
USACE / NAVFAC / AFCEA UFGS-07220 (February 2003)

Preparing Activity: NAVFAC Superseding
UFGS 07220N (March 2000)
UFGS 07220A (October 2001)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

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SECTION 07220

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02/03

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SECTION 07220

ROOF AND DECK INSULATION 02/03

NOTE: This guide specification covers the requirements for insulation materials used below built-up roofing and single ply roofing systems.

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

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

Use of electronic communication is encouraged.

This guide specification includes tailoring options for NAVY and USACE. Selection or deselection of a tailoring option will include or exclude that option in the section, but editing the resulting section to fit the project is still required.

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

Insulation materials applies to both organic and inorganic materials used for thermal protection as part of roofing assemblies or under decks.

In new construction, provide at least a one in 24 1/2 inch per foot slope in the structural deck and use non-tapered insulation. When it is clearly impracticable to provide at least the required slope or when reroofing where there is insufficient slope, consider the use of tapered insulation. Also, use tapered insulation for the construction of saddles and crickets to provide slope to drains.

Insulation for prefabricated metal buildings is not included in this section. Insulating sheathing, other materials which are not primarily thermal insulating materials, and insulating concrete are also not included. Such products are classified according to their primary use, and should be specified under the appropriate sections. Spray-applied polyurethane foam roof insulation is specified in Section 07571, "Foamed Roofing."

NOTE: On the drawings, show:

1. Extent and locations of work to be accomplished.
2. Dimensions when space limitations or construction features govern thickness of insulation materials.
3. Details at cants, edge strips, and nailers.
4. Location and spacing of wood nailers.

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.

ASTM INTERNATIONAL (ASTM)

ASTM C 1050	(1991) Rigid Cellular Polystyrene-Cellulosic Fiber Composite Roof Insulation
ASTM C 1177/C 1177M	(2001) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1289	(2002) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 208	(1995; R 2001) Cellulosic Fiber Insulating Board
ASTM C 552	(2000e1) Cellular Glass Thermal Insulation

ASTM C 578	(2003a) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 726	(2000a) Mineral Fiber Roof Insulation Board
ASTM C 728	(1997e1) Perlite Thermal Insulation Board
ASTM C 984	(1994) Perlite Board and Rigid Cellular Polyisocyanurate Composite Roof Insulation
ASTM D 2178	(1997a) Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 312	(2000) Asphalt Used in Roofing
ASTM D 41	(1994; R 2000e1) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4586	(2000) Asphalt Roof Cement, Asbestos Free
ASTM D 4601	(1998) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4897	(2001) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM E 84	(2003) Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM AS 4470	(1986; R 1992) Class I Roof Covers
FM P7825	(2003) Approval Guide
FM P7825c	(2003) Approval Guide Building Materials
FM P9513	(2002) Specialist Data Book Set for Roofing Contractors; contains 1-22 (2001), 1-28 (2002), 1-29 (2002), 1-28R/1-29R (1998), 1-30 (2000), 1-31 (2000), 1-32 (2000), 1-33 (2000), 1-34 (2001), 1-49 (2000), 1-52 (2000), 1-54 (2001)

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2004) Building Materials Directory
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1.2 SUBMITTALS

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

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

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

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [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-02 Shop Drawings

NOTE: Specify shop drawings for wood nailers when nailers are required for securing insulation on roofs sloped one in 24 1/8 inch per foot or more.

[Wood nailers]

[Tapered roof insulation system[; G][; G, [____]]]

[Taper cants and crickets]

NOTE: Include requirement for backnailing felts when backnailing of felts is specified for built-up roofing. Include bracketed second and third sentences when tapered insulation is specified.

[Show location and spacing of wood nailers that are required for securing insulation [and for backnailing of roofing felts]].

[Show a complete description of the procedures for the installation of each phase of the system indicating the type of materials, thicknesses, identity codes, sequence of laying insulation, location of ridges and valleys, special methods for cutting and fitting of insulation, and special precautions. The drawings shall be based on field measurements.]

SD-03 Product Data

[Fasteners] [Asphalt] [; G] [; G, [____]]

Insulation [; G] [; G, [____]]

NOTE: Insulation may be specified solely for use on steel decks as underlayment for roofing when insulation is not required for thermal properties. FM Approval Guide includes requirements for fasteners for 1-60 or 1-90 classifications or resistance to wind uplift pressures of 2.87 or 4.31 kPa 60 or 90 psf, respectively. Refer to MIL-HDBK-1002/2, for wind loads. Refer to FM Loss Prevention Data Sheet 1-7 for wind uplift prevention design. Specify no less than 4.31 kPa 90 psf for roofs located in coastal areas. Specify other fastener requirements if 1-90 standards are determined to be inadequate.

[Include minimum thickness of insulation for steel and concrete decks and fastener pattern for insulation on steel decks.]

SD-06 Test Reports

Flame spread and smoke developed ratings

Submit in accordance with ASTM E 84.

