SPRAY POLYURETHANE FOAM ALLIANCE

SPFA-103

Spray Polyurethane Foam Insulation Systems for Metal Service Vessels Operating Between -35°C (-30°F) and 93°C (200°F)

Spray Polyurethane Foam Alliance
O: (800) 523-6154 | F: (703) 563-7425
www.sprayfoam.org | info@sprayfoam.org

ABOUT SPRAY POLYURETHANE FOAM ALLIANCE (SPFA)

Founded in 1987, the Spray Polyurethane Foam Alliance (SPFA) is the voice, and educational and technical resource, for the spray polyurethane foam industry. A 501(c)6 trade association, the alliance is composed of contractors, manufacturers, and distributors of polyurethane foam, related equipment, and protective coatings; and who provide inspections, surface preparations, and other services. The organization supports the best practices and the growth of the industry through a number of core initiatives, which include educational programs and events, the SPFA Professional Installer Certification Program, technical literature and guidelines, legislative advocacy, research, and networking opportunities. For more information, please use the contact information and links provided in this document.

DISCLAIMER

This document was developed to aid building construction and design professionals in choosing spray-applied polyurethane foam systems. The information provided herein, based on current customs and practices of the trade, is offered in good faith and believed to be true to the best of SPFA's knowledge and belief.

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DOCUMENT HISTORY

Date	Sections Modified	Description of Changes
June 2004		
August 2015	All	Administrative changes
January 2021	Cover and Header	New SPFA Logo

TECHNICAL OVERSIGHT COMMITTEE

Mission Statement

The mission of the Technical Committee is to provide a wide range of technical service to the SPF (spray polyurethane foam) industry such as, but not limited to:

(1) Review existing documents and serve as a clearing house to ensure the "Continuity of Value" of technical information published by SPFA and others concerning the products and services to the SPF industry;

(2) Review, research, develop, and issue documents concerning new products, systems and services; and

(3) To identify, explore, develop, and communicate an understanding of technical issues facing to the SPF industry.

Participating Members	
Roger Morrison, Chairman North Carolina Foam Industries	Bruce Schenke BASF
Mary Bogdan Honeywell	Irene Schwechler Gaco Western Inc.
Bob Braun Dow Chemical	Chuck Skalski Gaco Western Inc,
John Courier Equipment and Coatings Technology	Larry Smiley Poly-Tek
John Hatfield Penta Engineering Group, Inc.	Robert Smith Invita
Dan Hensley Hensley Coating Inc.	John Stahl Preferred Soulutions Inc.
Tim Leonard ERSystems	Jay Zhang Convenience Products
David Lewis Coastal Coatings Inc.	**AD HOC MEMBERS:**
Roger Lock MacTec Engineering and Consulting	Laverne Dalgleish CUFCA
Jack Moore West Roofing Systems, Inc.	Scott Brown BaySystems North America LLC

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DESIGN CONSIDERATIONS

GENERAL CONSIDERATIONS

The performance of a spray-applied polyurethane foam (SPF) insulation system can be affected by all the component parts of a vessel, as well as the conditions inside and outside the vessel.

Proper structural design, specification review, and contractor and material selection, coupled with the compatibility and positioning of the various components of the insulation system, are a necessity to produce a successful insulation system.

Consult with the respective material suppliers and the successful contractor to receive written confirmation of their agreement to all the facets of the insulation system, including, but not limited to, material selection, surface preparation, metal primer, coating, design details, etc.

SURFACE PREPARATION, PROCEDURES AND CONSIDERATIONS

The following general practices must be observed on all metal surfaces that are to receive SPF:

(1) **General Surface Preparation Procedures**
   a. Prior to the application of primer or polyurethane foam, the substrate shall be dry and free of any contaminants that may interfere with proper adhesion of any of the respective components.
   b. Surface contaminants, depending on their severity and quantity, may be removed by the use of air pressure, vacuum equipment, hand power broom, chemical solvents, gritblasting, manual scraping, etc.
   c. Rough welds and other sharp projections shall be ground smooth. All flux, slag, or other lamination left from welding must be chipped or ground off and spot-stripped or primed.
   d. Name plates, valve stems, rotating equipment, etc., shall be protected from gritblasting and overspray by suitable masking materials.
   e. Gritblasted surfaces shall be coated before visible rusting occurs. In all cases the metal shall be primed or coated on the same day it is gritblasted.

