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Standard Guide for Prefabricated Panel and H–bar Insulation Systems for Vessels, Ducts and Equipment Operating at Temperatures Above Ambient Air[1]

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 (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

~~1.1This 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.~~

~~1.2The 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.~~

~~1.3Each 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~~

1.1 This guide describes design, fabrication, shipping, handling, jobsite storage, and installation of prefabricated panel and H-Bar insulation systems for vessels, ducts, and equipment operating at temperatures above ambient. Typical applications include, but are not limited to, air and gas ducts, steam generating units, air quality control systems, fans, 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 and environmental requirements. The insulation unit may also include special design features which facilitate the removal and replacement for maintenance and inspection.

1.3 When prefabricated panels are used, each insulation unit factory preassembled and typically comprised of the insulation, an outer lagging to which the insulation is attached, an inner retaining wire mesh, optional foil lining, and means for mechanically securing multiple units together in an assembly.

1.4 H-bar systems represent insulation units that are typically comprised of the insulation, outer lagging and a uniquely configured subgirt design which both supports the insulation and provides a means for mechanically securing multiple units together in an assembly. The design of the subgirt creates an "H" configuration which is fabricated from light gauge sheet metal. The subgirt components consist of: *(1)* a "J-bar" shape which frames the perimeter edges of the surface to be insulated, holds the insulation in place along the outer edge and provides a screen attachment point for the outer lagging; *(2)* the "H-bar" shape is placed at defined intervals. The web section of the "H-bar" supports the insulation while the exterior flange allows for the outer lagging to be attached with threaded fasteners.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *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 C167, C177, and C1061, and Terminology C168~~ 1—When prefabricated panel or H-Bar insulation systems are specified, Test Methods C 167, C 177 and C 1061, Material Specifications A 36/A 36M, A 463/A 463M, B 209, C 612, and Terminology C 168 should be considered.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A 36/A 36M Specification for Carbon Structural Steel

[1] This guide is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.40 on Insulation Systems.
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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* ~~, Vol 04.06.~~volume information, refer to the standard's Document Summary page on the ASTM website.

A 463/A 463M Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
C 167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations
C 168 Terminology Relating to Thermal Insulation
C 177 ~~Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[2]~~ Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
C 612 Specification for Mineral Fiber Block and Board Thermal Insulation
C 1061 Test Method for Thermal Transmission Properties of Non~~h~~-Homogeneous Insulation Panels Installed Vertically [3]

3. Terminology

~~3.1~~

3.1 Terminology C 168 shall be considered as applying to the terms in this specification.

3.2 *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.~~

3.2.1 *convection barrier (flue stop)*—barriers to internal air flow sometimes refered to as “chimney effect”) which are placed between the inner liner and the hot surface being insulated. The barriers are generally a combination of sheet metal and with the insulation material mechanically attached. Convection barriers are required when the insulation is not in direct contact with the plate surface and only on vertical and sloping surfaces of less than 45° incline.

3.2.2 *flashing*—sheet metal of the same material as the lagging, used to cover openings in the insulation typically occurring at locations, such as corners, penetrations framing of doors and closures. Flashing may be fixed (permanent) or removable to allow for inspection and maintenance, that is, expansion joints.

3.2.3 *inner liner*—the innermost surface or cover of the prefabricated panel (closest to the hot surface) composed of reflective aluminum foil and wire mesh.

3.2.4 *insulation*—essentially homogenous insulation, generally in semi-rigid board from and, 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.

3.2.5 *lagging*—the outermost cover or sheet of the prefabricated panel or H–bar system (farthest from the hot surface), which performs a structural function as well as provides protection from weather and mechanical abuse. The lagging is generally fabricated from corrugated, ribbed, or flat sheet; smooth or stucco-embossed; mill finish or painted; clad or non-clad.

3.2.6 *penetrations*—openings through a unit of insulation from the hot plate surface through to the exterior cold surface. Penetrations such as test ports should be covered with removable insulation assemblies. The insulation thickness should be equal to the surface being insulated.

3.2.7 *retaining devices*

3.2.7.1 *prefabricated panels*—metallic members passing through the insulation between the hot surface and the cold surface. Generally, these include: pins, prongs, or other acceptable means used and secured with washers and speed clips to hold the assembly together.

3.2.7.2 *H-bar systems*—H-bar systems includes retaining devices such as a backing strap or expanded metal between the H-bar. These devices are placed midway between the insulation boards and provide support on wall applications. On top of surfaces, the H-bar retaining device may be either expanded metal or a corrugated inner-liner to hold the insulation in the H-bar track

[3] ~~Discontinued. See 1994 *Annual Book of ASTM Standards* , Vol 04.06.~~
[3] Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.

3.2.9 *support member (subgrit)*—straps, bars, or angles attached to the plate surface or external casing stiffeners being insulated and to which the insulation units are attached.

4. Significance and Use

~~4.1The 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 The purpose of this guide is to ensure that a functional system will result when considering the use of prefabricated panel or H-bar insulation systems. Both systems require a varying degree of pre-engineering and prefabrication so that the insulation will produce the specified thermal, mechanical and environmental design requirements Both the prefabricated panels and H-bar systems which can also be used in combination with each other are to be designed to:

4.1.1 Limit loss of heat from insulated surface.

~~4.1.2Limit exposed surface temperatures for thermal protection of personnel.~~

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

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

4.1.2 Limit exposed surface temperatures for burn protection of personnel.

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

4.1.4 Produce a system or assembly that is designed to provide allowance for thermal expansion; is structurally adequate; is of a weathertight construction; and incorporates design features that promote efficient removal for inspection, repair and maintenance where required.

5. ~~Panel Design Specifications~~ Panel Design Specifications for Prefabricated Panel and H-bar Systems

5.1 *General*:

~~5.1.1The 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.~~

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

~~5.1.3Heat 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.~~

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

~~5.1.5Convection barriers should minimize internal heat paths.~~

~~5.1.6All 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.~~

~~5.1.7When 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.~~

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

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

~~5.1.10Insulation 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.~~

~~5.1.11Since 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.~~

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

5.1.1 The purchase specification should clearly indicate the surfaces to be insulated. Either insulation type and thickness or average 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. When up-set or worst-case temperature conditions are to be considered, the maximum temperature excursion and time duration should be stated.

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

5.1.4 Conduction paths which produce high heat on exterior lagging or "cold spots" on plate interior and are attributed to the insulation subgrit design should be minimized. The use of "through-fasteners" or bolts where protruding heads can occur should be kept to a minimum. There should be no "rattling" or "free-play" of the exterior lagging.

5.1.5 Convection barriers (flue stops) are typically installed at 12 to 15 ft (3657 to 4572 mm) vertical centers as well as to close