
USACE / NAVFAC / AFCEA UFGS-07511 (March 2004)

Preparing Activity: NAVFAC Superseding
UFGS 07511 (February 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Revised throughout - changes not indicated by CHG tags

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SECTION 07511

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03/04

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SECTION 07511

ASPHALT BUILT-UP ROOFING 03/04

NOTE: This guide specification covers the requirements for aggregate surfaced bituminous built-up roofing, and built-up roofing with granule-surfaced modified bitumen cap sheet on slopes from 1/4 inch to 1 1/2 inches per foot.

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

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

Use of electronic communication is encouraged.

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

NOTE: The requirements for hot-mopped, four-ply, aggregate surfaced, built-up bituminous roofing systems and built-up bituminous roof systems consisting of three-ply felts and granule-surfaced modified bitumen cap sheet are included in this guide specification. This guide specification does not include the structural roof deck, insulation, or sheet metal fascias, gravel stops, and flashings.

This section shall be coordinated with other roof system components specifications such as rough carpentry, insulation and sheet metal flashing. This section shall also be coordinated with the criteria contained in Unified Facilities Criteria (UFC) 3-110-06 DESIGN: ROOFING as it relates to the specific project and Service Exceptions indicated

therein.

NOTE: In most cases, aggregate surfacing or granule surfaced modified bitumen cap sheet surfacing should be used in lieu of smooth surfaced built-up roofs. Generally, when properly applied and maintained, aggregate surfaced roofing will have greater life expectancy. Granulated cap sheet surfacing should be considered where:

1. There is danger of aggregate being drawn into air intakes of jet aircraft.

2. There is danger of wind blown aggregate jeopardizing property and life safety.

PART 1 GENERAL

1.1 REFERENCES

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

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

ASTM INTERNATIONAL (ASTM)

| | |
|-------------|--|
| ASTM C 1153 | (1997; R 2003e1) Location of Wet Insulation in Roofing Systems Using Infrared Imaging |
| ASTM C 208 | (1995; R 2001) Cellulosic Fiber Insulating Board |
| ASTM C 728 | (1997e1) Perlite Thermal Insulation Board |
| ASTM D 1863 | (1993; R 2003) Mineral Aggregate Used on Built-Up Roofs |
| ASTM D 1864 | (1989; R 2002) Moisture in Mineral Aggregate Used on Built-Up Roofs |
| ASTM D 1970 | (2001) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection |

| | |
|---|---|
| ASTM D 2170 | (2001a) Kinematic Viscosity of Asphalts (Bitumens) |
| ASTM D 2178 | (1997a) Asphalt Glass Felt Used in Roofing and Waterproofing |
| ASTM D 312 | (2000) Asphalt Used in Roofing |
| ASTM D 3617 | (2002) Sampling and Analysis of New Built-Up Roof Membranes |
| ASTM D 41 | (1994; R 2000e1) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing |
| ASTM D 4402 | (2002) Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer |
| ASTM D 448 | (2003) Sizes of Aggregate for Road and Bridge Construction |
| ASTM D 4586 | (2000) Asphalt Roof Cement, Asbestos Free |
| ASTM D 4601 | (1998) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing |
| ASTM D 4637 | (2003) EPDM Sheet Used in Single-Ply Roof Membrane |
| ASTM D 4897 | (2001) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing |
| ASTM D 6162 | (2000a) 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 | (2000) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements |
| ASTM E 108 | (2000) Fire Tests of Roof Coverings |
| FM GLOBAL (FM) | |
| FM AS 4470 | (1986; R 1992) Class I Roof Covers |
| FM P7825c | (2003) Approval Guide Building Materials |
| NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA) | |
| NRCA 0405 | (2001; R 2003, 5th Ed) Roofing and Waterproofing Manual |

UNDERWRITERS LABORATORIES (UL)

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

UL RMSD (2004) Roofing Materials and Systems Directory

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEM[S]

NOTE: Coordinate requirements with Part 2 materials specification. Delete the bracketed option not applicable to the project.

Asphalt applied, [four-ply felt, aggregate surfaced] [three-ply felt with granule-surfaced modified bitumen cap sheet] built-up roof membrane system.

1.3 SUBMITTALS

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

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

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the

"G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

ASPHALT

Felts, including ply felt, base sheet and ventilating felt as applicable; G, [_____]

[Granule Surface Modified Bitumen Cap Sheet; G, [_____]]

FLASHING MEMBRANE; G, [_____]

FASTENERS

PRIMER

ASPHALT ROOF CEMENT

walkpad materials

Vapor Pressure Relief Vents

CANT STRIPS

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

PRE-MANUFACTURED ACCESSORIES to be incorporated in the system installation; G, [_____]

Sample warranties certificates; G, [_____]

Submit all data required by Section 07220 ROOF AND DECK INSULATION, together with requirements of this section. Data shall include written acceptance by the roof membrane manufacturer of the products and accessories provided. Products shall be as listed in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-06 Test Reports

Samples of Built-Up Roofing

Submit test results on roofing field samples as required, verifying composition of sample. Submit six copies of laboratory analysis within 30 calendar days after samples are taken. Submit reports in accordance with ASTM D 3617.

SD-07 Certificates

bill of lading

Submit when labels of asphalt containers do not indicate the finished blowing temperature, flash point and equiviscous

temperature.

Qualifications of Applicator

Submit evidence of the roofing system manufacturer's approval.

SD-08 Manufacturer's Instructions

**NOTE: Edit the manufacturers instructions
submission requirements as necessary for the system
specified. Include bracketed requirements only as
applicable to the system being specified.**

felts; G, [_____]

flashings; G, [_____]

[modified bitumen cap sheet; G, [_____]

Base Sheet attachment, including pattern and frequency of
mechanical attachments required in field of roof, corners, and
perimeters to provide for the specified wind resistance.]

Asphalt

Primer

roof cement

Fasteners

cold weather conditions installation; G, [_____]

Include detailed application instructions and standard
manufacturer drawings altered as required by these specifications.

[Include membrane manufacturer requirements for nailers and
backnailing of roof membrane on steep slopes.] Explicitly identify
in writing, differences between manufacturer's instructions and
the specified requirements.

