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SECTION 072100 - THERMAL INSULATION

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single_File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Molded polystyrene foam-plastic board.
3. Polyisocyanurate foam-plastic board.
4. Glass-fiber blanket.
5. Glass-fiber board.

3. Polyisocyanurate foam-plastic board.
4. Glass-fiber blanket.
5. Glass-fiber board.
6. Mineral-wool blanket.
7. Mineral-wool board.
8. Loose-fill insulation.
9. Spray-applied cellulosic insulation.
10. Cellular glass.
11. Reflective insulations and radiant barriers.

B. Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. [**Section 071326 "Self-Adhering Sheet Waterproofing"**] [**Section 071353 "Elastomeric Sheet Waterproofing"**] [**Section 071354 "Thermoplastic Sheet Waterproofing"**] [**Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"**] [**Section 071416 "Cold Fluid-Applied Waterproofing"**] for insulated drainage panels installed with plaza deck insulation.
4. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
5. [**Section 072600 "Vapor Retarders"**] [**Section 072713 "Modified Bituminous Sheet Air Barriers"**] [**Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers"**] [**Section 072726 "Fluid-Applied Membrane Air Barriers"**] for vapor retarders or air barriers.
6. [**Section 075113 "Built-up Asphalt Roofing"**] [**Section 075116 "Built-up Coal Tar Roofing"**] [**Section 075213 "Atactic-Polypropylene (APP) Modified Bituminous Membrane Roofing"**] [**Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing"**] [**Section 075316 "Chlorosulfonate-Polyethylene (CSPE) Roofing"**] [**Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing"**] [**Section 075416 "Ethylene Interpolymer (KEE) Roofing"**] [**Section 075419 "Polyvinyl-Chloride (PVC) Roofing"**] [**Section 075423 "Thermoplastic Polyolefin (TPO) Roofing"**] [**Section 075552 "Modified Bituminous Protected Membrane Roofing"**] [**Section 075556 "Fluid-Applied Protected Membrane Roofing"**] [and] [**Section 075700 "Coated Foamed Roofing"**] for insulation specified as part of roofing construction.
7. [**Section 092300 "Gypsum Plastering"**] [**Section 092400 "Portland Cement Plastering"**] [**Section 092613 "Gypsum Veneer Plastering"**] [**Section 092900 "Gypsum Board"**] for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

Retain "Product Data" Subparagraph below to require minimum recycled content for LEED 2009 MR Credit 2 - "Recycled Content."

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

"Product Data" Subparagraph below applies to LEED 2009 NC, CI, and CS; LEED v4; IgCC; ASHRAE 189.1; and Green Globes. Coordinate with requirements for adhesives.

2. Product Data: For adhesives, indicating VOC content.

"Laboratory Test Reports" Subparagraph below applies to LEED 2009 for Schools, LEED v4, IgCC, ASHRAE 189.1, and Green Globes. Coordinate with requirements for adhesives.

3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-

Laboratory Test Reports" Subparagraph below applies to LEED 2009 for Schools, LEED v4, IgCC, ASHRAE 189.1, and Green Globes. Coordinate with requirements for adhesives.

3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

"Laboratory Test Reports" Subparagraph below applies to LEED v4.

4. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For manufacturer's evaluation reports.
- C. Sample Warranty: For manufacturer's standard warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

Retain paragraph below for foam-plastic board insulation.

- B. Protect foam-plastic board insulation as follows:
 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or ARCOM. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

- B. Extruded Polystyrene Board, Type X <Insert drawing designation>: ASTM C 578, Type X, 15-psi (104-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. <Insert manufacturer's name>.

- b. Dow Chemical Company (The).
- c. Owens Corning.
- d. <Insert manufacturer's name>.

Retain "Fire Propagation Characteristics" Subparagraph below if required. Tested products are not available from all manufacturers for all types of assemblies.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

C. Extruded Polystyrene Board, Type IV <Insert drawing designation>: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. <Insert manufacturer's name>.

Retain "Fire Propagation Characteristics" Subparagraph below if required. Tested products are not available from all manufacturers for all types of assemblies.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Extruded Polystyrene Board, Type IV, Drainage Panels <Insert drawing designation>: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. <Insert manufacturer's name>.

E. Extruded Polystyrene Board, Type VI <Insert drawing designation>: ASTM C 578, Type VI, 40-psi (276-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Soprema, Inc.
 - e. <Insert manufacturer's name>.

F. Extruded Polystyrene Board, Type VI, Drainage Panels <Insert drawing designation>: ASTM C 578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Kingspan Insulation Limited.
 - d. Owens Corning.
 - e. <Insert manufacturer's name>.

- c. Kingspan Insulation Limited.
- d. Owens Corning.
- e. <Insert manufacturer's name>.

G. Extruded Polystyrene Board, Type VII <Insert drawing designation>: ASTM C 578, Type VII, 60-psi (414-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. <Insert manufacturer's name>.

H. Extruded Polystyrene Board, Type VII, Drainage Panels <Insert drawing designation>: ASTM C 578, Type VII, 60-psi (414-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. <Insert manufacturer's name>.

I. Extruded Polystyrene Board, Type V <Insert drawing designation>: ASTM C 578, Type V, 100-psi (690-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical Company (The).
 - b. Owens Corning.
 - c. <Insert manufacturer's name>.