SD-07 Certificates

NOTE: Include these requirements when tapered insulation is to be used.

Installer qualifications

SD-08 Manufacturer's Instructions

Nails and fasteners

Roof insulation, including field of roof and perimeter attachment requirements.

1.3 MANUFACTURER'S CERTIFICATE

Submit certificate from the insulation manufacturer attesting that the installer has the proper qualifications for installing tapered roof insulation systems.

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

1.4 QUALITY ASSURANCE

[1.4.1 Insulation on [Combustible] [Steel] [or] [Concrete] Decks

NOTE: Include this requirement when insulation is installed over plywood, wood planks other than nominal 50 mm 2 inch thick, tongue-and-groove type, or steel deck.

Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and listed in the UL Bld Mat Dir as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL Bld Mat Dir or listed as Class I roof deck construction in the FM P7825. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.]

[1.4.2 Foam Board on [Combustible] [Steel] Decks

Separate [polyurethane] [or] [polystyrene] insulation from a [combustible] [steel] deck with a thermal barrier of glass mat gypsum roof board or roof insulation in accordance with the requirements of the UL Bld Mat Dir or the FM P7825.]

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

- a. Name of manufacturer;
- b. Brand designation;
- c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification; and
- [d. Asphalt's flashpoint (FP), equiviscous temperature (EVT), and finished blowing temperature (FBT).]

Deliver materials in sufficient quantity to allow continuity of the work.

1.5.2 Storage and Handling

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or

moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. [Store felt rolls on ends. For the 24 hours immediately before application of felts, store felts in an area maintained at a temperature no lower than 10 degrees C 50 degrees F above grade and having ventilation around all sides.] Replace damaged material with new material.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 4 degrees C 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

1.7 PROTECTION OF PROPERTY

NOTE: Where built-up roofing is applied over insulation, delete paragraphs entitled "Flame Heated Equipment" through "Dripping of Bitumen" and specify requirement enclosed in brackets in paragraph entitled "Protection of Property." Insert in blank provided the number and title of section covering roofing where protection requirements are specified. Delete paragraphs entitled "Flame-Heated Equipment," "Protective Coverings," "Special Protection," and "Dripping of Bitumen" when roofing system or insulation does not require hot asphalt or torches for application.

[Provide protection as specified in [____].]

[1.7.1 Flame-Heated Equipment

Locate and use flame-heated equipment so as not to endanger the structure or other materials on the site or adjacent property. Do not place flame-heated equipment on the roof. Provide and maintain a fire extinguisher near each item of flame-heated equipment.

] [1.7.2 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoist and kettles prior to starting the work. Lap protective coverings at least 150 mm 6 inches, secure them against wind, and vent them to prevent collection of moisture on the covered surfaces. Keep protective coverings in place for the duration of the work with asphalt products.

] [1.7.3 Special Protection

Provide special protection approved by the insulation manufacturer, or avoid heavy traffic on completed work when ambient temperature is above 27 degrees C 80 degrees F.

] [1.7.4 Dripping of Bitumen

Seal joints in and at edges of deck as necessary to prevent dripping of asphalt into building or down exterior walls.

]PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

NOTE: Specify all types of insulation listed as Contractor options, except where method of construction and/or special requirements prohibit use. Thermal barrier of glass mat gypsum roof board or suitable roof insulation board must be installed directly on roof deck when polystyrene board will be applied over decks constructed of materials other than poured-gypsum; poured-concrete; nominal 50 mm 2 inch thick, tongue-and-groove wood plank or precast roof deck panels; or planks approved by FM as noncombustible roof deck construction.

For SOUTHNAVFACENGCOM projects, do not specify mineral fiber, glass fiber or cellular glass boards.

Roof insulation should be specified by thermal resistance (R value) necessary to obtain required overall thermal transmittance (U value) needed to satisfy design criteria for particular type of facility. Thickness of insulation will vary with type of material furnished to provide specified R value. When thickness of insulating material is governed by space limitations or construction features, R value and corresponding thickness should be coordinated with space available. Provide insulation of sufficient thickness to ensure that temperature of vapor retarder surface, when used, will be above dewpoint. R value for insulation should never be less than R value used in design of heating and/or air conditioning systems.

NOTE: Roof construction, air-to-air, may include finish ceilings, provided that ceilings extend over the entire same roof area; and space above the ceiling is not vented to the exterior and is not used as a plenum. Generally, roof insulation over mechanical rooms need not be increased in thickness when the mechanical room has no ceiling and the rest of the building has a ceiling.

Designer will determine the required R-value and show the R-value at the appropriate detail on the drawings. The required R-value will never be less than that used in the Energy Budget Analysis. The R-value of impermeable faced iso-foams and permeable faced polyisocyanurate components will be calculated using the aged R-value of 1.0 square meter K/W ("R" value 5.56) per 25 mm (inch) of thickness; $k = 0.31 \text{ W/m.k}$ ($k = 0.18$).