SD-11 Closeout Submittals

WARRANTY

INFORMATION CARD

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of Applicator

The roofing system applicator shall be approved, authorized, or licensed in
writing by the roofing system manufacturer and shall have a minimum of 3
years experience as an approved, authorized, or licensed applicator with
the manufacturer and be approved at a level capable of providing the
specified warranty.

1.4.2 Fire Resistance

Complete roof covering assembly shall:

NOTE: Specify Class B option only when Class A may not be attainable such as membrane system application directly to wood deck. Provide justification/rationale for Class B option with design submission

- a. Be Class A [or B] rated in accordance with ASTM E 108 , FM 4470, or UL 790; and
- b. Be listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM P7825c.

1.4.3 Wind Uplift Resistance

NOTE: Determine the required wind uplift resistance based on ASCE 7 wind loading calculations or applicable building code requirements. The specified FM rating incorporates a safety factor of 2 over the maximum calculated uplift pressure. Therefore, a FM rating of 1-90 correlates to a maximum uplift calculation of 2.2kPa (45 psf). When a rated system is specified, ensure the specified roof system is capable of meeting the wind uplift resistance specified. Where non-rated systems may be permissible, include the bracketed option.

Complete roof covering assembly, including insulation, shall be rated Class 1-[60][90][____] in accordance with FM P7825c capable of withstanding an uplift pressure of [2.85][4.30][] kPa per square meter ([60][90][____] psf). Non-rated systems shall not be installed[, except as approved by the Contracting Officer. Provide wind load calculations and submit engineering calculations and substantiating data to validate wind resistance of any non-rated roof system. Wind uplift calculations shall be based on a design wind speed of [] km/h ([] mph) in accordance with ASCE 7 or applicable building code requirements].

1.4.4 Preroofing Conference

After approval of submittals and before performing roofing [and insulation] system installation work, hold a preroofing conference to review the following:

- a. Drawings and specifications and submittals related to the roof work;
- b. Roof system components installation;
- c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution

of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer;

d. 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

e. Quality control plan for the roof system installation;

f. Safety requirements.

Preroofing conference scheduling shall be coordinated with the Contracting Officer. The conference shall be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing [and insulation], flashing and sheet metal work, [[mechanical] [and] [electrical] work], other trades interfacing with the roof work, [Fire Marshall,] and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with manufacturer's labels intact and legible. Mark and remove wet or damaged materials from site. Where materials are covered by a referenced specification, container shall bear specification number, type, and class, as applicable. Indicate on labels or bill of lading for roofing asphalt the asphalt type, finished blowing temperature (FBT), flash point (FP), and equiviscous temperature (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.

1.5.2 Storage

Protect materials against moisture absorption, contamination, or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms in dry locations in enclosed buildings or trailers with adequate ventilation. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work are finished and dry. 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. Maintain roll materials at temperature above 10 degrees C (50 degrees F) for a 24-hour period immediately prior to application. Aggregate shall be kept dry as defined by ASTM D 1863. Place only those materials to be used during one day's work on the roof at one time. Remove unused materials from the roof at the end of each day's work. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Damaged materials shall not be installed in the work. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roofing during precipitation, or fog, or when air temperature is below 4 degrees C (40 degrees F), or when there is ice, frost, moisture or visible dampness on roof deck.[Restriction on application of roofing materials below 4 degrees C (40 degrees F) may be waived if Contractor devises a means, satisfactory to Contracting Officer, of: (1) maintaining surrounding temperature above 4 degrees C (40 degrees F); (2) maintaining application temperature of heated materials without exceeding maximum specified heating temperature; and follows other recommendations of the membrane manufacturer for application in cold weather conditions.]

1.7 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 permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials.[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 covered with complete felt ply installation the same day.]

1.8 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Revision or amendment to standard membrane manufacturer warranty shall be provided as required to comply with the specified requirements.

1.8.1 Roof Membrane Manufacturer Warranty

NOTE: Buildings with roof area of 700 sq. meters (75 squares) or greater, administrative, classroom and other high use facilities, and facilities with sensitive use, contents, equipment, or functions require minimum 20 year warranty. All environmentally controlled interiors shall require a minimum 10 year roof warranty. Designer may specify 5 or 10 year manufacturer warranty on facilities of small roof area and of minor importance where interiors and contents are not severely impacted by water.

Furnish the roof membrane manufacturer's [5] [10] [20]-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. The warranty shall run directly to the Government and commence at time of Government's acceptance of the roof work. The warranty

shall state that:

- a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship shall be the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work shall be the responsibility of the roof membrane manufacturer.
- b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others shall not void the warranty.

1.8.2 Roofing System Installer Warranty

The roof system installer shall warrant for a period of not less than two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. The warranty shall run directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials shall be the responsibility of the roof system installer. All costs associated with the repair or replacement work shall be the responsibility of the installer.

1.8.3 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period shall be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.9 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system shall be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements shall be in general accordance with recommendations of the NRCA 0405, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Any deviation from specified or indicated requirements shall be submitted to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

NOTE: Edit the materials specification requirements as necessary for the system(s) specified in PART 1 - DESCRIPTION OF ROOF MEMBRANE SYSTEM.

See the Note in PART 1 - DESCRIPTION OF ROOF MEMBRANE SYSTEM for useful information in editing

the membrane materials requirements.

Include bracketed requirements only as applicable to the system being specified (e.g., torch applied systems may not require asphalt in the installation; granule surfaced cap sheets do not require gravel or coating surfacing).

2.1 GENERAL

Furnish a combination of specified materials that comprise the membrane manufacturer's standard system of the number and type of plies specified. Materials provided shall be approved by the roof membrane manufacturer and suitable for the service and climatic conditions of the installation.

2.2 FIBERGLASS FELT MATERIALS

NOTE: Select the base sheet option required and delete other base sheet options. Base sheets under insulation should be specified in the insulation specification section.

Perforated venting base sheet option should only be specified for application directly on concrete deck.

Base sheets with perforations are rolled into place and then top mopped with hot asphalt. Base sheets without perforations are mechanically attached to nailable substrates.

- a. [Venting Base Sheet: ASTM D 4897, Type II, [without] [with] perforations and as approved by the roof membrane manufacturer.]
- b. [Fiberglass Felt Base Sheet: ASTM D 4601, Type II, [without] [with] perforations and as approved by the roof membrane manufacturer.]
- c. Ply Felt: ASTM D 2178, Type [IV] [or] [VI].

