

FOAMGLAS[®] INSULATION SYSTEM SPECIFICATION



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FOAMGLAS[®]

Pittsburgh Corning

Application of FOAMGLAS[®] Insulation to Spherical Vessels

I-COLD-SPHERE 1/2016



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1. General Notes

- 1.1 This specification covers the application of FOAMGLAS[®] insulation and accessories, where applicable, to spheres, bullet tanks and similar vessels operating at temperatures ranging from -56°C to 82°C (-70°F to 180°F). Additional requirements for the insulation system, such as fire protection and/or acoustic insulation, will be covered by additional specifications or specification attachment.
- 1.2 Any deviation from this specification (i.e. alternative accessory materials, design etc.) must be authorized by written approval.
- 1.3 The product data sheets referenced in the text are listed at the end of the specification. Product data sheets for Pittsburgh Corning products may be accessed on line at: <http://www.foamglas.com/>.
- 1.4 Technical drawings are provided in Appendix B. Contact Pittsburgh Corning if additional details are needed.
- 1.5 SI and Metric unit conversions have been rounded to nearest United States customary unit equivalent.

2. Codes and Standards

- 2.1 AISI American Iron and Steel Institute
- 2.2 ASTM International Standards
 - 2.2.1 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation
 - 2.2.2 ASTM C1639 Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation
 - 2.2.3 ASTM C1729 Standard Specification for Aluminum Jacketing for Insulation
 - 2.2.4 ASTM C1767 Standard Specification for Stainless Steel Jacketing for Insulation
- 2.3 EN Standards
 - 2.3.1 EN 14305, Thermal insulation products for building equipment and industrial installations. Factory made cellular glass (CG) products. Specification
 - 2.3.2 EN ISO 1182, Reaction to fire tests for building products — Non-combustibility test (ISO 1182:2002)
 - 2.3.3 EN ISO 9229, Thermal insulation — Vocabulary (ISO 9229:2007)
- 2.4 International Organization for Standardization (ISO)
 - 2.4.1 ISO 9001: Quality management systems — Requirements
 - 2.4.2 ISO 9002: Quality systems. Modelled for quality assurance in production, installation, and servicing

3. Preliminary Conditions

- 3.1 FOAMGLAS[®] insulation and fabricated spherical segments should be transported and stored vertically. Packages should be handled with care and protected from the elements while in storage. FOAMGLAS[®] insulation should not be allowed to come into direct contact with the ground to prevent possible damage or contamination prior to application.
- 3.2 The surface to be insulated should be clean and free from all traces of grease, rust, dust and any foreign matter. The design engineer should decide whether a protective coating system is necessary, and to also determine if the system is compatible with the service temperature. If the engineer decides to specify an anti-corrosion product, the following rules should be observed:
 - 3.2.1 The specifying engineer or owner shall at their option designate a protective coating system to be applied before the application of any insulation. The application of the product is not a requirement of this specification.
 - 3.2.2 Any surface imperfection should be cleaned with a wire brush and then coated with a new layer of anti-corrosion paint or other suitable product. The surface should be moisture free before the insulation is applied and the product application should follow the anti-corrosion product manufacturer's guidelines.
 - 3.2.3 When an adhesive is used, the compatibility between the anti-corrosion paint and the adhesive should be verified before applying the insulation.
- 3.3 The surface and the materials used should be dry before and during application, and should remain dry until start-up of the insulated system.
- 3.4 The application of FOAMGLAS[®] insulation on pipes or equipment should be done at ambient temperature.
- 3.5 The temperature limits of the accessory products should be respected during both storage and application.
- 3.6 Hydrostatic, radiographic and other tests should be completed before the insulation is applied in order to assure proper system performance.

4. Design Requirements

- 4.1 The heat transfers should be limited to acceptable values with respect to both economic and functional aspects. Design thickness criteria will limit heat gain to between 25 to 37 W/m² (8 to 12 Btu/hr•ft²). In some cases this may also limit condensation (recommendable). The insulation thickness shall be determined through calculations based on particular and unique environmental and operating conditions.
- 4.2 The insulation thickness shall be calculated in accordance to ISO 12241, or ASTM C680, and based upon project requirements for heat gain, environmental conditions, etc.
- 4.3 Equipment shall be insulated according to insulation class, operating temperature and insulation thickness defined in the specifications, equipment diagram, vessel designation table, isometrics, drawings, general arrangement drawings, insulation thickness tables.
- 4.4 The entire system shall be fully insulated, including all associated components, instruments and tubing, drains to the extent specified.
 - 4.4.1 All metal parts that protrude through the insulation shall be insulated, over an extent of 4 times the insulation thickness.
- 4.5 The insulation at pipes and equipment shall end in such a distance to adjacent flanges, to allow removal of bolts without damage to the insulation.
 - 4.5.1 Nameplates and tags shall be insulated; vessel vendor shall provide a duplicate, to be installed by insulation contractor on the outside surface of the insulation.