2.2 MOLDED POLYSTYRENE FOAM-PLASTIC BOARD

Molded polystyrene boards in this article are also called "EPS boards," "expanded polystyrene boards," or "beadboards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

A. Molded Polystyrene Board, Type I <Insert drawing designation>: ASTM C 578, Type I, 10-psi (69-kPa) minimum compressive strength.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACH Foam Technologies, Inc.
 - b. Atlas EPS; a Division of Atlas Roofing Corporation.
 - c. DiversiFoam Products.
 - d. Insulfoam-a division of Carlisle Construction Materials Inc.
 - e. Plymouth Foam, Inc.
 - f. <Insert manufacturer's name>.

B. Molded Polystyrene Board, Type VIII <Insert drawing designation>: ASTM C 578, Type VIII, 13-psi (90-kPa) minimum compressive strength.

B. Molded Polystyrene Board, Type VIII <Insert drawing designation>: ASTM C 578, Type VIII, 13-psi (90-kPa) minimum compressive strength.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ACH Foam Technologies, Inc.
- b. Atlas EPS; a Division of Atlas Roofing Corporation.
- c. DiversiFoam Products.
- d. Plymouth Foam, Inc.
- e. <Insert manufacturer's name>.

C. Molded Polystyrene Board, Type II <Insert drawing designation>: ASTM C 578, Type II, 15-psi (104-kPa) minimum compressive strength.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ACH Foam Technologies, Inc.
- b. Atlas EPS; a Division of Atlas Roofing Corporation.
- c. DiversiFoam Products.
- d. Insulfoam-a division of Carlisle Construction Materials Inc.
- e. Plymouth Foam, Inc.
- f. <Insert manufacturer's name>.

D. Molded Polystyrene Board, Type IX <Insert drawing designation>: ASTM C 578, Type IX, 25-psi (173-kPa) minimum compressive strength.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ACH Foam Technologies, Inc.
- b. Atlas EPS; a Division of Atlas Roofing Corporation.
- c. DiversiFoam Products.
- d. Insulfoam-a division of Carlisle Construction Materials Inc.
- e. Plymouth Foam, Inc.
- f. <Insert manufacturer's name>.

E. Molded Polystyrene Board, Type XIV <Insert drawing designation>: ASTM C 578, Type XIV, 40-psi (276-kPa) minimum compressive strength.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ACH Foam Technologies, Inc.
- b. Atlas EPS; a Division of Atlas Roofing Corporation.
- c. Insulfoam-a division of Carlisle Construction Materials Inc.
- d. Plymouth Foam, Inc.
- e. <Insert manufacturer's name>.

F. Molded Polystyrene Board, Type XV <Insert drawing designation>: ASTM C 578, Type XV, 60-psi (414-kPa) minimum compressive strength.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ACH Foam Technologies, Inc.
- b. Atlas EPS; a Division of Atlas Roofing Corporation.
- c. Insulfoam-a division of Carlisle Construction Materials Inc.
- d. Plymouth Foam, Inc.
- e. <Insert manufacturer's name>.

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD

Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

A. Polyisocyanurate Board, Foil Faced <Insert drawing designation>: ASTM C 1289, foil faced, Type I, Class 1 or 2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Atlas EPS; a Division of Atlas Roofing Corporation.
- b. Atlas Roofing Corporation.
- c. Carlisle Coatings & Waterproofing Inc.
- d. Dow Chemical Company (The).
- e. Firestone Building Products.
- f. Hunter Panels.
- g. Rmax, Inc.
- h. <Insert manufacturer's name>.

Retain "Fire Propagation Characteristics" Subparagraph below if required. Tested products are not available from all manufacturers for all types of assemblies.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

B. Polyisocyanurate Board, Glass-Fiber-Mat Faced <Insert drawing designation>: ASTM C 1289, glass-fiber-mat faced, Type II, Class 2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Atlas Roofing Corporation.
- b. Carlisle Coatings & Waterproofing Inc.
- c. Firestone Building Products.
- d. Hunter Panels.
- e. Rmax, Inc.
- f. <Insert manufacturer's name>.

Retain "Fire Propagation Characteristics" Subparagraph below if required. Tested products are not available from all manufacturers for all types of assemblies.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.4 GLASS-FIBER BLANKET

Paragraph below applies to LEED v4.

A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Retain "Recycled Content" Paragraph below to specify recycled content if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

Copy paragraphs below and re-edit for each type of insulation required. Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

identify each product. Use these designations on Drawings to show where each insulation type is required.

- C. Glass-Fiber Blanket, Unfaced **<Insert drawing designation>**: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. **<Insert manufacturer's name>**.

- D. Glass-Fiber Blanket, Polypropylene-Scrim-Kraft Faced **<Insert drawing designation>**: ASTM C 665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. **<Insert manufacturer's name>**.

- E. Glass-Fiber Blanket, Kraft Faced **<Insert drawing designation>**: ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. **<Insert manufacturer's name>**.

- F. Glass-Fiber Blanket, Reinforced-Foil Faced **<Insert drawing designation>**: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. **<Insert manufacturer's name>**.

- G. Glass-Fiber Blanket, Foil Faced **<Insert drawing designation>**: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.
- e. <Insert manufacturer's name>.