2.3 BASE FLASHING MEMBRANE

ASTM D 6163. Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the built-up roof membrane and as recommended in membrane manufacturer's published literature. Base ply of flashing membrane shall be minimum 1.8 mm (70 mils) thick. Granule surface modified bitumen flashing cap sheet shall be minimum 3 mm (120 mils) thick on the selva edge.

2.4 ASPHALT

NOTE: Specify asphalt type based on roof slope.
Adhere to the following general requirements:

| <u>Roof Slope, in./ft.</u> | Type Asphalt |
|----------------------------|--------------------------|
| Less than 1/2 climate | Type II, Type III in hot |

1/2 to 1 Type III
1 to 1-1/2 Type III, Type IV in hot
climate

In locations where ambient temperature frequently exceeds 38 degrees C (100 degrees F) and roof slope is 1/2 inch per foot or greater, specify Type IV asphalt.

ASTM D 312, Type [III] [or] [IIII] [or] [IV], in accordance with membrane manufacturer requirements and compatible with the slope conditions of the installation.

2.5 SURFACING MATERIAL

[2.5.1 Aggregate for Surfacing Built-up Roofing

Water-worn gravel, crushed stone, or crushed slag, conforming to ASTM D 1863, or marble, expanded slag, or expanded shale, conforming to ASTM D 1863 except density not less than 880 kg/cubic meter (55 pcf). Aggregate conforming to gradation sizes No. 6, No. 7, and No. 67 in conformance with ASTM D 448 is acceptable provided other requirements of ASTM D 1863 are met. 2 percent maximum moisture content as determined by ASTM D 1864. Aggregate shall be light colored and opaque. Limestone, volcanic rock, crushed shells, and cinders are prohibited.

] 2.5.2 Granule Surface Modified Bitumen Cap Sheet

NOTE: Specify ASTM D 6163, fiberglass reinforced cap sheet, as a standard cap sheet. Also may include the alternate for ASTM D 6162 cap sheet, combination fiberglass and polyester. For high puncture resistance and for high traffic roofs, specify ASTM D 6164 only (polyester reinforced cap sheet).

[ASTM D 6163] [or ASTM D 6162] [ASTM D 6164]; Type II, Grade G, minimum 3 mm (120 mils) thick at selvage edge, and as required to provide specified fire safety rating.

] 2.6 PRIMER

ASTM D 41 for asphalt roofing systems and as approved by the membrane manufacturer.

2.7 ASPHALT ROOF CEMENT

ASTM D 4586 for use with asphalt roofing systems, Type II for vertical surfaces and built-up bituminous flashings; Type I for horizontal surfaces and as recommended by the membrane manufacturer.

2.8 CANT STRIPS

NOTE: Use wood cant in non-supported flashing and wood blocking details (i.e., expansion joints, area

dividers, and wall/roof intersections where roof deck is not supported by a wall).

Standard cant strips shall be of perlite conforming to ASTM C 728 [or woodfiber conforming to ASTM C 208] treated with bituminous impregnation, sizing, or waxing and fabricated to provide maximum 45 degree change in direction of membrane. Cant strips shall be minimum 38 mm (1-1/2 inches) thick and provide for minimum 125 mm (5 inch) face and 89 mm (3-1/2 inch) vertical height when installed at 45 degree face angle, except where clearance restricts height to lesser dimension. Kiln-dried preservative-treated wood cants, in compliance with requirements of Section[06100A][06100N] ROUGH CARPENTRY, shall be provided at base of wood nailers set on edge and wood curbing and where otherwise indicated.

2.9 UNSATURATED FELT OR ROSIN-SIZED BUILDING PAPER

NOTE: Include requirement for unsaturated felt or rosin-sized building paper under base sheet on wood decks substrates to prevent bitumen drippage through deck joints.

Minimum weight, 5 pounds per 100 square feet.

2.10 FASTENERS AND PLATES

Coated, corrosion resistant fasteners compatible with components being attached and contact surfaces. Fasteners for attachment to deck substrate shall conform to FM AS 4470 for Class I roof deck construction and FM P7825c for the wind resistance specified. Use hard copper fasteners in contact with copper; aluminum or stainless steel fasteners in contact with aluminum; and stainless steel fasteners in contact with stainless steel. For fastening only roofing felts, use fasteners driven through metal discs, or one-piece composite fasteners with heads not less than 25 mm (1 inch) in diameter or 25 mm (1 inch) square with rounded or 45-degree tapered corners.

[2.10.1 Wood Substrates and Nailers

Provide 11 gage annular threaded shank nails with 7/16 to 5/8 inch diameter heads; or one-piece composite nails with annular threaded shanks not less than 11 gage for securing felts and metal items. Fasteners shall be long enough to penetrate minimum 25 mm (1 inch) into or minimum 6mm (1/4 inch) through wood substrate materials. Fasteners shall not penetrate wood decking exposed to view on the underside.

] [2.10.2 Masonry or Concrete Walls and Vertical Surfaces

Provide hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 25 mm (1 inch) long for securing felts, metal items, and accessories. Use power-driven fasteners only when approved in writing by Contracting Officer.

] 2.10.3 Metal Plates

Flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM AS 4470; not less than 50 mm (2 inches) in diameter.

Discs shall be formed to prevent dishing or cupping.

[2.11 PRE-MANUFACTURED ACCESSORIES

NOTE: Edit, delete, and insert accessory materials
requirements as required for the specific project
and components to be installed.

Pre-manufactured accessories shall be manufacturer's standard for intended purpose, [comply with applicable specification section,] compatible with the membrane roof system and approved for use by the roof membrane manufacturer.

[2.11.1 Vapor Pressure Relief Vents

NOTE: Venting of roof insulation may be advisable
when vapor retarder is provided beneath insulation
or in recover projects when the old roof membrane
remains intact. The vapor retarder should be
specified in Section 07220 ROOF AND DECK INSULATION.
Coordinate with Section 06100 ROUGH CARPENTRY, to
ensure that kerfed wood nailers are specified at
edge of roof insulation and placed around periphery.
For roofs requiring venting that are more than 12
meters (40 feet wide), stack venting should be
provided to supplement edge venting. Underside
ventilation for steel decks should consist of
continuous openings 3 mm to 5 mm (1/8 to 3/16 inch)
wide between adjacent deck units. Coordinate these
requirements with appropriate specification sections.