5. Materials Used

- 5.1 Insulation material shall be FOAMGLAS[®] cellular glass insulation manufactured in accordance with ASTM C552, "Standard Specification for Cellular Glass Thermal Insulation" or EN14305, "Thermal insulation products for building equipment and industrial installations – factory made cellular glass (CG) products – Specification". Pittsburgh Corning's quality system for manufacturing, inspecting, and testing of FOAMGLAS[®] insulation is certified to meet the requirements of ISO 9001:2008. FOAMGLAS[®] pipe insulation shall be fabricated according to the requirements of ASTM C1639 "Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation".
- 5.1.1 For the best results, FOAMGLAS[®] insulation shall be provided in dished (spherical) segments with beveled edges in sizes consistent with the recommendations in Section 6.0 of this document.
- 5.2 Primer - If used, may be any of a number of non-asphalt, non-coal tar primers compatible with the adhesive. Primers of the following type are known to be compatible. (Strict adherence to the manufacturer's recommendations for application of these coatings is essential.)
 - 5.2.1 Polyamide type epoxy primers
 - 5.2.2 Modified phenolic epoxy coatings
- 5.3 Adhesive shall be one of the following:
 - 5.3.1 PC[®] 88 Adhesive as supplied by Pittsburgh Corning. PC[®] 88 Adhesive is a two-component urethane modified asphalt adhesive appropriate for temperatures from -56°C to 82 °C (70°F to +180°F).
 - 5.3.2 PC[®] 99 2K adhesive as supplied by Pittsburgh Corning. PC99 2K adhesive is a moisture curing, polyether adhesive appropriate for temperatures from - 73°C to 60°C (-100°F to +200°F).
- 5.4 Metal Bands shall be AISI type 304 (BSI 304 S16) stainless steel, 13 mm wide x 0.4 mm thick (0.5 in. x 0.016 in.), with matching seals or aluminum bands with matching seals, 13 x 0.5 mm (0.5 in. x 0.020 in.) for piping and equipment with O.D. up to 1219mm (48 in.), 19 x 0.5 mm (0.75 in. x 0.020 in.) for larger O.D.
- 5.5 Catalyst if using PC[®] 88 adhesive, shall be Hold Catalyst as manufactured by Pittsburgh Corning. This catalyst shall be used as a means of providing faster bonding to the vessel surface when using PC[®] 88 adhesive. The catalyst is a separate component of the PC[®] 88 adhesive system, not to be confused with the reactant provided in the PC[®] 88 Adhesive kits. The catalyst is only necessary on the bottom half of spheres and vessels, where there is no support for the insulation blocks. On the top half of the vessel, the blocks of insulation will be supported by the preceding course of insulation.
- 5.6 Reinforcing mesh fabric for the vapor retarder coating shall be one of the following:
 - 5.6.1 Synthetic fabric, 6.5 x 6 meshes, PC[®] Fabric 79 as supplied by Pittsburgh Corning.
 - 5.6.2 Glass reinforcing mesh, PC[®] 150 glass reinforcing mesh, as supplied by Pittsburgh Corning.

- 5.7 Protective coatings, or finishes will be installed to serve as a vapor retarder. This material will fill the surface cells of the FOAMGLAS[®] insulation to improve mechanical resistance of the system, improve freeze-thaw protection of the system, and to serve as an additional barrier to vapor and liquids. The protective coating, membrane, or finish shall be PITTCOTE[®] 300 coating supplied by Pittsburgh Corning. A vapor retarder asphalt coating especially formulated for use with FOAMGLAS[®] insulation. PITTCOTE[®] 300 finish must be reinforced with a synthetic or glass fabric mesh, and must be covered with a metal jacket.
- 5.8 Metal jacket finish shall be one of the following:
- 5.8.1 Use minimum 0.4mm (0.016 in.) aluminum jacket for insulation O.D.'s of 1219mm (48 in.) or less. For larger O.D.'s use 0.6mm (0.024 in.) aluminum jacket. Aluminum jacketing shall conform to ASTM C1729 Standard Specification for aluminum jacketing for Insulation.
- 5.8.2 Use minimum 0.4 mm (0.016 in.) smooth steel (i.e. stainless galvanized, aluminized, galvalume, etc.) where the FOAMGLAS[®] insulation system is also being used for fire protection.

6. Equipment Requirements

- 6.1 The following list of equipment is not intended to be all-inclusive. It is a guide to some of the tools necessary for the application of FOAMGLAS[®] insulation using the fully adhered method. Consult product data sheet or Pittsburgh Corning for more specific recommendations for the application of accessory materials.
- 6.2 Safety Equipment - Consult Material Safety Data Sheets for each product to determine the safety equipment necessary for the job.
- 6.3 Scaffolding - As per manufacturers' recommendations.
- 6.4 Mixer: Proper mixing of the adhesive is essential for a successful application. A heavy-duty variable speed drill with a ½ inch chuck is acceptable. The width of the mixer should be 80% of the container diameter to insure proper mixing. The adhesives are highly viscous so a strong mixer is required. Refer to Appendix B Figure 1 for a detailed drawing.
- 6.5 Adhesive Trowel - the application of the appropriate amount of adhesive is critical. The type of notched trowel will differ depending on the adhesive that is being used.
 - 6.5.1 For PC[®] 88 adhesive, the Red Devil A7 or similar notched trowel has been found to be the best for achieving the desired coverage. The appropriate trowel should have A1 or A2 type, 1.6 mm (¹/₁₆ in.) square or "U" notches.
 - 6.5.2 For PC[®] 99 2K adhesive, use a 6.4 mm X 6.4 mm x 3.2 mm (¹/₄ in. x ¹/₄ in. x ¹/₈ in.) square notched trowel to achieve the recommended adhesive application rate.
- 6.6 Spray Bottle - Available from local hardware.
- 6.7 Hacksaw blade – heavy-duty type, for field shaping FOAMGLAS[®] insulation. To avoid possible injury wrap one end of the blade with duct or other heavy duty tape.
- 6.8 Squeegee – 305 to 457 mm (12 in. to 18 in.) rubber tipped window squeegee for Finish application
- 6.9 Spray Equipment for PITTCOTE[®] 300 Coating - Graco 45:1 airless pump or equal, Graco #451 orifice and reversa-clean tip. 19 mm (³/₄ in.) I.D. lines, delivery pressure 91 kg/cm² (1300 psi).