(2) **Painted Iron and Steel Surfaces**
   a. If a significant amount of the existing coating, paint, or primer has failed, can be easily scraped off, or exhibits extreme chalking, the entire coating, paint, or Primer shall be completely removed. Gritblasting is recommended. All the items listed under “Recommended Gritblasting Procedures” should be followed.
   b. Gritblasting is not required on surfaces where the existing coating, paint, or primer, exhibits sound physical properties and good adhesion, and is compatible with the proposed polyurethane foam insulation system. Follow the manufacturer’s recommendations.

(3) **Ferrous Metal Surfaces**
   a. All surfaces shall be gritblasted in accordance with SSPC SP-6, Commercial Blast Cleaning (Surface Preparation Specifications Steel Structures Painting Council

SSPC Publication No. 91-08).

b. Prime and/or coat gritblasted surfaces in accordance with the polyurethane foam and/or primer/coating manufacturers' instructions and recommendations.

(4) **Other Metal Surfaces**

a. Clean galvanized metal, aluminum, copper, and stainless steel surfaces as recommended by the polyurethane foam and/or primer/coating manufacturer. Abrasive blasting may be necessary to achieve adequate primer/coating adhesion.

b. Prime galvanized metal, aluminum, copper and stainless steel surfaces as recommended by the polyurethane foam and/or primer/coating manufacturer.

c. Contact the polyurethane foam and/or primer/coating manufacturer for recommendations to prepare other metal surfaces.

SELECTION OF METAL PRIMER AND/OR COATING SYSTEM

The following items should be considered when choosing a metal primer and/or coating system:

(1) Surface preparation required
(2) Adhesion to the substrate
(3) Adhesion to the polyurethane foam
(4) Maximum and minimum vessel temperatures
(5) Corrosion resistance to the vessel contents or vapors
(6) Polyurethane foam and/or primer/coating manufacturer's recommendation

SELECTION OF THE POLYURETHANE FOAM SYSTEM

The contractor, in the case of SPF applications, is fabricating the product on-site in accordance with the manufacturers' instructions.

A wide range of polyurethane foam systems are available in various performance properties, each exhibiting different temperature limitations, combustibility characteristics, etc. The use of these systems in combination with each other or with other conventional insulation products offers a wide range of economical installations.

Most published data is run on laboratory produced samples. The thickness of polyurethane foam sprayed, number of passes, temperatures of substrate, ambient temperatures, etc., have a pronounced effect on all properties.

From a fire safety standpoint, polyurethane foams can be used safely. It is important, however, that all persons associated with the design, fabrication, storage, and installation understand the material and environments involved.

Polyurethane foam insulation is combustible and should be treated as such. Flame spread ratings provided for polyurethane products using small scale tests are not intended to reflect the hazards presented by this or any other materials under actual fire conditions.

This specification is not applicable where severe thermal shock is possible. Discuss with your contractor and systems manufacturer the heat-up and/or cool-down procedures, including expansion or contraction details, to be used on each vessel.

SELECTION OF A PROTECTIVE COATING

A protective coating system must be applied to the polyurethane foam as an integral part of the vessel insulation system.

The protective coating shall be a system that will cure to form a water-resistant protective membrane. The dry-film thickness (DFT) of the protective coating shall be in compliance with the coating manufacturer's specification.

On many vessels, or portions thereof, fireproofing over the insulation system may be required. If fireproofing is required, consult your selected contractor for the recommended procedure to accomplish the same.