The R-value of impermeable faced (ex. aluminum foil) polyisocyanurate components will be calculated using the aged R-value of 1.27 square meter k/w ("R" value 7.2) per 25 mm (1 inch) of thickness; $k = 0.24 \text{ W/m.k}$ ($k = 0.14$).

Delete foil-faced board when roofing is single-ply and fully adhered. Delete polystyrene and polystyrene composite when insulation will be applied with hot asphalt.

The recovered materials content levels specified below are based on the weight (not the volume) of the materials in the insulating core, excluding skins or facings.

Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 24 degrees C, 75 degrees F, and the thickness. Minimum thickness shall be as recommended by the manufacturer. Boards shall be marked individually. The thermal resistance of insulation shall be not less than the R-value shown on the drawings. The insulation manufacturing process shall not include chlorofluoro carbons (CFC) in conformance with Section 01670 RECYCLED/RECOVERED MATERIALS. Insulation shall be one, or a combination of the following materials:

Roof insulation shall be one or an assembly of a maximum of three of the following materials and compatible with attachment methods for the specified insulation and roof membrane:

NOTE: Detailed information concerning EPA requirements on recycled/recovered materials is available at the following URL's:
<http://www.epa.gov/cpg/products/> and then click on the appropriate item from the list (building.htm for building insulation, for example).
<http://www.epa.gov/cpg/products.htm> (similar results).
<http://www.gov/cpg/pdf/back.pdf> which opens up EPA530-R-98-003 (dated July, 1998, titled BACKGROUND DOCUMENT FOR PROPOSED CPG III AND DRAFT RMAN III).

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

- a. Expanded Perlite Board: ASTM C 728. Minimum 19 mm 3/4 inch thick when both top and bottom surfaces will be in contact with asphalt.

NOTE: Delete foil-faced board when fully adhered,
cold-applied single ply roofing is specified.

Blistering of roofing membranes has occurred over some polyurethane and composite (polyurethane) board insulation, possibly due to either release of gases from polyurethane, moisture entrapped in facing or plying felt, differential movement between roofing membrane and polyurethane resulting from thermal stresses on the materials, or inadequate brooming and mopping. When hot-applied built-up, modified bitumen sheet, or PIB sheet roofing is installed over insulation, it is recommended that thin layer of mineral fiber, wood fiberboard, expanded perlite board insulation, or glass mat gypsum roof board be placed over top surface of polyurethane board, embedded in solid asphalt mopping with joints of mineral fiber, wood fiberboard, or perlite board, or glass mat gypsum roof board staggered in both directions with respect to polyurethane board below. The same precautionary procedure should be followed when polyisocyanurate foam boards are specified even though there may not be documentation of similar problems with these types.

- b. Polyisocyanurate Board: ASTM C 1289 [Type I -- foil faced both sides] [or] [Type II, fibrous felt or glass mat membrane both sides], except minimum compressive strength shall be 140 kPa 20 pounds per square inch (psi).

NOTE: Delete polystyrene composite board when
insulation will be applied with hot asphalt.

- c. Composite Boards: ASTM C 1289, [Type III, perlite insulation board faced one side, fibrous felt or glass fiber mat membrane on other side.] [Type V, oriented strand board or waferboard on one side and fibrous felt or glass fiber mat membrane or aluminum foil on the other.]; ASTM C 984 (Polyisocyanurate-perlite) [; or ASTM C 1050 (Polystyrene-wood fiberboard), Type III, Grade 1, Class A].

- d. Cellular Glass Boards: ASTM C 552, Type IV.

NOTE: Delete non-composite polystyrene board when
insulation will be applied with hot asphalt or used
under hot asphalt-applied roofing. This type of
insulation is sensitive to hot asphalt, various
solvents, and certain single ply roofing membranes.

NOTE: Expanded or extruded polystyrene insulation
board is flexible enough for use on arched roofs.
For this application, each layer must be thin enough
to permit the required bending and each layer must

be mechanically fastened. Check individual
manufacturer requirement prior to application.

[e. Polystyrene Board: Shall be in accordance with ASTM C 578, Type
II, IV, or X.]

NOTE: Specify high density type wood fiberboard
where the board is used as an overlayment and
fully-adhered single-ply roofing is specified.

NOTE: Grade 1 insulating board is primarily for use
under built-up roof systems. Grade 2 board is
primarily for use under single-ply roof systems.

[f. Wood Fiberboard: ASTM C 208[, high density], except 4 by 4 feet
maximum board size.

ASTM C 208 Type II, Grade 1 or 2, roof insulating board, treated with
sizing, wax or bituminous impregnation. Bituminous impregnation shall be
limited to 4 percent by weight when used over steel decks. Maximum board
size: 4 feet by 4 feet.]

2.1.2 Mineral-Fiber Insulation Board

ASTM C 726.