7. Insulation Application

- 7.1 General Comments
 - 7.1.1 Pre-shaped insulation systems are available from Pittsburgh Corning and a number of FOAMGLAS[®] insulation Fabricating Distributors. Contact the local Pittsburgh Corning Regional Manager for further information the following procedures:
 - 7.1.2 The size of these blocks should be determined based on the size of the vessel. The following table is offered as a guide to block size.
 - 7.1.3 When insulating spherical vessels, it is recommended that blocks that are one-half the size indicated in Appendix A: Table 1 be used on the bottom hemisphere to reduce the weight of individual pieces.
 - 7.1.4 FOAMGLAS[®] insulation may be field shaped to conform to the vessel by making an abrasive mold and rubbing each block on the mold.
 - 7.1.4.1 Select an area on the vessel representative of its contour and rub a block against this area until the block does not rock.
 - 7.1.4.2 Construct a form around the shaped block with the concave side facing up. Pour concrete into the form and let cure.
 - 7.1.4.3 Remove the concrete from the form and rub insulation blocks against the mold to shape the block. Block edges can be beveled before application or on the vessel with a saw blade.
 - 7.1.4.4 Note: It is important that the block fit tightly to the vessel. Check the fit prior to application of adhesive and adjust if necessary.
- 7.2 Prior to application of FOAMGLAS[®] insulation, divide the sphere into top and bottom hemispheres and mark (Fig. 2). Divide the hemispheres into six segments as shown in Fig. 3.
- 7.3 Adhesive Mixing
 - 7.3.1 The proper method for mixing PC[®] 88 adhesive is found on Pittsburgh Corning product data sheet FI-125.
 - 7.3.2 The proper method for mixing PC[®] 99 2K adhesive is found on Pittsburgh Corning product data sheet FI-284(2k)
- 7.4 When using PC[®] 88 adhesive, HOLD Catalyst is used on the bottom hemisphere of a vessel to eliminate the need for temporary support. Prior to dispensing and spraying, shake the catalyst well. Further details on the use of HOLD Catalyst can be found in product data sheet FI-158.
- 7.5 Each insulation segment shall be fitted to the vessel or tank and adjacent segments so that no voids occur. Where the face of the segment does not fit the contour of the surface at irregular surfaces, it shall be shaped to fit prior to adhesive application.
- 7.6 Starting at the bottom of the vessel or tank fit a block to the surface. Be sure that the block is properly lined up vertically. Chalk lines may be struck prior to application to help with block or segment alinement. This will eliminate the need for excess trimming as the job progresses. Use a taped heavy duty hacksaw blade to contour the edge of the block to meet nozzles or other protrusions.

- 7.7 Using the appropriate trowel, apply a full surface application of adhesive in the notched trowel pattern onto the inside face of the block and side which will go against the banding ring or bottom nozzle.
- 7.8 When using PC[®] 88 adhesive, temporary banding may be required to support the insulation on the lower portion of the vessel until the adhesive has set. Special PC[®] 88 adhesive application techniques have been developed for applying block on the lower portion without the use of temporary banding. The "hold method" requires that HOLD Catalyst be applied to the coated block face just prior to placement. Using the spray applicator, mist spray HOLD Catalyst on the PC[®] 88 adhesive coated surface. Two mist sprays per sq. ft. is sufficient.
- 7.8.1 NOTE: It is important that the spray applicators be adjusted to produce a mist spray. Excessive amounts of catalyst can be more detrimental than none at all.
- 7.9 If using hold catalyst, apply the catalyzed adhesive coated insulation block to the surface of the vessel within 15 seconds. Place the block slightly away from adjacent blocks, rub it back and forth two or three times to work the catalyst into the adhesive, then push the block into position and hold for 60 seconds. Allow the block to remain undisturbed for three minutes. Each block shall be placed so that when pressed into position it will form a complete vapor sealed joint with adjacent segments. Succeeding courses shall be firmly butted against the preceding courses. All excess adhesive shall be removed from segment surfaces before the adhesive has set. This is easily accomplished by rubbing out joints and any high edges of insulation block with a piece of the insulation material.
- 7.10 When using PC[®] 99 2K adhesive, apply the adhesive coated insulation block to the surface. Press and rotate the FOAMGLAS[®] insulation block firmly into place. Hold the block in place for 60 seconds. Allow the block to remain undisturbed for three minutes. NOTE: No catalyst is needed with PC[®] 99 2K adhesive.
- 7.11 Fit the next block to the tank making sure joints between the blocks will be tight. Each block should form a complete vapor seal when pressed into position. Excessive adhesive on the outside face shall be removed before the adhesive sets using a scrap piece of FOAMGLAS[®] insulation as described in section 7.9.
- 7.12 Apply adhesive as described in above, coating inner block surface and two adjacent sides (sides which will butt up against insulation already on the vessel). IMPORTANT: A full surface application in the notched trowel pattern of adhesive must be used to insure a good seal and avoid premature failure of the system.
- 7.13 Repeat steps in Sections 7.7 through 7.11 for the entire surface to be insulated.
- 7.13.1 NOTE: For best results, a crew should begin to alternate blocks in a stair-step pattern to opposite sides of the insulation row as space permits. This will allow blocks additional time to set without being disturbed. Using this procedure, several crews can work at once on various sections. If block are properly aligned, only the end blocks at the meeting courses must be cut.
- 7.13.2 NOTE: Exposed edges of all blocks or segments must be sealed with adhesive at the end of each work day. In the event of a sudden rain or fog, exposed edges shall be sealed as above.