Consider the following items in the selection of the coating materials:

(1) **Physical Characteristics**
   a. Chemical resistance
   b. Water vapor permeance
   c. Tensile and elongation properties
   d. Retention of physical properties upon aging
   e. UV resistance

(2) **Performance Characteristics**
   a. Environment in which to be used (abrasion and impact)
   b. Life expectancy
   c. Ease of maintenance
   d. History of similar applications or laboratory data relating to the application in question
   e. Adhesion to the polyurethane foam
   f. Combustibility characteristics, individually and in combination with the selected polyurethane foam systems
   g. Aesthetic qualities

ADDITIONAL DESIGN CONSIDERATIONS

(1) Before applying polyurethane foam and protective coatings, protect individuals and areas from the application of the material by masking and sealing air intakes into buildings that may be affected. Take precautions to avoid the concentration of fumes in occupied areas.
(2) Best results will be obtained when polyurethane foam is applied to a warm substrate between 40–60oC (100–140oF). Consult your manufacturer for specific recommendations.
(3) Temperature-sensing indicators can be installed to help monitor maximum tank temperature.
(4) Use the following pull down schedule for insulated vessels operating at temperatures under 0oC (32oF).

COLD VESSEL PULL DOWN SCHEDULE

Materials used to construct and insulate cold storage vessels are affected by temperature changes. Gradual lowering of the temperature is designed to eliminate problems stemming from these temperature changes.

Reduce the temperature by 6oC (10oF) every 24 hours until the operating temperature is reached.

MAINTENANCE PROCEDURES

It is strongly recommended that maintenance procedures, including annual inspections, be established with your selected contractor for any insulation system to yield its full value.

CONTACT THE RESPECTIVE MANUFACTURERS, SUPPLIERS, AND CONTRACTORS FOR THEIR RECOMMENDED MAINTENANCE PROCEDURES.

NOTE: This guide is designed to help the specifier achieve a successful polyurethane foam insulation system. The specifier is responsible for consulting with the manufacturer of the material specified about the manufacturer's specific recommendations.

PART I – GENERAL

This guide discusses the application of seamless SPF with a protective coating for use as an insulation system for metal service vessels. Your contractor, the selected system's manufacturer, and regulatory agencies can assist you, as each project must be assessed individually.

1.01 SCOPE OF WORK

Furnish all labor, material, tools, and equipment necessary for the application of a polyurethane foam insulation system, including accessory items, subject to the general provisions of the contract.

1.02 RELATED WORK SPECIFIED ELSEWHERE

(1) Metals – Metal Fabrications	Section 05500
(2) Vapor and Air Retarders	Section 07190
(3) Insulation	Section 07200
(4) Fireproofing	Section 07250
(5) Special Coatings	Section 09800
(6) Special Construction – Liquid and Gas Storage Tanks	Section 13200

1.03 QUALITY ASSURANCE

(1) Contractor Qualifications: The contractor should provide information concerning projects that are similar in nature to the one proposed, including the location and the person to be contacted. SPFA-accredited companies are recommended. Some manufacturers of SPF systems and/or protective coatings have approval programs.
(2) Manufacturer Qualifications: Manufacturers of polyurethane foam and protective coatings shall show evidence of sufficient financial resources and manufacturing facilities to furnish materials for the project. References shall be required, and sufficient project lists and warranties shall be submitted for verification.
(3) Inspections: An inspection of the finished insulation system by the polyurethane foam and/or protective coating manufacturer or a third-party inspector is recommended.

1.04 SUBMITTALS

(1) The manufacturer's published data sheets or letter of certification that its products comply with the materials specified. This is to include primers, metal coating systems, polyurethane foam, thermal barriers, and protective coatings.
(2) Shop drawings on accessories, design details, and fabricated items.
(3) The manufacturer's application or installation instructions.
(4) Evidence of the contractor's or the applicator's qualifications and experience.
(5) A specimen copy of the applicable warranty for the project.
(6) Safety and handling instructions for storage, handling, and use of the materials, including any appropriate Materials Safety Data Sheets (MSDS).