2.5 GLASS-FIBER BOARD

Paragraph below applies to LEED v4.

- A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Retain "Recycled Content" Paragraph below to specify recycled content if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

Copy paragraphs below and re-edit for each type of insulation required. Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

- C. Glass-Fiber Board, Unfaced <Insert drawing designation>: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84[, **passing ASTM E 136 for combustion characteristics**]. Nominal density of **2.25 lb/cu. ft (36 kg/cu. m)**, thermal resistivity of **4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C)**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.
- e. <Insert manufacturer's name>.

- D. Glass-Fiber Board, Faced <Insert drawing designation>: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84. Nominal density of **2.25 lb/cu. ft. (36 kg/cu. m)**, thermal resistivity of **4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C)**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.
- e. <Insert manufacturer's name>.

- E. Glass-Fiber Board, Unfaced <Insert drawing designation>: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84[, **passing ASTM E 136 for combustion characteristics**]. Nominal density of **3 lb/cu. ft. (48 kg/cu. m)**, thermal resistivity of **4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C)**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the

x m/W at 24 deg C).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.
- e. <Insert manufacturer's name>.

F. Glass-Fiber Board, Faced <Insert drawing designation>: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.
- e. <Insert manufacturer's name>.

G. Glass-Fiber Board, Unfaced <Insert drawing designation>: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84[, passing ASTM E 136 for combustion characteristics]. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Knauf Insulation.
- b. <Insert manufacturer's name>.

H. Glass-Fiber Board, Faced <Insert drawing designation>: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Knauf Insulation.
- b. <Insert manufacturer's name>.

I. Glass-Fiber Board, Unfaced <Insert drawing designation>: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84[, passing ASTM E 136 for combustion characteristics]. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of 4.4 deg F x h x sq. ft./Btu x in. at 75 deg F (30.5 K x m/W at 24 deg C).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Johns Manville; a Berkshire Hathaway company.
- b. Knauf Insulation.
- c. <Insert manufacturer's name>.

J. Glass-Fiber Board, Faced <Insert drawing designation>: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-

J. Glass-Fiber Board, Faced <Insert drawing designation>: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of not less than 4.34 deg F x h x sq. ft./Btu x in. at 75 deg F (30.1 K x m/W at 24 deg C).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.
- e. <Insert manufacturer's name>.

2.6 MINERAL-WOOL BLANKETS

Paragraph below applies to LEED v4.

A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Retain "Recycled Content" Paragraph below to specify recycled content if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

Copy paragraphs below and re-edit for each type of insulation required. Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

C. Mineral-Wool Blanket, Unfaced <Insert drawing designation>: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Industrial Insulation Group, LLC.
- b. Roxul Inc.
- c. Thermafiber, Inc.; an Owens Corning company.
- d. <Insert manufacturer's name>.

D. Mineral-Wool Blanket, Reinforced-Foil Faced <Insert drawing designation>: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Thermafiber, Inc.; an Owens Corning company.
- b. <Insert manufacturer's name>.

2.7 MINERAL-WOOL BOARD

Paragraph below applies to LEED v4.

Paragraph below applies to LEED v4.

- A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Retain "Recycled Content" Paragraph below to specify recycled content if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert value>** percent.

Copy paragraphs below and re-edit for each type of insulation required. Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

- C. Mineral-Wool Board, Types IA and IB, Unfaced **<Insert drawing designation>**: ASTM C 612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of **4 lb/cu. ft. (64 kg/cu. m)**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Industrial Insulation Group, LLC.
 - b. Roxul Inc.
 - c. Thermafiber, Inc.; an Owens Corning company.
 - d. **<Insert manufacturer's name>**.

- D. Mineral-Wool Board, Types IA and IB, Faced **<Insert drawing designation>**: ASTM C 612, Types IA and IB; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84. Nominal density of **4 lb/cu. ft. (64 kg/cu. m)**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Industrial Insulation Group, LLC.
 - b. Thermafiber, Inc.; an Owens Corning company.
 - c. **<Insert manufacturer's name>**.

- E. Mineral-Wool Board, Type II, Unfaced **<Insert drawing designation>**: ASTM C 612, Type II; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of **6 lb/cu. ft. (96 kg/cu. m)**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Industrial Insulation Group, LLC.
 - b. Roxul Inc.
 - c. Thermafiber, Inc.; an Owens Corning company.
 - d. **<Insert manufacturer's name>**.

- F. Mineral-Wool Board, Type II, Faced **<Insert drawing designation>**: ASTM C 612, Type II; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84. Nominal density of **6 lb/cu. ft. (96 kg/cu. m)**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Industrial Insulation Group, LLC.
- b. Thermafiber, Inc.; an Owens Corning company.
- c. <Insert manufacturer's name>.

G. Mineral-Wool Board, Type III, Unfaced <Insert drawing designation>: ASTM C 612, Type III; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 8 lb/cu. ft. (128 kg/cu. m).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Industrial Insulation Group, LLC.
- b. Roxul Inc.
- c. Thermafiber, Inc.; an Owens Corning company.
- d. <Insert manufacturer's name>.