- 7.14 Use a scrap block of FOAMGLAS[®] insulation to smooth out the joints between blocks as work progresses. Doing this before the adhesive cures is much easier than going back over the job later. Use pieces of FOAMGLAS[®] insulation to fill gaps or voids in the joint area and seal with adhesive.
- 7.15 When a row of insulation intersects a protrusion, stop insulating three or four blocks short of the protrusion, fit a block to the protrusion, and then lay up the balance of the block in the row in reverse order. The final block laid in this row may require trimming.
- 7.16 Fire Protection Banding: Once insulation application is complete, permanent bands, if required for fire protection purposes, shall be affixed to a band support ring located at the equator (by others) and a floating ring at the bottom pole. Bands shall be spaced 305 mm (12 in.) on centers at the equator. Opposing bands (180° apart) shall be tightened simultaneously).

8. Protective Finish Application

- 8.1 Prior to application of the finish, the insulation shall be inspected for voids, cracked segments and open joints between segments. Cracked or broken insulation shall be refitted and sealed. Voids shall be filled with pieces of FOAMGLAS[®] insulation adhered with appropriate adhesive. Open joints shall be sealed with adhesive.
 - 8.1.1 NOTE: The FOAMGLAS[®] insulation and the surface must be free of dust, moisture and other contaminants prior to finish application. Do not apply finish if temperature is below 4°C (40°F) or if rain is expected within 24 hrs.
- 8.2 Starting at the top of the spray apply PITTCOTE[®] 300 finish to the entire insulated surface. The apply PITTCOTE[®] 300 finish should be applied at a rate of 0.8 to 1.2 liters/m² (2 to 3 gal/100 ft²).
- 8.3 NOTE: Application should begin in the area of the vessel shaded from the sun and continue from right to left. Care should be taken to ensure the mastic is pinhole free.
- 8.4 Use a squeegee where needed to produce a uniform coating over the entire insulated surface. Note: If a second coat of PITTCOTE[®] 300 finish is to be applied, embed the specified reinforcing fabric into the wet coat overlapping all fabric joints 10 cm (4 in). Smooth fabric and stretch to remove wrinkles.
- 8.5 Allow PITTCOTE[®] 300 finish to cure for a minimum of 24 hours prior to application of metal jacket finish or second coat of PITTCOTE[®] 300 finish.
- 8.6 If specified, apply a second coat of PITTCOTE[®] 300 finish (after the first coat dries) at a rate of 1.6 to 2.0 liters/m² (4 to 5 gal/100ft²). Allow the final coat of PITTCOTE[®] 300 finish to cure for a minimum of 24 hours prior to application of metal jacket finish.

9. Metal Jacket Application

- 9.1 Apply metal jacketing finish per engineering standards or practice codes.

10. Inspection

- 10.1 The general contractor, insulation contractor and owner shall provide sufficient inspection during the insulation and finish application. Continuous inspection of the application is not to be considered a requirement of Pittsburgh Corning.
- 10.2 Inspect all insulation and accessory materials to be certain they are applied in conformance with the specification recommendations. Joints should be tight, sealing and flashing should be thorough and water-tight, and finishes should be uniform and free of defects.

11. Quality Assurance

- 11.1 The insulation manufacturer's quality system including its implementation, shall meet the requirements of ISO 9001:2008.

12. Certificates

- 12.1 The manufacturer will furnish evidence of compliance with the quality system requirements of ISO 9001:2008.

13. Product Data Sheets

- 13.1 Product data sheets for Pittsburgh Corning products may be accessed on line at: <http://www.foamglas.com/>. The following are Pittsburgh Corning products referenced in this specification:
- | | | |
|------|---------------------------|------------|
| 13.2 | FOAMGLAS® ONE™ Insulation | FI-003 |
| 13.3 | Hold Catalyst | FI-158 |
| 13.4 | PC® 88 adhesive | FI-125 |
| 13.5 | PC® 99 2K adhesive | FI-284(2k) |
| 13.6 | PITTCOTE® 300 Finish | FI-120 |