Vents shall be manufactured for the purpose of releasing vapor pressure from the roofing system by heat and pressure. Vents shall be one-way type design to prevent reverse flow of moisture laden air into roofing system. Valve cap shall effectively seal out wind-blown rain and snow and shall not permit water entry if submerged.

] [2.11.2 Pre-fabricated Curbs

Curbs shall be [_____] gauge [G90 galvanized] [AZ55 galvalume] [_____] with minimum 100 mm (4 inch) flange for attachment to roof nailers. Curbs shall provide minimum height of 250 mm (10 inches) above the finished roof membrane surface.

] [2.11.3 Elevated Metal [Walkways] [and] [Platforms]

As specified in Section [05500A MISCELLANEOUS METALS] [05500N METAL FABRICATIONS] .

]] [2.12 WALKPADS

NOTE: Use walkpads as walkways and at roof access
points and where the roof or areas of the roof are
intended to bear foot traffic for maintenance or

other purposes once a month or more frequently.

Roof walkpads shall be polyester reinforced, granule-surfaced modified bitumen membrane material, ASTM D 6162 or ASTM D 6164, minimum [] [5 mm] ([] [200] mils) thick, compatible with the roof membrane and as recommended by the roof membrane manufacturer. Panels shall not exceed 1.2 meters (4 feet) in length. Other walkpad materials require approval of the Contracting Officer prior to installation.

] [2.13 PAVER BLOCKS

NOTE: Use concrete pavers as walkways on aggregate surface roofs where the roof or areas of the roof are intended to bear foot traffic for maintenance or other purposes once a month or more frequently. Use paver blocks under heavy bearing components, irregular base bearings and for support and attachment of lightweight pipe, conduit, and drainage lines routed along roof surface.

Precast concrete, minimum 38 mm (1-1/2 inch thick), minimum 450 mm (18 inches) square for walkways and minimum 150 mm by 300 mm (6-inch by 12-inch) for use in supporting surface bearing components but extending not less than 50 mm (2 inches) beyond all sides of surface bearing bases. Install walkpad material under all paver blocks.

] [2.14 ROOF INSULATION BELOW MODIFIED BITUMEN MEMBRANE SYSTEM

NOTE: If the roofing system contains insulation, coordinate with the appropriate insulation specification section. The insulation specification should include materials and installation up to the substrate on which the roof membrane base sheet and or membrane layers are to be installed. Coordinate base sheet attachment (mechanically fastened or mopped) with FM or UL fire and wind uplift requirements.

Insulation shall be compatible with the roof membrane, approved by the membrane manufacturer and as specified in Section 07220 ROOF AND DECK INSULATION.

] 2.15 MEMBRANE LINER

Self-adhering modified bitumen underlayment conforming to ASTM D 1970, EPDM membrane liner conforming to ASTM D 4637, or other waterproof membrane liner material as approved by the Contracting Officer.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before applying roofing materials, ensure that the following exist:

- a. [Drains,] [curbs,] [cants,] [control joints,] [expansion joints,] [perimeter walls,] [roof penetrating components,] [and] [equipment supports] are in place.
- b. Surfaces are rigid, clean, dry, smooth, and free of cracks, holes, and sharp changes in elevation. Joints in substrate are sealed to prevent drippage of bitumen into building or down exterior walls. 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.
- c. The plane of the substrate does not vary more than 6 mm (1/4 inch) within an area 3 by 3 meters (10 by 10 feet) when checked with a 3 meter (10 foot) straight edge placed anywhere on the substrate.
- d. Substrate is sloped as indicated to provide drainage.
- e. Walls and vertical surfaces are constructed to receive counterflashing and will permit mechanical fastening of the base flashing materials.
- f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.

NOTE: Coordinate with Section 06100, "Rough Carpentry," to ensure that waterborne preservative treatment is specified for wood which will be in contact with roofing components.

- g. Treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of felts, edging strips, attachment flanges of sheet metal, and roof fixtures. [Embedded nailers are flush with deck surfaces.] [Surface-applied nailers are same thickness as roof insulation.]

NOTE: Wood cants should also be used where there are non-wall supported flashings at wood blocking forming area dividers and expansion joints, and at wall and roof intersections where roof deck is not supported on wall.

- h. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is approximately 45 degrees and the height of the vertical leg is not less than nominal 89 mm (3-1/2 inches). Cants shall be laid in a solid asphalt mopping or coat of asphalt cement just prior to laying the roofing plies.

NOTE: Include venting provision for wet fill substrate materials like lightweight cellular concrete.

- [i. Venting is provided in accordance with the following:
 - [(1) Edge Venting: Perimeter nailers are kerfed across width of the nailers to permit escape of gaseous pressure at roof edges.]
 - [(2) Underside Venting: Vent openings are provided in steel form decking for cast-in-place concrete substrate.]
 - [(3) Vapor pressure relief vents: Holes equal to the outside diameter of vents are provided through the insulation where vents are required. Space vents in accordance with membrane manufacturer's recommendations.]]

NOTE: Coordinate with Section 06100 ROUGH CARPENTRY, to ensure that waterborne preservative treatment is specified for wood which will be in contact with roofing components.

- [j. Exposed nail heads in wood substrates are properly set. Warped and split [boards] [sheets] have been replaced. There are no cracks or end joints 6 mm (1/4 inch) in width or greater. Knot holes are covered with sheet metal and nailed in place. [Wood] [Plywood] decks are covered with rosin paper or unsaturated felt prior to base sheet or roof membrane application. [Joints in plywood substrates are taped with 50 mm (2 inch) wide masking tape to prevent air leakage from the underside.]]
- [k. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 6 mm (1/4 inch) in width. Insulation is being roofed over on the same day the insulation is installed.]
- [l. Cast-in-place concrete substrates have been allowed to cure and the surface dryness requirements specified under paragraph entitled "Field Quality Control" have been met.]
- m. [Joints between precast concrete deck units, including weld plates, are grouted, leveled, and covered with 4 inch wide ply felt or other bituminous stripping membrane set in bituminous cement prior to applying other roofing materials over the area.] Prior to application of primer on precast concrete decks, joints shall be covered with a minimum 100 mm (4 inch) strip of felt or bituminous stripping membrane set in bituminous cement.