H. Mineral-Wool Board, Type III, Faced <Insert drawing designation>: ASTM C 612, Type III; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84. Nominal density of 8 lb/cu. ft. (128 kg/cu. m).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Industrial Insulation Group, LLC.
- b. Roxul Inc.
- c. Thermafiber, Inc.; an Owens Corning company.
- d. <Insert manufacturer's name>.

2.8 LOOSE-FILL INSULATION

Paragraph below applies to LEED v4.

A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Retain "Recycled Content" Paragraph below to specify recycled content if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

Copy paragraphs below and re-edit for each type of insulation required. Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

C. Cellulosic-Fiber Loose-Fill Insulation <Insert drawing designation>: ASTM C 739, chemically treated for flame-resistance, processing, and handling characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Central Fiber LLC.
- b. GreenFiber.
- c. Hamilton Manufacturing Inc.
- d. Nu-Wool Co., Inc.

- c. Hamilton Manufacturing Inc.
- d. Nu-Wool Co., Inc.
- e. <Insert manufacturer's name>.

D. Glass-Fiber Loose-Fill Insulation <Insert drawing designation>: ASTM C 764, [Type I for pneumatic application] [or] [Type II for poured application]; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. <Insert manufacturer's name>.

2.9 SPRAY-APPLIED CELLULOSIC INSULATION

Paragraph below applies to LEED v4.

A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Retain "Recycled Content" Paragraph below to specify recycled content if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

Copy paragraph below and re-edit for each type of insulation required. Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

C. Self-Supported, Spray-Applied Cellulosic Insulation <Insert drawing designation>: ASTM C 1149, [Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications),] [Type II (materials containing a dry adhesive activated by water during installation; intended only for enclosed or covered applications),] [Type III (materials containing an adhesive mixed with water during application; intended for application on attic floors),] chemically treated for flame-resistance, processing, and handling characteristics.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Central Fiber LLC.
 - b. GreenFiber.
 - c. Hamilton Manufacturing Inc.
 - d. International Cellulose Corp.
 - e. Nu-Wool Co., Inc.
 - f. <Insert manufacturer's name>.

2.10 CELLULAR GLASS

Copy paragraph below and re-edit for each type of insulation required. Insert drawing designations to identify each product. Use these designations on Drawings to show where each insulation type is required.

A. Cellular Glass <Insert drawing designation>: ASTM C 552, [Type I (flat block)] [Type IV (board)] [faced on both sides with manufacturer's special kraft-paper sheets laminated to glass block with asphalt]

A. Cellular Glass <Insert drawing designation>: ASTM C 552, [Type I (flat block)] [Type IV (board)] [faced on both sides with manufacturer's special kraft-paper sheets laminated to glass block with asphalt].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pittsburgh Corning Corporation.
 - b. <Insert manufacturer's name>.

2.11 REFLECTIVE INSULATIONS AND RADIANT BARRIERS

Reflective insulation products generally require application adjacent to an air space to function. See manufacturers' literature for proper use.

Retain "Recycled Content" Paragraph below if required. An alternative method of requiring recycled content is to retain requirement in Project's Division 01 sustainable design requirements Section that gives Contractor the option and responsibility to determine how recycled content requirements will be met.

AA2 Vapor Shield contains 40 percent recycled content.
HY-Fi contains 20 percent recycled content.
VR Plus Shield contains 20 percent recycled content.
Silver Shield contains 10 percent recycled materials.

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [40] [20] [10] percent.

Reflective insulations in paragraph below consist of one or more sheets (substrates) separated with internal expanders or sheet bubble film and faced with aluminum foil or metallic coatings.

Fi-Foil's "AA2 Vapor Shield," "M-Shield," "HY-Fi," and "VR Plus Shield" multi-layered reflective insulation are proprietarily structured products, with one or more sheets (substrates) separated with internal expanders and faced with aluminum foil or metallic coatings.

Retain "Reflective Insulation" Paragraph below to specify Fi-Foil's "AA2 Vapor Shield," "M-Shield," "HY-Fi," and "VR Plus Shield." Fi-Foil's "AA2 Vapor Shield," "M-Shield," and "VR Plus Shield" are intended for use on furred-out masonry walls. Fi-Foil's "HY-Fi" is intended for use on furred-out frame walls.

- B. Reflective Insulation: ASTM C 1224, with one or more low-emittance surfaces with emittance value of 0.1 or less as measured per ASTM C 1371.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; [AA2 Vapor Shield] [M-Shield] [HY-Fi] [VR Plus Shield] multilayered reflective insulation or comparable product by one of the following:
 - a. <Insert manufacturer's name>.
 2. Construction: Surfaces separated with internal expanders.
 3. Tabs: [Staple tabs for wood furring] [Tape tabs for metal framing].
 4. Surface-Burning Characteristics: Flame-spread [maximum of 25] [between 26 and 75], and maximum smoke-developed indexes of 450.
 5. R-Value, Heat Flow Horizontal, ASTM C 1224:

Retain the first six subparagraphs below for Fi-Foil's "AA2 Vapor Shield."
Retain subparagraphs b., d., and f. for Fi-Foil's "M-Shield."

