

SECTION 07510
BUILT-UP ROOFING
08/96

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

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

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

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825c	(1998) Approval Guide Building Materials
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1.2 SUBMITTALS

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

SD-08 Statements

Inspection; [____].

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

SD-13 Certificates

Bitumen; [____]. Felt; [____].

Certificates of Compliance for felts and bitumens.

Cants; [____].

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

1.3 STORAGE OF MATERIALS

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

PART 2 PRODUCTS

2.1 PRIMER

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

2.2 BITUMEN

2.2.1 Asphalt

ASTM D 312, [Type II on slopes from 21 mm per m 1/4 inch per foot up to and including 42 mm per m 1/2 inch per foot; Type II or Type III on slopes above 42 mm per m 1/2 inch per foot up to and including 83 mm per m 1 inch per foot; Type III on slopes above 83 mm per m 1 inch per foot up to and including 250 mm per m 3 inches per foot.] [Type III on slopes from 21 mm per m 1/4 inch per foot up to and including 250 mm per m 3 inches per foot; Type IV on slopes above 250 mm per m 3 inches per foot.] Bills of lading shall indicate the flash point and equiviscous temperature (EVT) or this information shall be shown on labels for each container of asphalt.

2.2.2 Coal-Tar Bitumen

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

2.3 BITUMINOUS CEMENT

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

2.4 CANTS

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

2.5 FELT

2.5.1 Base Sheet

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

2.5.2 Venting Inorganic Base Sheet

ASTM D 4897, Type II.

2.5.3 Glass Roofing Felt

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

2.5.4 Organic Felt Base

ASTM D 2626 for use with asphalt roofing system.

2.5.5 Organic Felt

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

2.6 MINERAL-SURFACED ROLL ROOFING

ASTM D 3909.

2.7 NAILS AND FASTENERS

Nails and fasteners shall be an approved type recommended by the roofing felt manufacturer. Fasteners for steel or concrete deck shall conform to FM P7825c for Class I roof deck construction, to withstand an uplift pressure of [290] [440] [_____] kg per square meter. [60] [90] pounds per square foot.

2.8 AGGREGATE SURFACING MATERIALS

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

2.9 WALKWAY SURFACES

2.9.1 Mineral Asphalt Plank

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

2.9.2 Concrete Slab

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

2.10 WOVEN GLASS FABRIC

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

2.11 INSULATION

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

2.12 Glass Mat Gypsum Roof Board

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

2.12 FLASHINGS

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

PART 3 EXECUTION

3.1 COORDINATION

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

3.1.1 Insulation

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

3.1.2 Sheet Metalwork

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

3.2 ENVIRONMENTAL CONDITIONS

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

3.3 PREPARATION REQUIREMENTS

The substrate construction of a bay or section of the building shall be completed before roofing work is begun thereon. [Roofing applied directly on lightweight insulating concrete shall not be scheduled until the insulating concrete passes the air-dry density test specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.] [Roofing applied directly on concrete shall not be scheduled until frothing or bubbling does not occur when hot bitumen is applied to the concrete and until the hot bitumen sticks tightly to the concrete.] Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Nailers, curbs and other items attached to roof surface shall be in place before roofing is begun.

3.4 INSTALLATION OF CANTS

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

3.5 CONDITION OF SURFACES

Surfaces shall be inspected and approved immediately before application of roofing and flashings. The roofing and flashings shall be applied to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials. Prior to application of primer on precast concrete decks, joints shall be covered with a 100 mm 4 inch strip of roofing felt, embedded in and coated with bituminous cement.

3.6 MECHANICAL APPLICATION DEVICES

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

3.7 PRIMING

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

3.8 HEATING OF BITUMEN

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

3.9 BITUMEN STOPS

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

bituminous cement and secured with roofing nails spaced 75 mm 3 inches on centers.

3.10 BITUMEN APPLICATION

Asphalt shall be applied within a range of 14 degrees C 25 degrees F below to 14 degrees C 25 degrees F above the EVT. Temperature of coal-tar bitumen at the time it is applied shall be in accordance with the bitumen manufacturer's recommendations. Application temperatures shall be measured at the mop bucket or mechanical applicator. Bitumen at a temperature below the recommended temperature shall be returned to the kettle. Each layer of felt shall be laid in not less than 0.97 kg (20 pounds) 20 pounds nor more than 1.7 kg (35 pounds) 35 pounds of asphalt per square meter or not less than 1.4 kg 30 pounds nor more than 1.7 kg 35 pounds of coal-tar bitumen per square meter. Where solid moppings are required, the following requirements as evidenced in any one roof cut-out sample shall apply:

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

3.11 APPLICATION OF FELTS

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

3.11.1 On Gypsum, Lightweight Concrete or Insulating Concrete Surfaces

One ply of venting inorganic base sheet shall be laid, shingle fashion, without mopping and with each sheet lapping 100 mm 4 inches over the previous sheet. Each base sheet shall be nailed or fastened at 225 mm 9 inch intervals along laps and shall also be nailed or fastened at 450 mm 18 inch intervals staggered down the center of the sheet in 2 rows 275 mm 11 inches apart. Three plies of glass roofing felts shall be immediately

placed shingle-fashion in solid mopped bitumen over the base sheet as specified. Felts shall be applied in 900 mm 36 inch widths with 24 17 mm 2/3 inch side laps and starter sheets 300, 600 and 900 mm 12, 24 and 36 inches wide along eaves to maintain 3 full plies over the base sheet.

3.11.2 On Concrete or Insulation Surfaces

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

3.12 MECHANICAL FASTENING

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

3.13 PROTECTION OF APPLIED ROOFING

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

3.14 FLASHINGS

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

3.14.1 Base Flashings

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

3.14.2 Strip Flashings

Sheet metal flashings, bitumen stops and gravel stops installed over the

roofing top ply shall be strip flashed with 2 layers of roofing felt, 225 mm 9 inches and 300 mm 12 inches wide and successively cemented in place.

3.14.3 Valleys and Ridges

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

3.15 WALKWAYS

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

3.16 AGGREGATE SURFACING

After roofing felts have been laid and flashings installed, the roof surface, except for cants, shall be flood-coated uniformly with 2.9 kg 60 pounds of hot asphalt per square meter per square or [3.7] [3.5] [_____] kg per square meter [75] [70] [_____] pounds per square of coal-tar bitumen if coal-tar roof system is used. Aggregate surfacing materials shall be spread on the hot bitumen at a rate of 19.5 kg per square meter 400 pounds per square for gravel or 14.6 kg per square meter 300 pounds per square for other approved surfacing aggregate.

3.17 GLAZE COAT

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

3.18 ROOF CUT-OUT TESTS

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

3.19 INSPECTION

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

- a. Environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.
- b. Verification of compliance of materials before, during, and after installation.
- c. Inspection of condition of equipment and accuracy of thermometers and metering devices.
- d. Inspection of flashings, cants and curbs.
- e. Inspection of membrane placement, including edge envelopes, widths of starter sheets, laps, proper use of squeegee, and mechanical fastening.
- f. Inspection of application of bitumen, aggregate, and walkways.
- g. Inspection of embedment of aggregate for required weight and coverage.
- h. Cutout sampling and analysis as directed.

3.20 INFRARED INSPECTION

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

-- End of Section --