



Designation: C945 – 05 (Reapproved 2023)

Standard Practice for Design Considerations and Spray Application of a Rigid Cellular Polyurethane Insulation System on Outdoor Service Vessels¹

This standard is issued under the fixed designation C945; 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

1.1 This practice concerns itself with the substrate preparation and priming, the selection of the rigid cellular polyurethane system, and the protective insulation coatings for outdoor service equipment.

NOTE 1—For the purpose of this practice, polyurethane is defined to mean either polyurethane or polyisocyanurate and is hereafter referred to as “PUR/PIR.”

1.2 The values given in inch-pound are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard may involve hazardous materials, operations, and equipment. 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

C168 Terminology Relating to Thermal Insulation

D883 Terminology Relating to Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2200 Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces

2.2 *American National Standards:*

Z87.1 Practice for Occupational and Educational Eye and Face Protection³

2.3 *Clemtex Limited Standard:*
“Anchor Pattern Standard”⁴

2.4 *National Association of Corrosion Engineers Standard:*
TM-01-70 Visual Surface Preparation Panels⁵

2.5 *Other Documents:*

Safety Precautions in Handling and Spraying of PUR/PIR Systems^{6,7}

3. Terminology

3.1 *Definitions*—Definitions included in Terminology C168, Definitions D883, and Abbreviations D1600 apply to the terms used in this standard.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *blasting*—the process of cleaning surfaces by use of abrasive particles propelled at high velocity upon the surface to be cleaned.

3.2.2 *coatings/coverings*—ultraviolet ray-absorbing and water-shedding protective materials applied over the urethane foam.

3.2.3 *density:*

3.2.3.1 *in-place density*—the weight per unit volume of the cross section of foam from substrate to exposed surface, including all skins (or surfaces).

3.2.3.2 *core density*—the weight per unit volume of a single layer of foam excluding top and bottom skins or (if present) interlayer skins.

¹ This practice 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* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from Clemtex Ltd., P.O. Box 15214, Houston, TX 77020.

⁵ Available from NACE International (NACE), 1440 South Creek Dr., Houston, TX 77084-4906, <http://www.nace.org>.

⁶ Spray Polyurethane Foam Alliance (SPFA), 4400 Fair Lakes Ct, Suite 105, Fairfax, VA, <http://sprayfoam.org>

⁷ Alliance for the Polyurethane Industry (API), 1300 Wilson Blvd Suite 800, Arlington, VA 22209, <http://polyurethanes.org>

3.2.4 *foam system*—appropriate formulations of two liquid components, polyisocyanate, or A side, and polyol, or B side, for intended applications.

3.2.5 *ignition barrier*—cement plaster or equivalent coating/covering providing a resistance to ignition of the foam insulation acceptable to the concerned building or fire department(s), or both. (Designated UL test is optional.)

4. Significance and Use

4.1 This practice facilitates the selection and application of an insulation system for use at service temperatures between -30 and $+107^{\circ}\text{C}$ (-22 and $+225^{\circ}\text{F}$). Although the successful installation of spray-applied PUR/PIR is influenced by many factors, this practice treats those four areas found to be of major importance:

- (1) Substrate preparation,
- (2) Substrate priming,
- (3) Insulation application, and
- (4) Protective coatings.

4.2 Abrasive blasting, primer application, spray application of the insulation, and protective coating application each contribute their unique health and safety hazards to the job site and will be dealt with in more detail under their respective headings.

5. Substrate Preparation

5.1 Proper substrate preparation is mandatory to obtain a successful foam application. These preparation methods must remove any contaminants that will interfere with development of the maximum adhesion of the urethane foam. The method(s) chosen are dependent upon the contaminants present on the surface and the end-use design service temperature.

5.1.1 *Previously Coated Iron and Steel Surfaces*—The adhesion of spray-applied urethane to previously coated surfaces is directly influenced by the age, type, and condition of the surface. For this reason any coating that exhibits chalking, peeling, or other evidence of failure or damage must be removed and an appropriate primer applied. **Abrasive blasting is recommended.** If blasting is to be accomplished, all items listed under Section 6 should be followed. In all cases, the coated substrate must be cleaned and free of rust, grease, oil, dirt, dust, moisture, etc., immediately prior to foam spraying by one or more of the following methods: (a) wash with water and allow to dry, (b) brush, (c) broom, or (d) air blast.

5.1.2 *New Iron or Steel Surfaces*—Field blasting and priming is recommended. All blasting is to be accomplished in accordance with items listed in Section 6. Shop preparation is also acceptable with proper field surface preparation of the weld joints and all damaged areas. In all cases, the substrate to be sprayed with foam shall be free of rust, grease, oil, loose particles, and mill scale, moisture, dirt, etc. After priming is complete, all areas that are specified to be insulated shall be washed with water and allowed to dry, brushed, broomed, or air-blasted prior to applying the insulation.

NOTE 2—Caution: Be sure the primer is useable at the design temperature and acceptable under the foam insulation.

5.1.3 *Galvanized Metal Surfaces*—Clean with an acceptable solvent, wash with water to remove deposits, spray with an acceptable wash primer, and then coat all areas with an acceptable primer or coating.

NOTE 3—This procedure is not always required depending on the age of the metal, exposure, and use.

5.1.4 *Aluminum Surfaces*—Degrease with appropriate solvents. Coat the clean, dry surface with a recommended primer or coating.

5.1.5 *Stainless Steel Surfaces*—Degrease with appropriate solvents. Coat the clean, dry surface with a recommended primer or coating. (Chloride-free materials are recommended on surfaces operating above 140°F (60°C).)

6. Recommended Blasting Procedures

6.1 All surfaces to be primed or coated shall be prepared to the degree of cleanliness and surface profile as recommended by the primer supplier. Pictorial D2200 shall be used as the standard. Blast-cleaned surface acceptance will be by one or more of the following visual comparison methods: “Anchor Pattern Standards” NACE Visual Surface Preparation Panels (Standard TM-01-70), and Pictorial D2200.

6.2 All welding, burning, etc., shall be completed prior to the blasting operation.

6.3 Remove any grease or oil with a petroleum solvent or water-detergent solution. All flux, spatter, slag, or other laminations left from welding must be chipped or ground off. Rough welds and other sharp projections should be ground smooth by the fabricator prior to the blasting operation.

6.4 Sandblast sand shall be sharp, graded flint or silica sand (16 to 30 mesh). Where inorganic zinc coatings are applied, the surface preparation shall be abrasive blasted using 16 to 30-mesh sand, G40 to 50 grit, or an equivalent abrasive that will provide a similar surface profile. All abrasives shall be free of all dust, dirt, and other foreign matter. They shall be kept dry and free of oil at all times.

MANDATORY HEALTH AND SAFETY PRECAUTIONS FOR BLASTING OPERATIONS

6.4.1 Effective oil and water traps shall be used to ensure clean, dry air supply to the abrasive pot. Water shall be continuously bled from the moisture trap.

6.4.2 A “dead-man” valve shall be used on all blast nozzles.

6.4.3 All blast hoses shall have an antistatic lining.

6.4.4 All blast nozzles shall be properly grounded.

6.4.5 Nozzle blast operators exposed to blasting dust shall wear a U.S. Bureau of Mines-approved helmet connected to a clean, breathable compressed air source.

6.4.6 All others exposed to blasting dust shall wear a U.S. Bureau of Mines-approved filter-type respirator. Adequate personnel protection from flying particles shall be provided in any blasting operation.

6.4.7 If at any time the blasting equipment and material specifications are not being met, the owner may suspend the operation.