- a. 3/4-inch (19-mm) Cavity: R-4.2, standard or non-perforated version.
- b. 3/4-inch (19-mm) Cavity: R-4.1, hi-perm or perforated version.
- c. 7/8-inch (22-mm) Cavity: R-4.7, standard or non-perforated version.
- d. 7/8-inch (22-mm) Cavity: R-4.6, hi-perm or perforated version.
- e. 1-1/2 to 1-5/8 inch (38- to 41-mm) Cavity: R-5.2, standard or non-perforated version.
- f. 1-1/2 to 1-5/8 inch (38- to 41-mm) Cavity: R-5.1, hi-perm or perforated version.

- e. 1-1/2 to 1-5/8 inch (38- to 41-mm) Cavity: R-5.2, standard or non-perforated version.
- f. 1-1/2 to 1-5/8 inch (38- to 41-mm) Cavity: R-5.1, hi-perm or perforated version.

Retain the first four subparagraphs below for Fi-Foil's "VR Plus Shield."

7/8-inch (22-mm) Cavity: R-5.1, standard or non-perforated version.

- g. 7/8-inch (22-mm) Cavity: R-5.0, hi-perm or perforated version.
- h. 1-1/2- to 1-5/8-inch (38- to 41-mm) Cavity: R-7.1, standard or non-perforated version.
- i. 1-1/2- to 1-5/8-inch (38- to 41-mm) Cavity: R-7.0, hi-perm or perforated version.

Retain three subparagraphs below for Fi-Foil's "HY-Fi." For other R-value calculations, see www.fifoil.com.

- j. 2- by 4-inch (51- by 102-mm) Frame Wall, Multilayered Reflective Insulation with 2-inch (51-mm) R-6.75 Closed Cell Spray Foam: R-21.
- k. 2- by 6-inch (51- by 152-mm) Frame Wall, Multilayered Reflective Insulation with 4-inch (102 mm) R-3.5 Open Cell Spray Foam: R-22.
- l. 2- by 6-inch (51- by 152-mm) Frame Wall, Multilayered Reflective Insulation with 3.5-inch (89-mm) R-13 Unfaced Fiberglass Batt: R-21.

Retain first option in "Water-Vapor Transmission" Subparagraph below if reflective insulation is to serve as vapor retarder; if not, retain second option.

Two versions of Fi-Foil's "AA2 Vapor Shield" (1 or 4.7 perms), "HY-Fi" (1 or 2.6 perms), and "VR Plus Shield" (1 or 2.6 perms) are offered; non-perforated or standard reflective insulation with vapor retarder, and perforated or hi-perm reflective insulation without vapor retarder. "M-Shield" is only offered in perforated or hi-perm reflective insulation without vapor retarder (7.4 perms).

- 6. Water-Vapor Transmission: [**1 perm (57 ng/Pa x s x sq. m), maximum**] [**2.6 perms (149 ng/Pa x s x sq. m) or greater**] [**4.7 perms (270 ng/Pa x s x sq. m) or greater**] [**7.4 perms (425 ng/Pa x s x sq. m) or greater**].

Retain "Pass" option in "Mold and Mildew Resistance" Subparagraph below for ASTM C 1338 testing below for Fi-Foil's "AA2 Vapor Shield," "HY-Fi," and "VR Plus Shield." Retain "No Growth" option for M-Shield.

- 7. Mold and Mildew Resistance, ASTM C 1338: [**Pass**] [**No growth**].

Insulations in "Reflective Insulation" Paragraph below consist of one or more sheets (substrates) separated with sheet bubble film and faced with metallic or polyethylene coatings.

Retain paragraph for Fi-Foil's "RBI Shield" and "RetroShield System."

- C. Reflective Insulation: ASTM C 1224, with one or more low-emittance surfaces with emittance value of 0.1 or less as measured per ASTM C 1371.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; [**RBI Shield multilayer, double bubble reflective insulation**] [**RetroShield System, RBI Shield multilayer, double bubble reflective, with Clip-and-Pin components**] or comparable product by one of the following:

- a. Innovative Energy, Inc.
- b. Reflectix, Inc.
- c. <Insert manufacturer's name>.

- 2. Construction: Surfaces separated by double layer.
- 3. Facings: [**Metalized film on both sides**] [**Metalized film on one side and white polyethylene on other side**].
- 4. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes of 25 and 450.
- 5. R-Values, ASTM C 236, ASTM STP 1116, and ASHRAE's "Book of Fundamentals and National Bureau of Standards" including Lower Air Film:

- a. Attached to bottom of 6- to 8-inch (152- to 203-mm) purlin.

1) Heat Flow Down: [**R-16, reflective/reflective**] [**R-12, reflective/white**].

2) Heat Flow Up: [**R-4.7, reflective/reflective**] [**R-4.0, reflective/white**].

- 1) Heat Flow Down: [R-16, reflective/reflective] [R-12, reflective/white].
- 2) Heat Flow Up: [R-4.7, reflective/reflective] [R-4.0, reflective/white].
- 3) Heat Flow Horizontal: [R-5.4, reflective/reflective] [R-4.4, reflective/white].

6. Tensile Strength, ASTM D 2261:

- a. Machine Direction (MD): 94.3 lb/sq. in (650.2 kPa).
- b. Transverse Direction (TD): 93.0 lb/sq. in (641.2 kPa).

7. Tear Strength, ASTM D 2261:

- a. Machine Direction (MD): 5.0 lb/sq. in (34.5 kPa).
- b. Transverse Direction (TD): 6.0 lb/sq. in (41.1 kPa).