14. Appendix B: Table 1

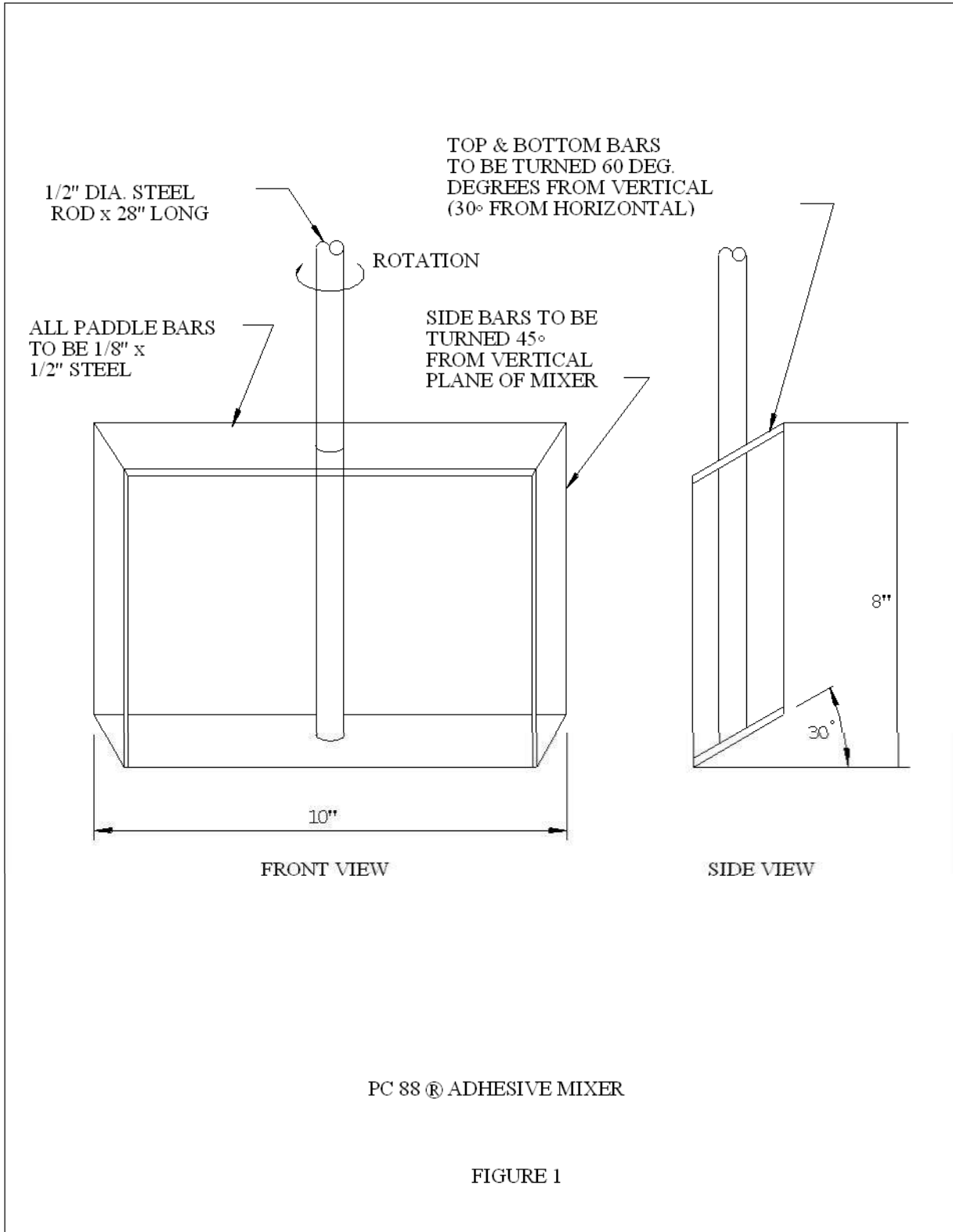
14.1 Appendix A1: Table 1

TABLE 1

Vessel Diameter m (ft.)	Pre- shaped Vessel or Sidewall Segment	152mm x 229 mm (6 in. x 9 in.) Block	229mm x 305 mm (9 in. x 12 in.) Block	305mm x 457 mm (12 in. x 18 in.) Block	457mm x 610 mm (18 in. x 24 in.) Block
Up to 7 (24)	X	X			
7.5 to 14 (25 to 48)	X		X		
15 to 30 (49 to 100)	X			X	
Over 30 (Over 100)	X				X

15. Appendix B: Technical Drawings

15.1 Appendix B1: Mixing Paddle



15.2 Appendix B2: Figure 2

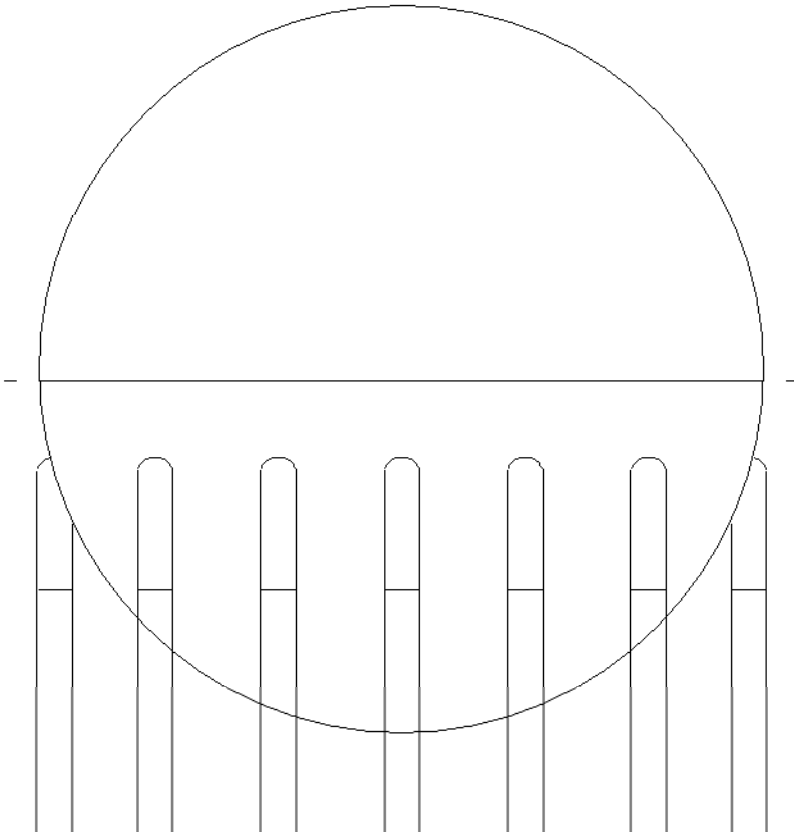
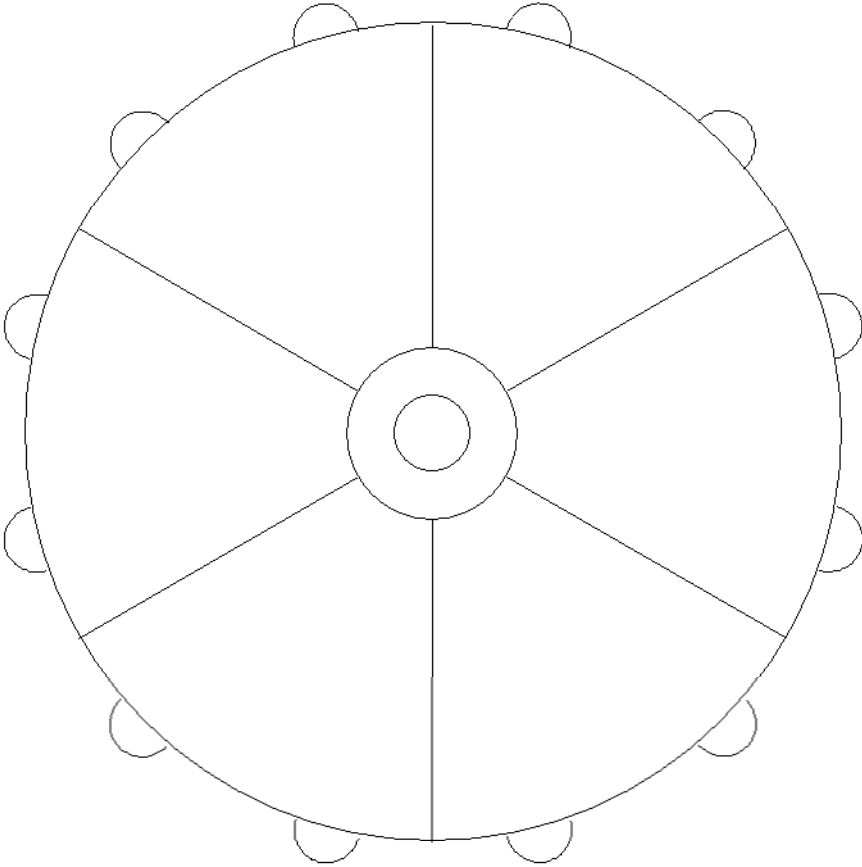


