



## Standard Guide for Prefabricated Panel Insulation Systems for Ducts and Equipment Operating at Temperatures Above Ambient Air<sup>1</sup>

This standard is issued under the fixed designation C 1146; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This guide describes construction and installation of prefabricated panel insulation systems for vessels, ducts, and equipment operating at temperatures above ambient. Typical applications include, but are not limited to, power plant ducts, steam generating units, precipitators, bag houses, fans, refinery storage tanks, process vessels, and coke drums.

1.2 The insulation described herein is limited to systems consisting of insulating units specially designed to fit the surfaces to be insulated, and engineered for the service requirements.

1.3 Each insulation unit is a prefabricated construction typically comprised of insulation, an outer lagging to which the insulation is attached, an inner metal mesh and foil lining, and means for securing multiple units together in an assembly.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—When prefabricated panel systems are specified, Test Methods C 167, C 177, and C 1061, and Terminology C 168 should be considered.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

C 167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulation<sup>2</sup>

C 168 Terminology Relating to Thermal Insulation<sup>2</sup>

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus<sup>2</sup>

C 1061 Test Method for Thermal Transmission Properties of Nonhomogeneous Insulation Panels Installed Vertically<sup>3</sup>

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *convection barriers*—barriers to air flow placed between the inner liner and the hot surface being insulated. These may be a combination of sheet metal and insulation material. Generally, these are required on vertical and inclined surfaces.

3.1.2 *flashing*—sheet metal of the same material as the lagging, used to cover openings in the insulation, such as corners and penetration.

3.1.3 *inner*—the innermost surface or cover of the prefabricated panel (closest to the hot surface). This may be composed of aluminum foil and metal mesh.

3.1.4 *insulation*—essentially homogenous insulation in which relevant properties are not a function of position within the material itself, but may be a function of such variables as time and temperature.

3.1.5 *lagging*—the outermost cover or sheet of the prefabricated panel (farthest from the hot surface), which performs a structural function as well as provides weather protection. The lagging is generally fabricated from corrugated, ribbed, or flat sheet.

3.1.6 *penetrations*—openings in a unit of insulation from the hot surface through to the cold surface.

3.1.7 *retaining devices*—metallic members passing through the insulation between the hot surface and the cold surface. Generally, pins, prongs, or other acceptable means used to hold the assembly together.

3.1.8 *support member*—straps, bars, or angles attached to the surface being insulated and to which the insulation units are attached.

3.1.9 *unit of insulation*—a single structurally-independent assembly typically consisting of lagging, inner liner, insulation, and retaining devices.

### 4. Significance and Use

4.1 The purpose of this guide is to ensure proper specification and installation of thermally and mechanically engineered units of prefabricated insulation panels. These panels are to be designed to:

4.1.1 Limit loss of heat from insulated surface.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.06.

<sup>3</sup> Discontinued. See 1994 *Annual Book of ASTM Standards*, Vol 04.06.

4.1.2 Limit exposed surface temperatures for thermal protection of personnel.

4.1.3 Maintain temperatures of the insulated equipment at or above a specified minimum value required for the proper operation of the equipment.

4.1.4 Produce an assembly that provides allowance for thermal expansion and is of a weathertight construction.

## 5. Panel Design Specifications

### 5.1 *General:*

5.1.1 The purchase specification should clearly indicate the surfaces to be insulated. Either insulation type and thickness or heat loss requirements shall be part of the specification.

5.1.2 The purchase specification should clearly indicate the operating temperature of the item to be insulated. Up-set or worst-case conditions may be considered.

5.1.3 Heat loss through uninsulated surfaces, or increased heat loss that results when it is necessary to reduce insulation thickness to accommodate mechanical interferences with other equipment, supports, hangers, etc., should be accounted for in the insulation design.

5.1.4 High heat conduction paths through the insulation should be minimized.

5.1.5 Convection barriers should minimize internal heat paths.

5.1.6 All components of the insulation units, as physical structures, must be capable of withstanding the temperatures to which they will be subjected without mechanical failure or detrimental changes in physical properties.

5.1.7 When subjected to maximum service temperature, insulation units should not warp, deform, or shrink so as to affect their performance. The materials should perform their functions for the specified service life and be compatible with the specified environment.