8. Water-Vapor Transmission: 0.12 perm (6.89 ng/Pa x s x sq. m) or less.

9. Mold and Mildew Resistance, ASTM C 1338: Pass.

10. Hot Surface Performance, ASTM C 411: 50 to 250 deg F (10 to 121 deg C).

11. Mold and Mildew Resistance, ASTM C 1338: Pass.

12. Sheet Width: [16 inches (406 mm)] [24 inches (610 mm)] [48 inches (1219 mm)] [54 inches (1372 mm)] [66 inches (1676 mm)] [72 inches (1829 mm)] [96 inches (2438 mm)].

Sheet radiant barriers in first paragraph below consist of sheets (substrates) faced with aluminum foil or metallic coatings.

D. Sheet Radiant Barrier: ASTM C 1313/C 1313M with at least one surface with emittance value of 0.1 or less as measured per ASTM C 1371.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; Radiant Shield multilayered, perforated, radiant barrier or comparable product by one of the following:

- a. Innovative Energy, Inc.
- b. Innovative Insulation, Inc.
- c. <Insert manufacturer's name>.

Fi-Foil's "Silver Shield" multilayered radiant barrier is a proprietary structured product, with one or more sheets (substrates) separated with internal expanders and faced with aluminum foil or metallic coatings.

2. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; Silver Shield multilayered, perforated, radiant barrier or comparable product by one of the following:

- a. <Insert manufacturer's name>.

Retain first option in "Construction" Subparagraph below for Fi-Foil Radiant Shield.

Retain second option for Fi-Foil's "Silver Shield."

3. Construction: [Two outer-layers of aluminum foil laminated to layer of woven polyethylene] [Inner layer of metalized polymer with outside layer of reinforced aluminum foil and kraft paper bonded with fire-retardant adhesive].
4. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
5. Tear Resistance: ASTM D 2261.

Retain first option in first two subparagraphs below for Fi-Foil's "Radiant Shield." Retain second option for Fi-Foil's "Silver Shield."

- a. Machine Direction (MD): [27.6 lb (122.8 N)] [1.77 lb (7.9 N)]
- b. Cross-Machine Direction (CD): [26.1 lb (106.1 N)] [2.32 lb (10.3 N)].

Retain first option in "Water Vapor Transmission" subparagraph below for Fi-Foil's "Radiant Shield." Retain second option for Fi-Foil's "Silver Shield."

Retain first option in "Water Vapor Transmission" subparagraph below for Fi-Foil's "Radiant Shield."
Retain second option for Fi-Foil's "Silver Shield."

6. Water-Vapor Transmission: [**13 perms (747 ng/Pa x s x sq. m)**] [**5 perms (287 ng/Pa x s x sq. m)**] or greater.

Sheet width options for Fi-Foil's "Radiant Shield" are 25.5, 48, and 51 inches (648, 1219, and 1295 mm).
Sheet width options for Fi-Foil's "Silver Shield" are 17.5, 25.5, and 31.5 inches (445, 648, and 800 mm).

7. Sheet Width: [**17.5 inches (445 mm)**] [**25.5 inches (648 mm)**] [**31.5 inches (800 mm)**] [**48 inches (1219 mm)**] [**51 inches (1295 mm)**].

Barriers in "Sheet Radiant Barrier" Paragraph below consist of sheets (substrates) faced with metalized film or polyethylene, separated by sheet bubble film.

- E. Sheet Radiant Barrier: ASTM C 1313/C 1313M with at least one surface with emittance value of 0.1 or less as measured according to ASTM C 1371.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; [**RBI Shield multilayer, double bubble reflective insulation**] [**RetroShield System, RBI Shield multilayer, double bubble reflective insulation with clip-and-pin components**] or comparable product by one of the following:

- a. Innovative Energy, Inc.
- b. Reflectix, Inc.
- c. **<Insert manufacturer's name; product name or designation>**.

First option in "Construction" Subparagraph below relates to Fi-Foil's "RBI Shield Reflective/Reflective."
Second, to Fi-Foil's "RBI Shield Reflective/White."

2. Construction: Surfaces separated by double-layer polyethylene bubble film.
3. Facings: [**Metalized film on both sides**] [**Metalized film on one side and white polyethylene on other side**].
4. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
5. R-Values, ASTM C 236, ASTM STP 1116, and ASHRAE's "Book of Fundamentals and National Bureau of Standards" including Lower Air Film:
 - a. Draped over Purlins with **1-inch (25-mm)** airspace.
 - 1) Heat Flow Down: [**R-10, reflective/reflective**] [**R-6.5, reflective/white**].
 - 2) Heat Flow Up: [**R-4.1, reflective/reflective**] [**R-3.4, reflective/white**].
 - 3) Heat Flow Horizontal: [**R-5.5, reflective/reflective**] [**R-4.1, reflective/white**].

6. Tensile Strength, ASTM D 638:

- a. Machine Direction (MD): **94.3 lb/sq. in (650.2 kPa)**.
- b. Transverse Direction (TD): **93.0 lb/sq. in (641.2 kPa)**.

7. Tear Strength, ASTM D 2261:

- a. Machine Direction (MD): **5.0 lb/sq. in (34.5 kPa)**.
- b. Transverse Direction (TD): **6.0 lb/sq. in (41.4 kPa)**.