2.1.3 Recovered Materials

Provide thermal insulation materials containing recycled materials to the
extent practical. The required minimum recycled material content for the
listed materials are:

Perlite Composition Board:	23	percent postconsumer paper
Polyisocyanurate/polyurethane:	9	percent recovered material
Phenolic Rigid Foam:	5	percent recovered material
Wood Fiberboard	[]	percent recovered material

NOTE: Whenever possible, provide insulation which
has a minimum of 4 percent post consumer waste or 20
percent recycled material by weight of installed
products as defined by (NIBS) September 1999.

2.1.4 Insulation Thickness

As necessary to provide a thermal resistance (R value) of [_____] or more
[for average thickness of tapered system]. Thickness shall be based on the
"R" value for aged insulation. [Insulation over steel decks shall satisfy
both specified R value and minimum thickness for width of rib opening
recommended in insulation manufacturer's published literature].

[2.1.5 Tapered Roof Insulation

NOTE: Where tapered roof insulation is used on a substrate sloped one in 48 1/4 inch per foot and greater, insulation having a slope of one in 48 1/4 inch per foot may be specified. Otherwise, specify tapered insulation having a slope of one in 24 1/2 inch per foot.

One layer of the tapered roof insulation assembly shall be factory tapered to a slope of not less than one in [24] [48] [1/4] [1/2] inch per foot. Provide starter and filler blocks as required to provide the total thickness of insulation necessary to meet the specified slope and thermal conductance. Mitered joints shall be factory fabricated and shall consist of two diagonally cut boards or one board shaped to provide the required slopes. Identify each piece of tapered insulation board by color or other identity coding system, allowing the identification of different sizes of tapered insulation board required to complete the roof insulation system.

] [2.1.6 Cants and Tapered Edge Strips

NOTE: Generally cant strips are not required for single ply roofing systems. However, if cant strips are necessary, coordinate the location of cant strips with mechanical drawings to ensure that no projections, such as vent pipes and braces, will be constructed through cant strips or within 250 mm 10 inches from cant strips. Specify wood cants, edge strips, and pressure preservative treatment in Section 06100NA.

Provide preformed cants and tapered edge strips of the same material as the roof insulation; or, when roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer, unless otherwise indicated. Face of cant strips shall have incline of 45 degrees and vertical height of 100 mm 4 inches. Taper edge strips at a rate of 85 to 125 mm per meter one to 1 1/2 inch per foot down to approximately 3 mm 1/8 inch thick.

] [2.2 PROTECTION BOARD

For use as a thermal barrier (underlayment), fire barrier (overlayment), or protection board for hot-mopped, torched-down, or adhesively-applied roofing membrane over roof insulation.

] [2.2.1 Glass Mat Gypsum Roof Board

NOTE: Specify glass mat gypsum roof board as a contractor's option to wood fiberboard, expanded perlite, or other suitable material, when an underlayment or overlayment is required for the roof insulation board.

ASTM C 1177/C 1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E 84, 3450 kPa 500 psi, Class A, non-combustible, [6][13][16] mm [1/4][1/2][5/8] inch thick, 1220 by 2440 mm 4 by 8 feet board size.

] [2.3 BITUMENS

NOTE: Where insulation is installed under roofing that does not require hot asphalt and vapor retarder is not required, delete asphalt, asphalt roof cement, asphalt-saturated felt, asphalt-coated glass felt, and asphalt primers. Always mechanically secure first layer of insulation to steel decks. For installation over steel and other decks not requiring vapor retarders or where asphalt is not used in installing insulation, specify only mechanical fastening of insulation. Coordinate requirements of this section with section specifying the roofing.

[2.3.1 Asphalt Primer

ASTM D 41.

] [2.3.2 Asphalt

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

] [2.3.3 Asphalt Roof Cement

ASTM D 4586, Type I for horizontal surfaces and for surfaces sloped from 0 to 3 inches per foot, Type II for vertical and surfaces sloped more than 3 inches per foot.

]] [2.4 SHEATHING PAPER FOR WOOD DECKS

Rosin-sized building paper or unsaturated felt weighing not less than 2.5 kilograms per 10 square meters 5 pounds per 100 square feet.

] 2.5 MOISTURE CONTROL

NOTE: Vapor retarder should be specified only where:

1. Outside, average January temperature is below 4 degrees C 40 degrees F, and expected winter interior relative humidity is 45 percent or greater;
2. Roofing system will be subject to continuing excessively high interior humidity; and
3. Results of detailed analysis indicate potential

roofing problem resulting from water-vapor infiltration.

Delete contractor's option for single-layer vapor retarder for roofs over areas having excessively high interior humidity such as swimming pools and laundries. Generally, vapor retarder should be in direct contact with deck. However, compute dewpoint temperature and location and locate vapor retarder below dewpoint location. Avoid use of vapor retarder over steel decks unless vapor retarder is determined to be absolutely necessary. Do not specify wood fiberboard or any type of insulation that is highly sensitive to moisture for layer directly on steel deck. Specify installation of insulation over vapor retarder using hot asphalt to avoid puncturing vapor retarder. Combination of two or more layers of insulation should be of such thickness that dewpoint temperature will occur above vapor retarder located directly over first layer of insulation. Topside venting should always be provided by insulation vents and perimeter edge vents when vapor retarder is used. Specify venting requirements in roofing membrane specification section.

