

-- End of Section --