8. Water-Vapor Transmission: **0.12 perm (6.89 ng/Pa x s x sq. m)** or less.
9. Mold and Mildew Resistance, ASTM C 1338: Pass.
10. Hot Surface Performance, ASTM C 411: **50 to 250 deg F (10 to 121 deg C)**.
11. Mold and Mildew Resistance, ASTM C 1338: Pass.
12. Sheet Width: [**16 inches (406 mm)**] [**24 inches (610 mm)**] [**48 inches (1219 mm)**] [**54 inches (1372 mm)**] [**66 inches (1676 mm)**] [**72 inches (1829 mm)**] [**96 inches (2438 mm)**].

Interior radiation control coating systems in paragraph below are liquid coatings available in either a solvent- or water-based formulation. If retaining solvent-based coating, verify its acceptability with local air quality control board.

Interior radiation control coating systems in paragraph below are liquid coatings available in either a solvent- or water-based formulation. If retaining solvent-based coating, verify its acceptability with local air quality-control board.

F. Interior Radiation Control Coating System: Silver-colored, low-emissivity, [solvent] [water]-based coating; with a surface emittance value of 0.25 or less as measured per ASTM C 1371.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. SOLEC Corporation.
 - b. STS Coatings, Inc.
 - c. <Insert manufacturer's name; product name or designation>.

2.12 INSULATION FASTENERS

Anchor in "Adhesively Attached, Spindle-Type Anchors" Paragraph below is an example of a mechanical fastener. Prong anchors, welding pins, pointed rods, for example, are also available; insert here as required.

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGM Industries, Inc.
 - b. Gemco.
 - c. <Insert manufacturer's name; product name or designation>.

Revise "Plate" and "Spindle" subparagraphs below if stainless steel or another metal is required.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

Anchors in "Adhesively Attached, Angle-Shaped, Spindle-Type Anchors" Paragraph below are intended for attaching insulation to mullions while preventing it from touching spandrel glass.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Gemco.
 - b. <Insert manufacturer's name; product name or designation>.

Revise "Angle" and "Spindle" subparagraphs below if stainless steel or another metal is required.

2. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

Revise size in "Insulation-Retaining Washers" Paragraph below if required.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the

insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGM Industries, Inc.
 - b. Gemco.
 - c. <Insert manufacturer's name; product name or designation>.

Retain subparagraph below if anchors are used in crawl spaces, ceiling plenums, attic spaces, and so forth, where sharp ends of spindles would be exposed to human contact.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
 - d. <Insert location>.

D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of [1 inch (25 mm)] [2 inches (50 mm)] [3 inches (76 mm)] between face of insulation and substrate to which anchor is attached.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Gemco.
 - b. <Insert manufacturer's name; product name or designation>.

E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGM Industries, Inc.
 - b. Gemco.
 - c. <Insert manufacturer's name; product name or designation>.

2.13 ACCESSORIES

Retain "Insulation for Miscellaneous Voids" Paragraph below for miscellaneous voids if needed for thermal protection or air-infiltration reduction.

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

Retain "Adhesive for Bonding Insulation" Paragraph below for insulation adhesively bonded to substrates.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

Subparagraph below applies to LEED 2009 NC, CI, and CS; LEED v4; IgCC; ASHRAE 189.1; and Green Globes. VOC content limit is that for multipurpose construction adhesives.

1. Adhesives shall have a VOC content of [70] <Insert value> g/L or less.

1. Adhesives shall have a VOC content of [70] <Insert value> g/L or less.

Subparagraph below applies to LEED v4.

2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Retain "Asphalt Coating for Cellular-Glass Block Insulation" Paragraph below for field-applied coating if required.

- C. Asphalt Coating for Cellular-Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by manufacturer of cellular-glass block insulation.

Retain "Eave Ventilation Troughs" Paragraph below if required for vented eaves in attics to receive blanket insulation.

- D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

Fi-Foil's "FSK Shield" sheet vapor barrier is intended to be used as Class A facing for unfaced batts in walls, above drop ceilings or attached to the bottom of exposed wood or metal floor joists. Install with kraft paper facing batts and foil exposed (in walls) or foil facing down (above dropped in ceilings or under floor joists).

- E. Sheet Vapor Barriers: Foil facing comprised of 0.0003-inch (0.008-mm) aluminum foil bonded to 30-lb (13.6-kg) kraft paper with flame-retardant adhesive with tri-directional fiberglass scrim.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; FSK Shield.
2. Surface-Burning Characteristics, ASTM E 84, Class A: Maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

Fi-Foil's "SkyFlex" air barrier is intended to be used to reduce radiant heat transfer, when exposed to air films, or enclosed air spaces in building cavities.

- F. Air Barrier: Multilayered air barrier with two layers of aluminum foil laminated to a layer of woven polyethylene.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; SkyFlex.
2. Layer Thickness: 0.0025 inch (0.064 mm).
3. Air Permeability, ASTM E 2178: Less than 0.004 cfm/sq. ft. at 1.57 lb/sq. ft. (0.02 L x s/sq. m at 75 Pa).
4. Vapor Retarder: Class I.
5. Surface-Burning Characteristics, ASTM E 84, Class A: Maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

Fi-Foil's "Thermal Barrier Blanket System" or "TBB" is approved for use over Icynene's "Spray Foam" in commercial and residential buildings. This patented system offers an easy single-pass installation. An innovative "Clip-and-Pin" mechanically snaps on the metal purlins or wood trusses. TBB is available perforated, allowing vapor transmission or solid, to function as a vapor retarder. TBB provides improved acoustic performance over other thermal barrier coatings.