FIGURE 2



15.3 Appendix B3: Figure 3



Hemisphere divided into six segments

FIGURE 3



15.4 Appendix B4: Figure 4

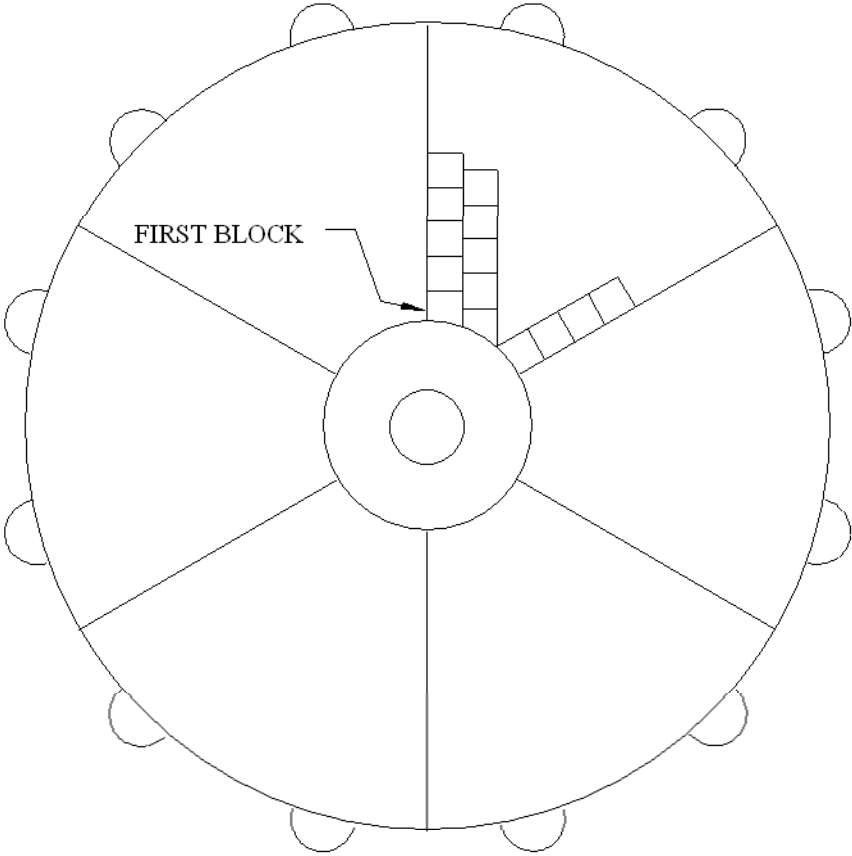


FIGURE 4