Unless otherwise directed, do not specify vapor retarder for projects in the SOUTHNAVFACENGCOM area.

[2.5.1 Vapor Retarderr]

[2.5.1.1 Asphalt-Saturated Felt Base Sheet for Single Layer Application

ASTM D 4601, weighing not less than 17.5 kilograms per 10 square meters 35 pounds per 100 square feet.]

[2.5.1.2 Asphalt-Coated Glass Felt

ASTM D 2178, Type [IV] [VI].]

[2.5.2 Ventilating Felt for [Poured] [Precast] Concrete Decks

NOTE: Specify ventilating felt for new and existing concrete decks suspected of having retained moisture to aid in dissipation of any moisture retained in concrete. This felt shall not be considered to be a vapor retarder.

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

2.5.3 Organic Roofing

ASTM D 226, Type I.

2.6 FASTENERS

Flush-driven through flat round or hexagonal steel or plastic plates. Steel plates shall be zinc-coated, flat round not less than 35 mm 1 3/8 inch diameter or hexagonal not less than 0.4 mm 28 gage. Plastic plates shall be high-density, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 75 mm 3 inches in diameter. Fastener head shall recess fully into the plastic plate after it is driven. Plates shall be formed to prevent dishing. Do not use bell-or cup-shaped plates. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than [178 N 40 pounds] [534 N 120 pounds] each in steel deck. Fasteners for steel or concrete decks shall conform to FM P7825c for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of [2.87] [4.3] [_____] kPa [60] [90] [_____] pounds per square foot.

2.6.1 Roofing Nails for Wood Decks

Barbed 3 mm 11 gage, zinc-coated nails with 11 to 16 mm 7/16 to 5/8 inch diameter heads or annular ring shank, square head, one-piece composite nails. Nails shall be long enough to penetrate wood deck at least 16 mm 5/8 inch but shall not protrude through underside of decking.

2.6.2 Fasteners for Plywood Decks

Annular ring shank, square head, one-piece composite nails long enough to penetrate into plywood decks approximately 13 mm 1/2 inch but not protrude through underside of decking.

2.6.3 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws conforming to FM AS 4470 and listed in FM P7825c for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of [2.87] [4.31] [_____] kPa [60] [90] [_____] psf conforming to FM P7825.

2.6.4 Fasteners for Poured Concrete Decks

Approved hardened fasteners or screws to penetrate deck at least 25 mm one inch but not more than 38 mm 1 1/2 inches, conforming to FM AS 4470, and listed in FM P7825 for Class I roof deck construction. Quantity and placement to withstand an uplift pressure of [2.87] [4.31] [_____] kPa [60] [90] [_____] psf conforming to FM P7825.

2.7 WOOD NAILERS

NOTE: When roof slope exceeds one in 24 1/2 inch per foot, insulating materials beneath built-up roofing should be both mopped and held in place by treated wood nailers. Non-nailable decks should be provided with surface-applied nailing strips of same thickness as insulation. See built-up bituminous roofing specifications for requirements on nailing of roofing felts. For all insulated roof decks, treated wood nailers should be applied at eave edgings and sides of roofs and around curbs and elsewhere as necessary to provide nailing for gravel stops and flashings. Refer to FM Loss Prevention

Data Sheet 1-49 for method of attachment of nailers.
A water-borne preservative treatment should be
specified in Section 06100NA for wood which will be
in contact with bituminous materials.

Pressure-preservative-treated as specified in Section 06100N ROUGH
CARPENTRY.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

NOTE: Unless otherwise directed, do not refer to
vapor retarders for projects in the
SOUTHNAVFACENGCOM area. Vapor retarder may be
specified for heated buildings where the average
January temperature is below 5 degrees C (40 degrees
F) and the expected interior winter humidity exceeds
45 percent. Vapor retarder will be specified for
heated buildings where a high humidity condition is
expected, such as indoor swimming pool or laundry.

Where a vapor retarder is to be installed, the
designer will make sure that the computations show
that the dew point is on the cold side of the vapor
retarder. Computations should use recognized
methods in agreement with ASHRAE Handbook,
Fundamentals.

Surfaces shall be clean, smooth, and dry. [Surfaces receiving vapor
retarder shall be free of projections which might puncture the vapor
retarder.] Check roof deck surfaces, including surfaces sloped to roof
drains and outlets, for defects before starting work.

The [Contractor shall] [Contracting Officer will] inspect and approve the
surfaces immediately before starting installation. Prior to installing
[vapor retarder] [ventilating felt] [insulation], perform the following:

- [a. Examine wood decks to ascertain that deck boards have been
properly nailed and that exposed nail heads have been set.]
- [b. Examine steel decks to ensure that panels are properly secured to
structural members and to each other and that surfaces of top
flanges are flat or slightly convex.]
- [c. Examine precast concrete decks to ensure that joints between
precast units are properly grouted and leveled to provide suitable
surfaces for installation of [ventilating felt] [vapor retarder]
[and] insulation.]
- [d. In the presence of the Contracting Officer perform the following
surface-dryness test on concrete substrates:

- (1) Foaming: When poured on the deck, 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.