- G. Thermal Barrier: A reflective faced fibrous insulation attached with a "Clip-and-Pin" component and held in place with a friction washer, to create a thermal barrier over open or closed-cell spray foam.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; Thermal Barrier Blanket System or TBB.
2. Surface-Burning Characteristics, ASTM E 84, Class A: Maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

Retain "Clip-and-Pin Component" Paragraph below for use with the following thermal barrier insulation of

2. Surface Finishing Characteristics, ASTM E 87, Class IV Minimum flame spread and smoke developed indexes of 25 and 450, respectively.

Retain "Clip-and-Pin Components" Paragraph below for use with tape tab, reflective bubble insulation for metal building and framing applications or thermal barrier blanket to secure mechanical connections.

H. Clip-and-Pin Components:

1. Beam/Bar Joist Clips: For beams, bar joists, and Z-type purlins.
2. C-Purlin Clips: For C-type purlins.
3. Angle Clips: For sidewalks and floors.
4. Tube Clips: For wood beams and metal tubular framing.
5. Locking Washers: Aluminum; white to match reflective bubble insulation facing colors.

I. Tapes for Reflective Insulation and Radiant Barriers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fi-Foil Company; **[Aluminum-foil tape] [and] [Double-sided tape] [Reinforced-foil tape]**.
2. Aluminum-foil tape for repairs or splicing material.
3. Double-sided tape for adhering to metal framing or overlapping material.
4. Reinforced-foil tape: for sealing tears or cuts in sheet vapor barrier.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 1. If not otherwise indicated, extend insulation a minimum of **[24 inches (610 mm)] [36 inches (915 mm)]** <Insert dimension> below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 1. If not otherwise indicated, extend insulation a minimum of **[24 inches (610 mm)] [36 inches (915 mm)]** <Insert dimension> in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

Verify, with manufacturer, methods of installation of insulation for concrete substrates. Revise paragraph below to indicate type of concrete substrate, such as architectural precast concrete panels or cast-in-place

Verify, with manufacturer, methods of installation of insulation for concrete substrates. Revise paragraph below to indicate type of concrete substrate, such as architectural precast concrete panels or cast-in-place concrete walls. Revise to include channels for exposed insulation if required.

A. Butt panels together for tight fit.

Retain "Anchor Installation" or "Adhesive Installation" Paragraph below to suit Project.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.

Show width of cavity on Drawings.

2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately **24 inches (610 mm)** o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

Retain subparagraph below if insulation does not fill cavity. Coordinate with Section 042000 "Unit Masonry" where ties are specified.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

Retain "Cellular-Glass Board Insulation" Paragraph below if required. Revise to include sealed joints and asphalt coating for moisture protection of units if required.

B. Cellular-Glass Board Insulation: Install with closely fitting joints using [**adhesive pad**] [**serrated trowel**] attachment method according to manufacturer's written instructions.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain **3-inch (76-mm)** clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

Retain first subparagraph below for eave ventilation.

4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.

4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.

Retain first subparagraph below for metal-framed construction.

5. For metal-framed wall cavities where cavity heights exceed **96 inches (2438 mm)**, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

Retain first subparagraph below for wood-framed construction.

6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

Specify location of vapor retarder in "Exterior Walls" Subparagraph below based on vapor-flow analysis of a construction assembly.

- a. Exterior Walls: Set units with facing placed toward **[exterior of construction]** **[interior of construction]** **[as indicated on Drawings]**.

Retain "Interior Walls" Subparagraph below for interior walls around high-humidity areas such as shower rooms and swimming pools.

- b. Interior Walls: Set units with facing placed **[as indicated on Drawings]** **[toward areas of high humidity]** **<Insert location>**.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately **2.5 lb/cu. ft. (40 kg/cu. m)**.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

Retain "Loose-Fill Insulation" Paragraph below for loose-fill glass-fiber or cellulosic insulation.

C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

Retain subparagraph below for cellulosic-fiber loose-fill insulation.

1. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."

Retain "Spray-Applied Cellulosic Insulation" Paragraph below for self-supported, spray-applied cellulosic insulation or spray polyurethane foam insulation.

D. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.7 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

Show width of cavity on Drawings.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window

Show width of cavity on Drawings.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
2. Install insulation to fit snugly without bowing.

3.8 INSTALLATION OF REFLECTIVE INSULATION AND RADIANT BARRIERS

Fi-Foil has Grade 1 Installation Guidelines and Standards for multi-layered reflective insulation for masonry wall applications. See www.fifoil.com.

- A. Install reflective insulation according to manufacturer's written instructions and ASTM C 727.
- B. Install sheet radiant barriers according to manufacturer's written instructions and ASTM C 1743 or ASTM C 1744.
- C. Install interior radiation control coating system according to manufacturer's written installation instructions and ASTM C 1321.

3.9 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

THERMAL INSULATION 072100 - 1