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 hoists and kettles prior to starting the work. Lap protective coverings not less than six inches, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

3.2.1.2 Bitumen Stops

Provide felt bitumen stops or other means to prevent bitumen drippage at roof edges, openings, and vertical projections before hot mopped application of the roofing membrane. Felt bitumen stops shall be formed with two 300 mm (12 inch) wide strips of organic ply felt. Laminate with and set strips into a coating of asphalt roof cement with one-half of the width overhanging the edge of the roof or opening. Where nailers are provided, nail the strips with roofing nails spaced 300 mm (12 inches) on center in addition to embedding in asphalt roof cement. The free portion of each strip shall be protected from damage throughout the roofing period.

After the plies of felt are in place, fold free portion of the strips back over the roofing membrane and embed in a continuous coating of asphalt roof cement. Secure with roofing nails spaced 75 mm (3 inches) on center.

3.2.2 Equipment

3.2.2.1 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.

3.2.2.2 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.

[3.2.2.3 Open Flame Application Equipment

Open flame equipment shall be specifically designated for use in application of roofing materials and approved by the roofing materials manufacturer. Open flame equipment shall not be ignited (burning) when left unattended. Provide and maintain a fire extinguisher adjacent to open flame equipment on the roof.

]3.2.3 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 3 liters per 10 sq. meters (0.75 gallon per 100 sq. ft.) or as recommended by roof membrane manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane base flashing applications.

[3.2.3.1 Priming of Concrete and Masonry Surfaces

NOTE: Include this paragraph when roofing and base flashing are applied directly to concrete or masonry surfaces.

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

]3.2.3.2 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roofing system prior to setting in bituminous materials or stripping into roofing system.

3.2.4 Covering of Wood Substrate

Cover wood substrate with a layer of unsaturated felt or rosin-sized building paper lapped 50 mm (2 inches) at sides and 100 mm (4 inches) at ends. Nail to hold in place prior to application of roofing system.

3.2.5 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 working 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 (2 degrees F), 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.

3.2.5.1 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 finished blowing temperature (FBT). Do not heat asphalt between 260 and 274 degrees C (500 and 525 degrees F) for longer than four consecutive hours. Do not heat asphalt to the flash point (FP). Apply asphalt and embed membrane sheets when temperature of asphalt is within plus or minus 14 degrees C (25 degrees F) of 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 APPLICATION

NOTE: Include requirements for temporary roofing and flashing when construction will require considerable work on roof (that is, installing cooling towers, antennas, pipes, ducts, solar collectors) and temporary roofing is considered necessary to ensure that permanent roofing is not damaged during construction.

Apply roofing materials as specified unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Except for aggregate surfacing, 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 temperature for asphalt. [Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system.] Do not apply aggregate surfacing until the other roofing application procedures specified herein

are completed.

3.3.1 Phased Membrane Construction

NOTE: Include bracketed option only when
granule-surfaced modified bitumen cap sheet is
specified as the built-up roof surfacing.

Phased application of membrane plies is prohibited. [Any delay in modified bitumen cap sheet installation shall result in thorough cleaning of the applied membrane material surface and drying immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the Contracting Officer prior to cap sheet installation.]

[3.3.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing [cooling towers,] [antennas,] [pipes,] [ducts,] [_____,] is to be performed on the roof or where construction scheduling or weather conditions require protection of building interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing.

3.3.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of permanent roofing system.

] 3.3.3 Base Sheet Application - General

NOTE: Include this paragraph when either base sheet
or ventilating base sheet is specified in paragraph
entitled "Description of Roof Membrane System."

Mechanically fastened base sheets are required when
uninsulated roof membrane system is to be applied
directly to nailable decks, excluding steel deck.
Ventilating base sheet is required when roof
membrane is applied directly to wet fill deck
materials like lightweight insulating or cellular
concrete and gypsum fill, and when applied over new
poured concrete decks.

NOTE: Select the applicable application method.
Delete other options.

Delete requirements for adhered base sheets where
the sheet is to be mechanically fastened through to
nailable deck.

Apply base sheets at right angles to roof slope,
except on insulated roofs where nailers (insulation
stops) have been applied at right angles to slope

and on decks sloped 1:12 (one inch per foot) or more, apply felts parallel to roof slope. Include requirements for applying felts to barrel-type roofs only when applicable.

[[Fully adhere][Spot adhere]base sheets in accordance with membrane manufacturer's printed instructions. [Spot adhesion shall be with hot asphalt applied in 300 mm (12 inch) diameter spots installed in two staggered rows, centered 300 mm (12 inches) in from edge of the base sheet.] Roll and broom in the base sheet to ensure full contact with the hot asphalt application.] [On nailable substrates, mechanically fasten base sheet in conformance with specified wind resistance requirements and membrane manufacturer's printed instructions, and to include increased fastening frequency in corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Where applicable, base sheet may be mechanically fastened in conjunction with insulation to the substrate, in accordance with membrane manufacturers printed instructions.]

Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 50 mm (2 inches) unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 150 mm (6 inches) and staggered a minimum of 1 meter (36 inches). Apply sheets [at right angles to the roof slope so that the direction of water flow is over and not against the laps] [parallel to the roof slope] [so that plies of sheets extend from eave line on one side of the barrel-type roof and 450 mm (18 inches) over the center line of the crown of the roof. Apply sheets on the other side in the same manner, resulting in twice the normal amount of roofing sheets and asphalt at the crown]. Extend base sheets approximately 50 mm (2 inches) above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Application shall be free of ridges, wrinkles, and buckles.

[3.3.3.1 Ventilating Base Sheets

NOTE: Include this paragraph in conjunction with applicable portions of the above paragraph when ventilating base sheets are specified in paragraph entitled "Description of Roof Membrane System." Where rigid board roof insulation is a component of the roof system, ventilating base sheets should be specified in the roof insulation section 07220.