5.1.8 Since permanent deformation of the insulation can cause loss of efficiency, the design specification should define the areas required to have reinforced lagging construction.

5.1.9 Insulation units should be provided with joint laps or other suitable means to form a natural watershed and preclude siphoning of water.

5.1.10 Insulation units and assemblies of units should be equipped with overlapping slip joints or other suitable means to provide for the differential movement between the hot surface insulated and the insulation, since the outer lagging temperature of the insulation will be lower than that of the hot surface.

5.1.11 Since this insulation is prefabricated to fit the purchaser's equipment, it is the responsibility of the purchaser to supply drawings and pertinent operation data for the equipment to be insulated.

5.1.12 Purchase specification should make provisions to preclude galvanic action between dissimilar metals.

### 5.2 *Thermal:*

5.2.1 When maximum heat loss is specified by the purchaser, the purchase specification should clearly indicate the operating parameters permissible average heat loss through a unit of area of the insulation. This thermal performance should be referenced to the area of the hot surface unless otherwise specified.

5.2.2 When maximum lagging temperature for personnel protection is specified by the purchaser, maximum anticipated ambient air temperature and minimum wind velocity should also be supplied.

5.2.3 If personnel exposure to high surface temperature is considered to be a danger in limited areas, those areas should be explicitly identified and one or more of the following alternatives will be required:

5.2.3.1 External guarding,

5.2.3.2 Additional insulation,

5.2.3.3 High emittance outer lagging, or

5.2.3.4 Other acceptable techniques agreed to between the purchaser and the supplier.

## 6. Panel Shipping, Storage, and Handling

6.1 All insulation materials should be shipped, stored, and handled in a manner that will result in their remaining in the same condition as they left the supplier.

6.2 Shipping containers should be weather-resistant and sturdy to limit entrance of contaminants and damage to the insulation during shipment and storage.

6.3 Shipping containers should be identified with the purchase order number, the material identification number, special shipping and handling instruction (this side up, stacking limitations), and special instructions (storage, unpacking restrictions, etc., as appropriate).

6.4 Shipping containers should be arranged in such a manner that identification markings on the outside are clearly visible.

6.5 Insulation should be stored in its "as shipped" condition in the shipping containers to preserve its shop cleanliness level until it is ready to be installed.

6.6 Containers in storage should be sufficiently elevated above ground level to prevent surface water and drainage damage.

6.7 Periodic storage inspection should be conducted until the insulation is removed for installation. The frequency of the inspections should be governed by the results of previous inspection and on-site storage conditions.

## 7. Panel Installation Procedure

7.1 Since prefabricated insulation units are custom-made to fit the equipment to which they are to be installed, with lapping of the lagging or other mechanical means required for expansion, water shedding, and weather protection, they must be installed in proper sequence. The prefabricated panel manufacturer is expected to provide installation diagrams or procedures, or both, to show the proper sequence of installation.

7.2 Unit of insulation shall be installed in proper sequence with ends closely butted and lagging arranged to shed water.

7.3 Normally, insulation modifications should be referred to the manufacturer. Field cutting or fitting should be done in a workmanlike manner with cuts clean and neat and flashed to prevent water entrance and to restrict air flow in or out of the insulation.

7.4 Insulation and support member should be handled in such a manner that prevents damage to the insulation, the insulation supports, and the items being insulated.

7.5 Insulation units should be fabricated and installed so that they will resist specified mechanical abuses, vibration, and wind or other loads.

7.6 Convection barriers should be installed where excessive convection currents may occur.

7.7 Where screws are used for securing the insulation units, they should be installed in properly drilled holes. Units should be erected with screws securely tightened or with locking devices to prevent loosening under vibration or other movement.

7.8 Where subsequent removal of units is involved, they may be secured by bands and seals, hinges and snap-locks, or sheet-metal screws. Where removals are anticipated for fre-

quent inspection, the units should be secured by buckles or other clamping devices. Use of non-corrosive fasteners should be considered for exterior locations.

7.9 After installation is completed, there should be a final inspection to ensure that there are no excessive heat losses through the insulated surfaces. The utilization of thermographic techniques may provide valuable information as part of a final acceptance procedure when agreed upon by purchaser and supplier.

## **8. Keywords**

8.1 insulation units; panel insulation units

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