15.5 Appendix B5: Figure 5

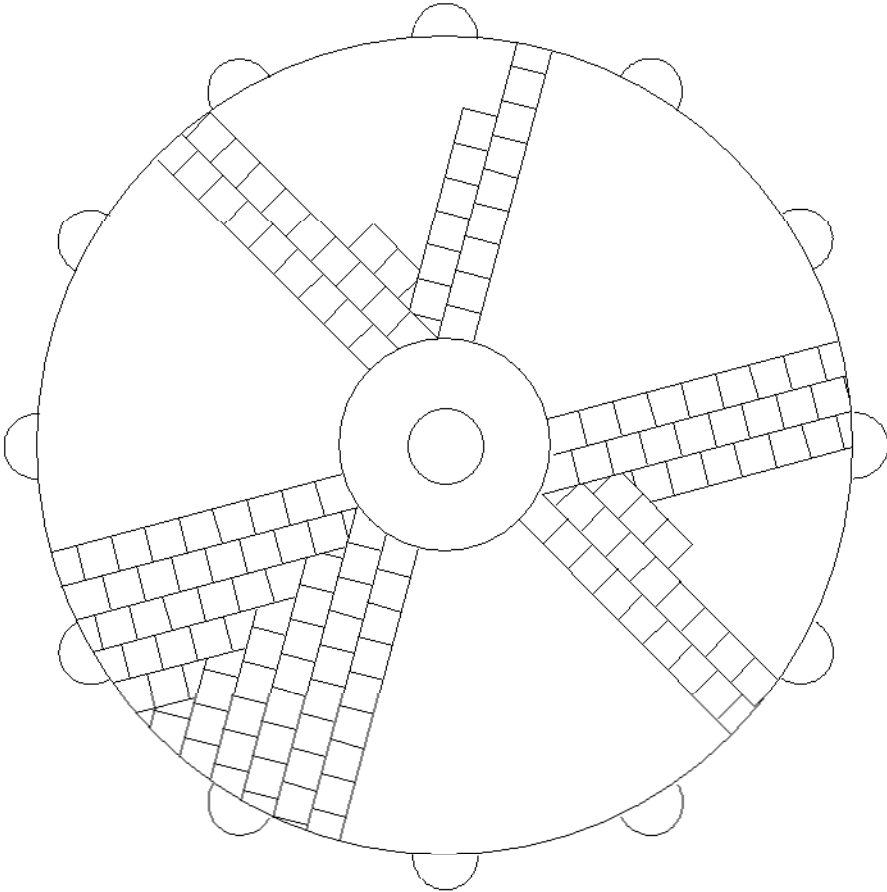


FIGURE 5



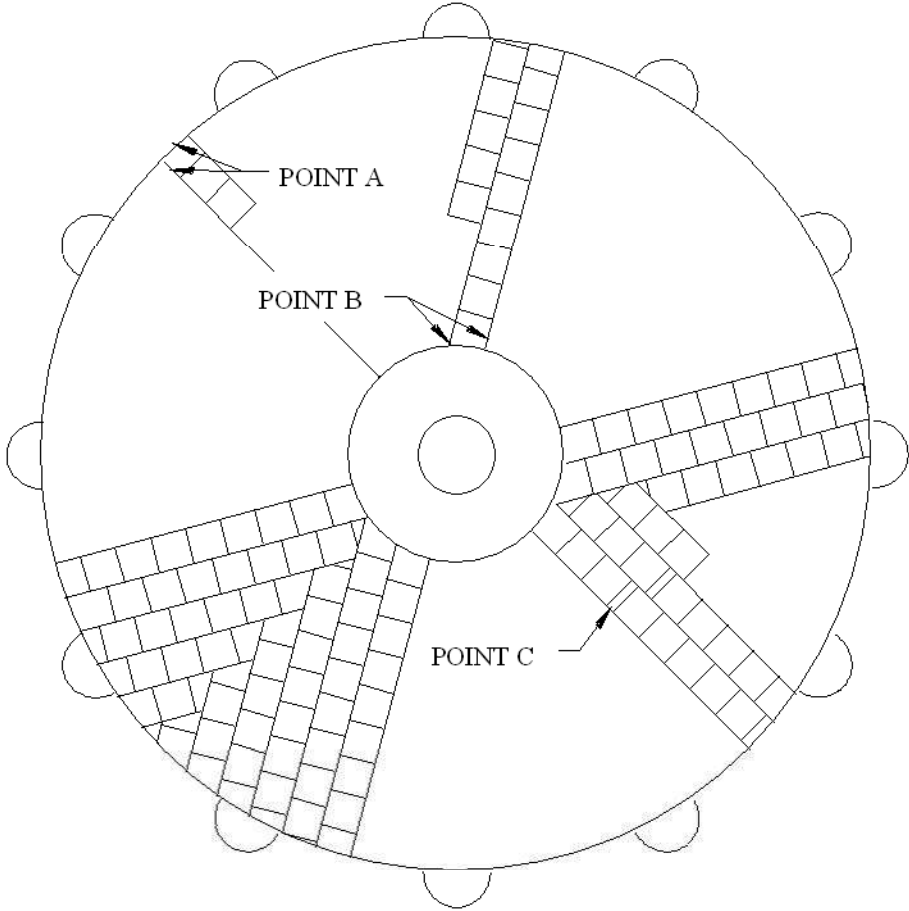
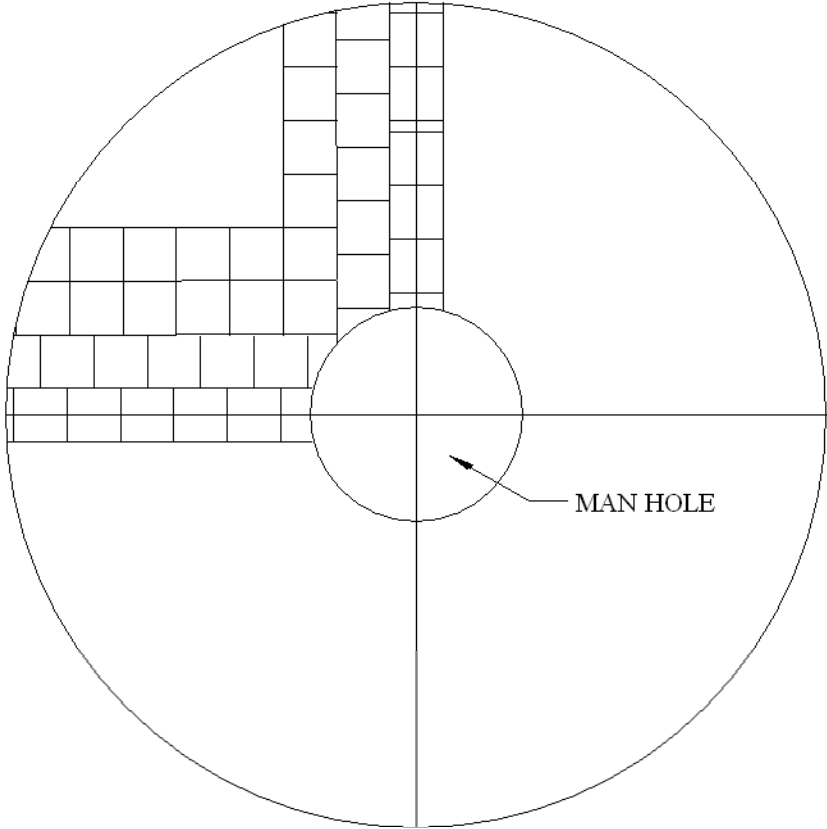