Apply ventilating base sheet material recommended by the roof membrane manufacturer. Extend sheets over roof cants, up vertical surfaces, and terminate under cap flashing; at roof edges terminate sheets under outside edge of perimeter edge nailers or under gravel stop. [Top mop perforated ventilating base sheet with a full, continuous mopping of hot asphalt.]

]3.3.4 Ply Felts

NOTE: Apply roofing felts at right angles to the roof slope, except that on insulated roofs where surface-applied wood nailers (insulation stops) have been applied running at right angles to roof slope

and on decks sloped 1:6 (1/2 inch per foot) or more,
apply the roofing felts parallel to roof slope.
Delete the add-on requirement for applying felts to
barrel-type roofs when not applicable.

NOTE: When roof slope exceeds 1:12 (1 inch per
foot) specify backnailing. Coordinate with
insulation Section 07220 and nailer requirements
Section 06100 to allow for backnailing of the
membrane.

Ensure proper alignment of felts prior to installation. [Apply ply felts shingle fashion perpendicular to slope of roof, including application on areas of tapered insulation that change slope direction.] [Apply ply felts parallel to slope of roof [so that plies of felt extend from eave line on one side of barrel-type roof and 450 mm (18 inches) over center line of the crown of roof. Apply felts on other side in same manner, resulting in twice normal amount of roofing felts and asphalt at crown].] Bucking or backwater laps are prohibited. Apply felts in a continuous operation. Provide starter sheets of felt to maintain the specified number of plies throughout the roofing. Apply felts with side laps in accordance with the material manufacturer's printed instructions for the number of plies to be installed and in uniform alignment. Lap ends not less than 150 mm (6 inches) and stagger one meter (36 inches) minimum. The full width of each ply shall be placed in hot bitumen immediately behind the bitumen applicator. Plies shall be laid free of wrinkles, creases, ridges, or fishmouths. Extend felts approximately 50 mm (2 inches) above top of cant strips at vertical surfaces and to top of cant strips elsewhere. Trim felts to a neat fit around vent pipes, roof drains, and other projections. Avoid traffic on mopped surfaces when the bitumen is fluid and for a minimum of one hour after ply application.

3.3.4.1 Hot-Mopping of Ply Felts

Bond plies to each other and to the [base sheets] [substrate] with hot asphalt. Apply felts immediately following application of asphalt. Do not work ahead with asphalt. At the instant felts come into contact with asphalt, asphalt shall be completely fluid, with asphalt temperatures within specified EVT range. Apply asphalt uniformly in a full, continuous mopping and firmly bonding film. Apply asphalt at the rate of approximately 13 kg per 10 sq. meters (25 pounds per 100 square feet) plus or minus 25 percent. Application rate on the high end of the application range shall be required when mopping directly to absorptive insulation substrates of perlite and woodfiber. As felts are rolled into the hot asphalt, immediately squeegee, roll or broom down to eliminate trapped air and to provide tight, smooth laminations without wrinkles, buckles, kinks, or fish mouths. Bitumen shall be visible beyond all edges of each ply as it is being installed. Individual ply installation and the completed roof membrane system shall be free of air pockets, felt delaminations, ridges, creases, fishmouths, dry laps, or blisters. Do not lay felts dry or turn back laps for mopping between plies.

[3.3.4.2 Backnailing of Ply Felts

NOTE: When roof slope exceeds 1:12 (1 inch per

foot) include the applicable paragraphs on backnailing. For insulated roofs, delete the second bracketed option. For uninsulated roofs on nailable decks, delete the first bracketed option and include only the second.

Unless otherwise recommended by the roof membrane manufacturer and approved by the Contracting Officer, [provide minimum 90 mm (3-1/2 inch) wide nailing strips matching insulation thickness and applied perpendicular to roof slope for backnailing of roof membrane. Space nailing strips as recommended by the membrane manufacturer, but not exceeding 5 meters (16 feet) on center unless approved otherwise by the Contracting Officer. Coordinate the nailer installation with insulation requirements. As the felt plies are installed, nail each ply 25 mm (1 inch) from the leading edge at each nailer line.] [fasten each felt ply 25 mm (1 inch) from the leading edge and spaced at maximum 5 m (15 feet) on center along the leading edge.] Fasteners shall have 25 mm (1 inch) diameter metal cap or be fastened through 25 mm (1 inch) diameter caps. Set fasteners firm and flush without puncturing felt ply. Conceal fasteners with succeeding plies of felt.

]3.3.4.3 Valleys and Ridges

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

3.3.5 Membrane Flashing

Provide two plies of modified bitumen membrane strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Top ply of flashing shall be granule-surfaced modified bitumen membrane. Install flashing after plies of roof membrane felt have been applied but before aggregate surfacing is applied. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of base flashing 150 mm (6 inches) on center through minimum 25 mm (1 inch) diameter tin caps with fasteners of sufficient length to embed minimum one inch into attachment substrate. [Apply matching granules in any areas of asphalt bleed out while the asphalt is still hot.] Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components. Metal flashing are specified under Section 07600 FLASHING AND SHEET METAL.

3.3.5.1 Strip Flashing

Set primed flanges of sheet metal flashings to be incorporated into roofing system in a uniform coating of asphalt roof cement not less than 1/16 inch thick applied over the ply felts. Strip-in with one layer of smooth surface modified bitumen membrane and cap with granule-surfaced modified bitumen membrane. Set strip flashing in hot asphalt or cement to the tops

of the flanges, roofing membrane, and to each other. Use coatings of asphalt roof cement not less than 1/16 inch thick for ply felt. Use hot asphalt or modified bitumen cement for modified bitumen sheets. Extend first stripping ply not less than 100 mm (4 inches) beyond outer edge of flange onto roof membrane. Extend each additional ply 100 mm (4 inches) beyond the edge of the previous ply.

[3.3.5.2 Membrane Flashing at Roof Drain

**NOTE: Include these requirements where roof drains
are provided.**

Roof drains are specified in Section[15400A PLUMBING GENERAL PURPOSE] [15400N PLUMBING SYSTEMS]. Flashings for roof drains are specified in Section 07600 FLASHING AND SHEET METAL. Extend roofing plies to edge of drain bowl opening at roof drain deck flange. Neatly fit and press primed roof drain flashing into heavy coat of asphalt roof cement applied to top of roofing plies. Strip in and completely cover flashing with two layers of modified bitumen sheet, extending the first sheet 150 mm (6 inches) on the roofing beyond the edge of flashing. Extend the cap sheet 150 mm (6 inches) beyond the previous flashing ply. Bond the two layers to the metal flashing and to each other with hot asphalt. Securely clamp membrane, metal flashing, and strip flashing in the flashing clamping ring. Secure clamps so that strip flashing and metal flashing are free from wrinkles and folds. Trim membrane, flashing, and stripping flush with inside of clamping ring.