(2) 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 surface, do not consider 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 method above and found dry.]

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage and hollow or low spots and perform the following:

- a. Install wood nailers the same thickness as insulation at eaves, edges, curbs, walls, and roof openings for securing cant strips, gravel stops, [gutters,] and flashing flanges. [On decks with slopes of one in 12 one inch per foot or more, install wood nailers perpendicular to slope for securing insulation [and for backnailing of roofing felts]. Space nailers in accordance with approved shop drawings.]
- [b. Fill or cover cracks or knot holes larger than 13 mm 1/2 inch in diameter in wood decks as necessary to form an unyielding surface.]

NOTE: Include the following requirements when a vapor retarder is required over wood deck or when insulation is applied directly to the wood deck with hot asphalt.

- [c. Cover wood decks with a layer of rosin-sized building paper or unsaturated felt. Lap sides and ends not less than 75 mm 3 inches. Nail sufficiently to prevent tearing or buckling during installation.]
- [d. Cover steel decks with a layer of insulation board of sufficient thickness to span the width of a deck rib opening, and conforming to fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement conforming to FM P7825. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs.]
- [e. Solidly apply asphalt primer to [poured] [precast] concrete decks at the rate of 4 liters per 10 square meters one gallon per 100 square feet of roof surface [, stopping approximately 100 mm 4 inches from joints between the precast concrete units]. Allow primer to dry thoroughly. [Place felt strips, 100 mm 4 inches or more in width, over joints, 50 mm 2 inches on each side, between precast concrete units in a heavy coating of cold-applied asphalt roof cement.]]

3.2 INSTALLATION OF VAPOR RETARDER

NOTE: Unless directed otherwise, do not specify a vapor retarder for projects in the SOUTHNAVFACENGCOM area.

Vapor retarder may be specified for heated buildings where the average January temperature is below 5 degrees C (40 degrees F) and the expected interior winter humidity exceeds 45 percent. Vapor retarder will be specified for heated buildings where a high humidity condition is expected, such as indoor swimming pool or laundry.

Where a vapor retarder is to be installed, the designer will make sure that the computations show that the dew point is on the cold side of the vapor retarder. Computations should use recognized methods in agreement with ASHRAE Handbook, Fundamentals.

Install vapor retarder in direct contact with [roof deck surface] [ventilating felt] [insulation]. Vapor retarder shall consist of [either] two plies of No. 15 asphalt-saturated felt, two plies of asphalt-coated glass felt [, or one layer of asphalt-saturated felt base sheet]. Lay vapor retarder at right angles to direction of slope. Install first ply of felt [or base sheet] as specified herein for the specific deck. Apply second ply of 2-ply vapor retarder system using asphalt at rate of 10 to 18 kgs per 10 square meters 20 to 35 lbs per 100 square feet, applied within plus or minus 15 degrees C 25 degrees F of EVT. Do not heat asphalt above asphalt's FBT or 275 degrees C 525 degrees F, whichever is less. Use thermometers to check temperatures during heating and application. Side and end laps shall be completely sealed. Asphalt shall be visible beyond all edges of each ply as it is being installed. Plies shall be laid free of wrinkles, buckles, creases or fishmouths. Workers shall not walk on mopped surfaces when the asphalt is sticky. Press out air bubbles to obtain complete adhesion between surfaces. At walls, eaves and rakes, and other vertical surfaces, the vapor retarder organic felts shall be extended 225 mm, 9 inches, or separate organic felt plies shall be extended 225 mm, 9 inches, with not less than 225 mm 9 inches on the substrate, and the extended portion turned back and mopped in over the top of the insulation. At roof penetrations other than walls, eaves and rakes, and vertical surfaces, the vapor retarder or separate plies shall be extended 225 mm 9 inches to form a lap which shall later be folded back over the edge of the insulation. Asphalt roof cement shall be used under the vapor retarder for at least 225 mm 9 inches from walls, eaves, rakes and other penetrations.

[3.2.1 Vapor Retarder on Poured Concrete Decks

Solidly mop primed substrate with asphalt at rate of 10 to 18 kgs per 10 square meters 20 to 35 lbs per 100 square feet before installing vapor retarder. Lay first ply of 2 ply system with each sheet lapping 480 mm 19 inches over the preceding sheet. Lap ends not less than 100 mm 4 inches. Stagger laps a minimum of 300 mm 12 inches. [For a vapor retarder consisting of one layer of asphalt base sheet, provide side and end laps not less than 100 mm 4 inches. Stagger laps a minimum of 300 mm 12 inches. Cement base sheets together with a solid mopping of asphalt.]