FIGURE 6



15.7 Appendix B7: Figure 7



BANDING RING AREA

FIGURE 7



15.8 Appendix B8: Figure 8

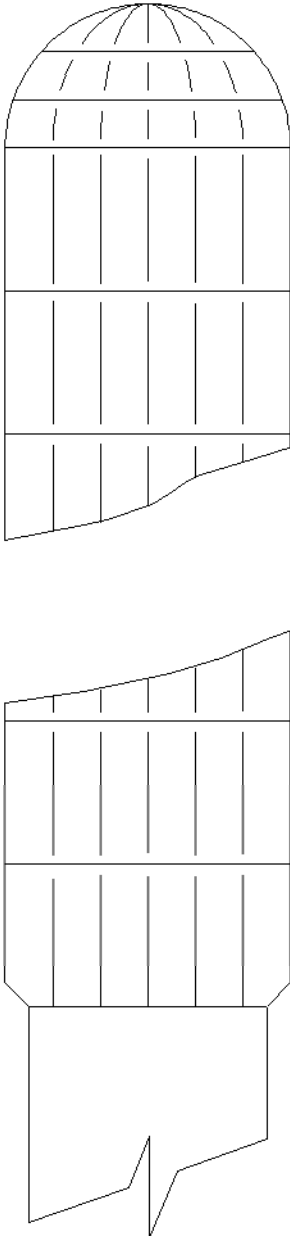


FIGURE 8



15.9 Appendix B9: Figure 9

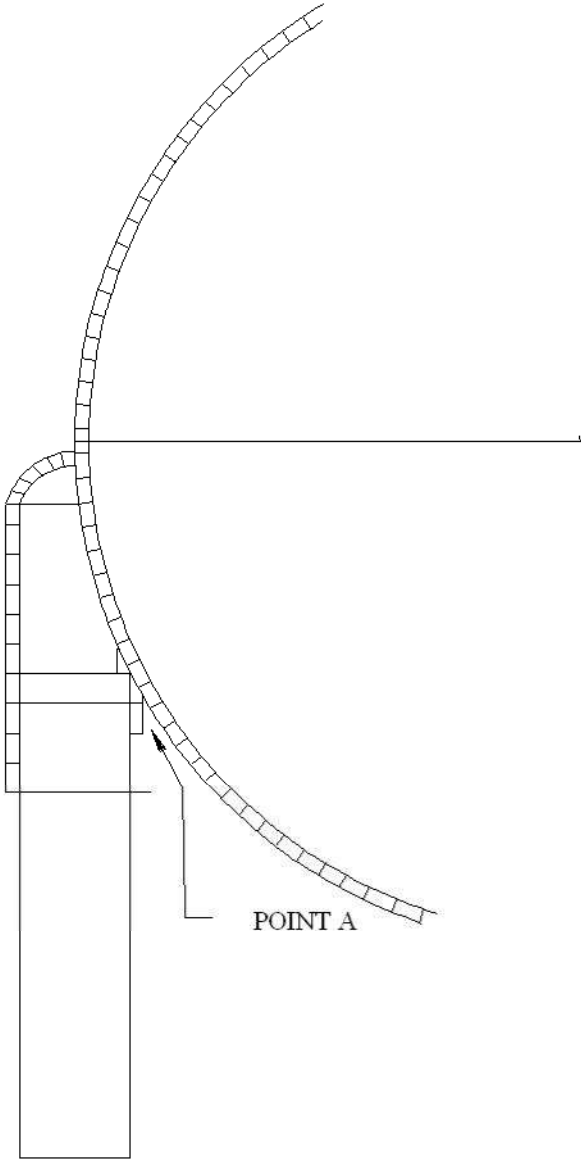


FIGURE 9

16. Appendix B: Other Product Manufacturers

- 16.1 Amercoat 370 - Ameron International, Corporate Centre One 13010 Morris Road, Suite 400 Alpharetta, GA 30004 Telephone: +1 678 393 0653 Fax: +1 678 566 2699 <http://www.ameroncoatings.com/>
- 16.2 Amercoat 90HS or equal, also available through Ameron International.
- 16.3 The recommended mixer paddle for a 19 liter (5 gallon) pail is CS Unitec MH 240 available from CS Unitec, Inc. 22 Harbor Ave., Norwalk, CT 06850 USA 1(800)700-5919 +1 203-853-9522 +1(203)853-9921 <http://www.csunitec.com/> or equal.
- 16.4 For PC[®] 88 adhesive, the Red Devil A7 notched trowel has been found to be the best for achieving the desired coverage and is available from Red Devil Inc. 2400 Vaunhall Rd. Union, NJ 07083 1933, (908) 688-8872, (800)423-3845, Trowel SKU 2085 <http://www.reddevil.com/index.php> or equal.

17. Additional Information

Questions regarding this report should be directed to:

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