] [3.3.5.3 Pre-fabricated Curbs

Prefabricated curbs shall be securely anchored to nailer or other base substrate as indicated and flashed with modified bitumen flashing membrane.

] 3.3.5.4 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.5.5 Lightning Protection

Lightning protection system components shall be flashed or attached to the roof membrane in a manner acceptable to the roof membrane manufacturer.

[3.3.6 Roof Walkpads

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Provide minimum 150 mm (6 inch) separation between adjacent walkpads to accommodate drainage. Provide walkpad [or an additional layer of cap sheet] under precast concrete paver blocks to protect the roofing.

] [3.3.7 Elevated Metal [Walkways] [and] [Platforms]

Install over completed roof system in accordance with Section 05500.
Provide protection mat of walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

] 3.3.8 Paver Blocks

Install paver blocks where indicated and as necessary to support surface bearing items traversing the roof area. Paver block shall be set on a layer of walkpad [or modified bitumen cap sheet] applied over the completed roof membrane.

[3.3.9 Vapor Pressure Relief Vents

NOTE: Include this paragraph only where vapor pressure relief venting over wet fill substrate material or insulation over vapor retarder is required. Coordinate with venting provisions in other paragraphs of this specification.

Provide vents in a uniform pattern and at a minimum rate of one for each 100 square meters (1000 square feet) of roof area. Space and install in strict accordance with the membrane manufacturer's instructions. Before applying roof surfacing, cut a hole, of diameter to suit base opening size of vent, through the roofing membrane and down to the deck[vapor retarder] surface. Fill the cut out with loose fill fiberglass or crumbled polyisocyanurate insulation. Set vent flange over hole on top of roofing membrane in a 1/8 inch thick bed of asphalt roof cement or special adhesive or cement recommended by vent manufacturer. Strip-in vent flanges with strip flashing membrane. Apply a bead of roof cement at membrane termination at base of vent.

NOTE: Include only the applicable surfacing, delete the other option.

] [3.3.10 Aggregate Surfacing

After completion of roof membrane ply and flashing installation, and correction of tears, gouges or other deficiencies in the installed work, apply aggregate surfacing. Uniformly flood coat the surface with hot asphalt at a rate of approximate 2.9 kg (60 pounds) per square. While asphalt is still hot, apply gravel aggregate surfacing material at a rate of 19.5 kg (400 pounds) per square or 14.5 kg (300 pounds) per square for slag or other approved aggregate surfacing. Provide for full and uniform coverage of the roof surface. Approximately 50 percent of the aggregate shall be solidly adhered in the asphalt.

] [3.3.11 Granule-Surfaced Modified Bitumen Cap Sheet

NOTE: Include the option of hot asphalt or torch application of cap sheet where permissible. Torch applied cap sheet can be applied over hot mopped membrane plies.

Where finished appearance of the roof is of consequence, include the bracketed requirement for granule application in areas of bitumen bleed out.

Underlying applied membrane shall be inspected and repaired free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Provide cleaning and artificial drying with heated blowers or torches as necessary to ensure clean, dry surface prior to cap sheet application. When delays in cap sheet installation may have occurred, do not apply cap sheet if underlying materials have been exposed to rain or frozen precipitation within the previous 24 hours. Unroll cap sheet membrane and allow to relax a minimum of 30 minutes prior to installation and as otherwise recommended by the membrane manufacturer. Apply cap sheet in same direction as the underlying felt plies. Align cap membrane and apply with minimum 75 mm (3 inch) side laps and minimum 150 mm (6 inch) end laps and as otherwise required by membrane manufacturer. Cap sheet shall be set in hot asphalt. Cap sheet may be torch applied with approval of the Contracting Officer and written approval of the felt membrane manufacturer, and as recommended by the modified bitumen membrane manufacturer. Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. [Apply matching granules in any areas of bitumen bleed out while the bitumen is still hot]. Minimize traffic on newly installed cap sheet membrane.

[3.3.11.1 Backnailing of Cap Sheet Membrane

NOTE: Include this paragraph for roof slopes greater than or equal to 1:6 (2 inches per foot). Coordinate with insulation Section 07220 and nailer requirements Section 06100 to allow for backnailing of the membrane.

Unless otherwise recommended by the roof membrane manufacturer and approved by the Contracting Officer, install the modified bitumen cap sheet to provide for end laps at nailer locations. Nail the modified bitumen cap sheet at the end lap area across the width of the sheet. Nail within 25 mm (1 inch) of each edge of the sheet and at 200 mm to 215 mm (8 to 8-1/2 inches) on center across the width of the sheet in a staggered fashion. Nails shall have 25 mm (1 inch) diameter metal cap or be nailed through 25 mm (1 inch) diameter caps. Cover nails by overlapping adjacent upslope sheet at the end lap area.

]3.3.12 Correction of Deficiencies

Where any form of deficiency is found, additional measures shall be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions shall be as directed by the Contracting Officer. [Where interply moppings are too light, apply additional two plies of felt in full moppings of asphalt. Apply with 100 mm (4 inch) side and end laps. Where free water, skips, excessive voids, dry laps, disbonding or any form of delamination are discovered between the plies, remove and rebuild affected area. Correction of inadequate number of plies, improper lap widths, or non-uniform or excessive asphalt mopping

shall be as directed by the Contracting Officer.] Where insulation is found to be wet, remove insulation and provide new built-up roofing and insulation.

3.3.13 Clean Up

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

3.4 PROTECTION OF APPLIED ROOFING

3.4.1 Protection Against Moisture Absorption

When precipitation is imminent and at the end of each day's work, protect applied roofing as follows:

[3.4.2 Water Cutoffs

**NOTE: Include this paragraph when roof insulation
is a substrate for the modified bitumen sheet
roofing.**

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system in an effective manner. [Seal off flutes in metal decking along the cutoff edge.] Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

]3.4.3 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. Remove temporary flashing before applying permanent flashing.