] [3.2.2 Vapor Retarder on Precast Concrete Decks

Solidly mop primed substrate with asphalt at rate of 10 to 18 kgs per square meters 20 to 35 lbs per 100 square feet before installing vapor retarder. Lay first ply of 2 ply system with each sheet lapping 480 mm 19 inches over preceding sheet. Lap ends not less than 100 mm 4 inches. Stagger laps a minimum of 300 mm 12 inches. [For vapor retarder consisting of one layer of asphalt base sheet, provide side and end laps not less than 100 mm 4 inches and stagger laps a minimum of 300 mm 12 inches. Cement base sheets together with a solid mopping of asphalt.]

] [3.2.3 Vapor Retarder on Wood Decks

NOTE: A vapor retarder should be specified only where:

1. The outside, average January temperature is below 4 degrees C 40 degrees F, and the expected winter interior relative humidity is 45 percent or greater;
2. The roofing system will be subject to continuing excessively high interior humidity; and
3. The results of a detailed analysis indicate a potential roofing problem resulting from water-vapor infiltration.

Delete contractor's option for a single-layer vapor retarder for roofs over areas having excessively high interior humidity such as swimming pools and laundries. Generally, the vapor retarder should be in direct contact with deck. However, compute dewpoint temperature and location and locate vapor retarder below dewpoint location. Avoid use of vapor retarder over steel decks unless vapor retarder is determined to be absolutely necessary. Do not specify wood fiberboard or any other type of insulation sensitive to moisture for the layer directly on steel deck. Glass mat gypsum roof board is not sensitive to moisture and may be used in such situations. Specify installation of insulation over vapor retarder using hot asphalt to avoid puncturing the vapor retarder. The combination of two or more layers of insulation shall be of such thickness that the dewpoint temperature will occur above vapor retarder located directly over first layer of insulation. Topside venting should always be provided by insulation vents and perimeter edge vents when a vapor retarder is used. Specify venting requirements in roofing membrane specification section.

Lay first ply of 2 ply system dry with each sheet lapping 50 mm 2 inches over the preceding sheet. Lap ends not less than 100 mm 4 inches. Stagger laps a minimum of 300 mm 12 inches. Nail felt at 150 mm 6 inch intervals along side laps and install two rows of nails approximately 275 mm 11 inches apart down longitudinal center of each sheet, with nails staggered at 450

mm 18 inches O.C. [For vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 100 mm 4 inches over the preceding sheet. Provide end laps not less than 100 mm 4 inches and stagger laps a minimum of 300 mm 12 inches.] Cement side and end laps together with solid mopping of asphalt or heavy coat of asphalt roof cement. Nail side laps at 150 mm 6 inch intervals. Apply asphalt mopping at rate of 10 to 18 kgs per 10 square meters 20 to 35 lbs per 100 square feet. Install two rows of nails approximately 275 mm 11 inches apart down longitudinal center of each sheet, with nails staggered at 450 mm 18 inches O.C.

] [3.2.4 Vapor Retarder on Steel Decks

Solidly mop the mechanically secured insulation surface with asphalt before installing vapor retarder. For a 2 ply vapor retarder, install each sheet lapping 480 mm 19 inches over the preceding sheet. Lap ends not less than 100 mm 4 inches. Stagger the laps a minimum of 300 mm 12 inches. Cement felts together with solid mopping of asphalt. Apply asphalt moppings at rate of 10 to 18 kgs per 10 square meters 20 to 35 lbs per 100 square feet. [For a vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 100 mm 4 inches over preceding sheet. Lap ends not less than 100 mm 4 inches, and stagger laps a minimum of 300 mm 12 inches. Cement base sheets together with solid mopping of asphalt.]

] 3.2.5 Over Gypsum Insulating Concrete or Lightweight Insulating Concrete

NOTE: Some types of light weight insulating concrete may require bottom side deck venting; edit this paragraph accordingly if bottom side-venting is used.

One ply of venting inorganic base sheet shall be laid, without mopping, at right angle to the slope with 100 mm 4 inch side laps and 150 mm 6 inch end laps. Laps shall be bonded with hot asphalt. End laps shall be staggered. Base sheet shall be [nailed 220 mm 9 inches on centers at side laps and in 2 rows 270 mm 11 inches apart down the center of the sheet with nails 450 mm 18 inches on centers and staggered] [attached to the concrete as determined by uplift requirements]. The 2-ply vapor retarder shall then be applied over the base sheet as specified above.

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

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

3.2.7 Over Structural Concrete on Non-Venting Support

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

[3.3 INSTALLATION OF VENTILATING FELT

NOTE: Specify ventilating felt for new and existing concrete decks suspected of having retained moisture to aid in dissipation of any moisture retained in

concrete. This felt shall not be considered to be a vapor retarder.

Include bracketed phrase only when insulation is to be applied with hot asphalt.

Apply ventilating felt in accordance with manufacturer's printed instructions[, spot-mopped with asphalt to concrete deck]. Extend over roof cants, up vertical surfaces and terminate under cap flashing; at roof edges terminate under outside edge of perimeter edge nailers or under gravel stop fascia.