3.4.4 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, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

[3.4.5 Glaze Coat

Light glaze coating of bitumen shall be used to waterproof roof areas requiring extended time to complete. Glaze coating shall be at the discretion of the Contracting Officer. When required bitumen glaze coat on exposed felts shall be applied at a rate of 0.25 kg to 0.50 kg per square meter (5 to 10 pounds per square). Lower application rates, in accordance with membrane manufacturer's recommendations, may be required when modified bitumen cap sheet surfacing is specified. Valleys and low areas that may pond water shall receive glaze coating.

]3.5 FIELD QUALITY CONTROL

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

3.5.1 Test for Surface Dryness

Before application of insulation or membrane materials 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 materials are to be applied, one pint of asphalt when heated in the range of 176 to 204 degrees C (350 to 400 degrees F), 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.

3.5.2 Construction Monitoring

During progress of the roof work, Contractor shall make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

- a. Equipment is in working order. Metering devices are accurate.
- b. Materials are not installed in adverse weather conditions.
- c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

Nailers and blocking are provided where and as needed.

Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

The proper number, type, and spacing of fasteners are installed.

Materials comply with the specified requirements.

All materials are properly stored, handled and protected from moisture or other damages.

Asphalt is heated and applied within the specified temperature parameters.

Hot asphalt application is provided uniformly for voidless coverage and as necessary to ensure full adhesion of materials. Materials are set in place while asphalt is within the specified temperature range.

The proper number and types of plies are installed, with the specified overlaps.

Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

Membrane is without ridges, wrinkles, kinks, fishmouths, or other

voids or delaminations.

Installer adheres to specified and detailed application parameters.

Associated flashings and sheet metal are installed in a timely manner in accord with the specified requirements.

Temporary protection measures are in place at the end of each work shift.

[3.5.2.1 Manufacturer's Inspection

NOTE: Include this paragraph when manufacturer's inspection of work is required. Select desired frequency of manufacturer inspection and coordinate with text of optional 2nd and 3rd bracketed sentences.

Manufacturer's technical representative shall visit the site a minimum of [three][_____] times [once per week] during the installation for purposes of reviewing materials installation practices and adequacy of work in place.[Inspections shall occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion prior to surfacing application, at a minimum. Additional inspections shall not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer.] After each inspection, a report, signed by the manufacturer's technical representative shall be submitted to the Contracting Officer within 3 working days. The report shall note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

]3.5.3 Samples of Built-Up Roofing

NOTE: This requirement is included for optional enforcement at the discretion of the Contracting Officer. It is not the intent to require cut samples on all roof projects.

After application of specified roofing felts and prior to applying surfacing, take field samples of built-up roofing as directed by the Contracting Officer. Take and test samples in accordance with ASTM D 3617 and at locations selected by the Contracting Officer immediately prior to cutting. Cut 100 mm by 1000 mm (4-inch by 40-inch) samples across felt laps in a manner to expose the specified number of plies. The 100 mm (4 inch) edge shall coincide with an edge lap of felt and shall not be positioned over an end lap. The 100 mm by 1000 mm (4-inch by 40-inch) samples shall be used for visual inspection. The Contracting Officer will inspect the samples for the specified number of plies, bond between plies, skips in interply moppings, uniform asphalt mopping, presence of excessive voids or large voids in the ply construction, presence of harmful foreign materials, visible presence of moisture in the sandwich and wet insulation. 300 mm by 300 mm (12 inch by 12 inch) cut samples shall be used to calculate bitumen quantities in accordance with ASTM D 3617 when necessary and directed by the Contracting Officer. Do not proceed with surfacing

until all deficiencies disclosed as a result of cut tests have been corrected and approved by the Contracting Officer. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area and patch as specified.

3.5.3.1 Number of Cut Tests

Cut samples shall be taken as directed by the Contracting Officer for quality assurance validation or as necessary to determine the extent of deficiencies discovered in the construction. Except where cut samples are taken to investigate deficiencies, no more than two cut samples per 1000 square meters (100 squares) or one cut sample from each day's work shall be required.

3.5.3.2 Sample Cutting Device

Provide a rectangular, 100 mm by 1000 mm (4-inch by 40-inch template and 300 mm by 300 mm (12 inch by 12 inch) template, of a type that will permit accurate cutting of samples with standard roofing knives. Keep cutting edge of knife clean by washing in solvent after each cut.

3.5.3.3 Patching Cut-Out Area

Immediately after inspection, replace cut-out sample. When sample is needed for laboratory analysis or other circumstance makes it unavailable, substitute a new section of equivalent size and structure. For non-nailable decks, replace sample in hot asphalt. For nailable decks, insert one ply of ply felt into opening from which sample was taken and sprinkle nail to hold in place; coat felt heavily with asphalt roof cement and press cutout sample firmly into asphalt roof cement. Repair area of cut with new patch of the same number of plies as the primary roof membrane. Extend the first ply minimum 150 mm (6 inches) all around the cut area. Extend each additional ply minimum 100 mm (4 inches) beyond the previous ply.

[3.5.4 Roof Drain Test

NOTE: Include this paragraph when roof drains are required. Consult with structural engineer to verify loading capability of roof structural system.

After roofing system is complete except for surfacing, perform the following test of roof drains and adjacent roofing for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect the installation. Repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

] [3.6 INFRARED INSPECTION

NOTE: This optional requirement should be included only under special circumstances and on roof systems

conducive to effective infrared scanning, or as
otherwise instructed.

[Eight][_____] months after completion of the roofing system, the Contractor shall inspect the roof surface using infrared (IR) scanning as specified in ASTM C 1153. Where the IR inspection indicates moisture intrusion, wet insulation and damaged or deficient materials or construction shall be replaced in a manner to provide watertight construction and maintain the specified roof system warranties.

]3.7 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 1 mm (0.032) inch thick aluminum card for exterior display. Card shall be 215 mm by 275 mm (8 1/2 by 11 inches) minimum. Information card shall identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. The card shall be a minimum size of 215 mm by 275 mm (8 1/2 by 11 inches). Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

-- End of Section --