] 3.4 INSULATION INSTALLATION

Apply insulation in two layers with staggered joints when total required thickness of insulation exceeds 13 mm 1/2 inch. Lay insulation so that continuous longitudinal joints are perpendicular to direction of [felts for the built-up] roofing, as specified in Section [_____, "_____"], and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and offset in both directions with respect to layer below. Keep insulation 13 mm 1/2 inch clear of vertical surfaces penetrating and projecting from roof surface.

[3.4.1 Installation Using Asphalt

Firmly embed each layer in solid asphalt mopping; mop only sufficient area to provide complete embedment of one board at a time. Provide 10 to 18 kgs 20 to 35 lbs of asphalt per 10 square meters 100 square feet of roof deck for each layer of insulation. Apply asphalt when temperature is within plus or minus 15 degrees C 25 degrees F of EVT. Do not heat asphalt above asphalt's FBT or 275 degrees C 525 degrees F, whichever is less, for longer than 4 consecutive hours. Use thermometers to check temperatures during heating and application.

] [3.4.2 Installation Using Asphalt on Steel Decks

NOTE: Delete these requirements and include paragraph entitled "Installation Using Asphalt" when a vapor retarder is required over steel decks.

Secure first layer of insulation [and thermal barrier] to deck with piercing or self-drilling, self-tapping fasteners. Engage fasteners by driving them through insulation into top flange of steel deck. Use driving method prescribed by fastener manufacturer. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs. Secure succeeding layers with solid asphalt moppings. Where insulation is applied over steel deck, long edge joints shall continuously bear on surfaces of the steel deck. Insulation which can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is waterproofed the same day. Phased construction will not be permitted. Application of impermeable faced insulation shall be performed without damage to the facing.

]3.4.3 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation with penetrating type fasteners.

]3.4.4 Special Precautions for Installation of Foam Insulation

3.4.4.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 13 mm 1/2 inch thick wood fiberboard, glass mat gypsum roof board, or 19 mm 3/4 inch thick expanded perlite board insulation over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

[3.4.4.2 Polystyrene Insulation

NOTE: Include these requirements when polystyrene insulation is used under fully-adhered EPDM, CPE, PIB, or PVC roofing.

- a. Over top surface of non-composite polystyrene board, install 13 mm 1/2 inch thick high density wood fiberboard, 19 mm 3/4 inch thick expanded perlite board, glass mat gypsum roof board, or other overlayment approved by roofing sheet manufacturer. Tightly butt and stagger joints of field applied overlayment board at least 150 mm 6 inches with respect to the polystyrene board below. Apply 150 mm 6 inch wide glass fiber roofing tape centered over joints and edges of overlayment board.
- b. Where composite boards consisting of polystyrene insulation are provided, apply 150 mm 6 inch wide glass-fiber roofing tape centered over joints and edges of composite board. Apply joint strips as recommended by roofing sheet manufacturer.

]3.4.5 Cant Strips

NOTE: Generally cant strips are not required for single ply roofing systems. However, if cant strips are necessary, coordinate location with mechanical drawings to ensure that no projections, such as vent pipes and braces, will be constructed through or within 250 mm 10 inches of cant strips. Specify wood cants, edge strips, and pressure preservative treatment in Section 06100NA. Delete reference to asphalt application unless asphalt is used in applying the insulation.

Where indicated, provide cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Wood cant strips shall bear on and be anchored to wood blocking. Fit cant strips flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in [heavy mopping of asphalt or set in a heavy coating of asphalt roof cement] [an approved adhesive].

3.4.6 Tapered Edge Strips

NOTE: Delete reference to asphalt application
unless asphalt is used in installing the insulation.

Where indicated, provide edge strips in the right angle formed by junction of roof and wood nailing strips that extend above level of roof. Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in [heavy mopping of asphalt or set in heavy coating of asphalt roof cement] [an approved adhesive].

3.5 PROTECTION

3.5.1 Protection of Applied Insulation

NOTE: Insert appropriate Section number and title
in the blank below using format per UFC 1-300-02.

Completely cover each day's installation of insulation with the finished roofing specified in [_____] on same day. Do not permit phased construction. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to [indicated live load limits of roof construction] [a [_____] kg/sq. m psf live load limit]. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement [or single ply] [or EPDM membrane] set in roof cement. Fill all profile voids in cut-offs to prevent entrapping of moisture into the area below the membrane. Cutoffs shall be removed when work is resumed.

3.5.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.6 INSPECTION

NOTE: When justified by the amount or criticality of the insulation and roofing involved, and when requirements for a roof insulation technician are not established for the Contractor Quality Control organization, the following requirement will be added at the end of this paragraph: "A roof insulation technician, responsible directly to the Contractor and experienced in the installation of roof insulation and related work, shall perform the inspection functions and be on the site whenever roof insulation operations are in progress."

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

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

-- End of Section --