1.05 MATERIALS, DELIVERY, AND STORAGE

(1) Material shall be delivered in the manufacturer's original, tightly sealed containers, or unopened packages, all clearly labeled with the manufacturer's name, product identification, safety information, and batch or lot numbers, where appropriate.
(2) Containers shall be stored out of the weather and direct sun where the temperatures are within the limits specified by the manufacturer.
(3) All materials shall be stored in compliance with local fire and safety requirements.

1.06 ENVIRONMENTAL CONDITIONS

(1) The polyurethane foam applications shall not proceed during periods of inclement weather. Do not apply the polyurethane foam below the temperature and/or above the humidity specified for ambient air and substrate by the manufacturer.
(2) Do not apply protective coatings when there is ice, frost, surface moisture, or other visible dampness present on the surface to be coated. Prior to applying the coatings, check the polyurethane foam to ensure that the surface is dry. Apply protective coatings in accordance with the coating manufacturer's application instructions.
(3) Wind barriers may be used if wind conditions could affect the quality of the polyurethane foam or protective coating installation.

1.07 SEQUENCING AND SCHEDULING

In vessel insulation projects, the SPF is installed when all welding is complete, and the metal surface is prepared according to specification. There should not be any other tradespeople working on the vessel when the SPF and coating are being installed.

1.08 WARRANTY

Warranty agreements vary in duration and content. If a warranty is desired, established parameters as a prerequisite to the execution of a contract.

1.09 SAFETY REQUIREMENTS

(1) See API Bulletin AX-119, "MDI-Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal."
(2) Refer to the appropriate Materials Safety Data Sheets (MSDS).
(3) Take precautions to avoid the concentration of fumes in occupied areas.

PART 2 – PRODUCTS

2.01 POLYURETHANE FOAM

(1) The polyurethane foam shall be a two-component system made by combining an isocyanate (A–component) with a polyol (B–component) and shall possess the following physical characteristics:

PROPERTIES (Sprayed-in-Place)	ASTM TEST	METRIC (SI)		(TRADITIONAL U.S.)	
		VALUE	UNITS	VALUE	UNITS
Density	D-1622	40-55	kg/m^3	2.5-3.5	lb/ft^3
Compressive Strength	D-1621	240 min	kPa	35 min	lb/in^2
Closed-Cell Content	D-2856	90% min	% value	90% min	% value
R-Value*	C-177 or C-518	1.1	$m^2•K/W$	6.0 aged	$(ft^2•hr•°F)/Btu$
Flammability**	E-84	75 max		75 max	

*Refer to API Bulletin AX-113, “An Assessment of the Thermal Performance of Rigid Polyurethane and Polyisocyanurate Foam Insulation for Use in Building Construction.”

**This standard is used solely to measure and describe the properties of products in response to heat and flame under controlled laboratory conditions. This numerical flame spread rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.

(2) Fire Safety Requirements: See CPI Bulletin AX-119, “MDI-Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal.”

2.02 PROTECTIVE COATING

(1) The elastomeric coating system may be one or more of the following types:
   a. Acrylic
   b. Butyl rubber
   c. Hypalon
   d. Neoprene
   e. Silicone
   f. Polyurethane elastomer
   g. Modified asphalt

(2) Physical properties: The elastomeric coating system shall possess the following physical characteristics:

PROPERTIES	ASTM TEST	VALUE (See Note)
Tensile Strength	D-412	
Elongation	D-412	
Hardness Shore A	D-2240	
Tear Resistance	D-624	
UltraViolet Exposure	G-53	
Moisture Vapor Transmission	E-96 Procedure E	
Chemical Resistance	D-1308	

(NOTE: The specifier shall list the physical properties of the chosen elastomeric coating system.)

(3) General: It is recommended that the coating systems be elastomeric in nature (at least 100% elongation). Elastomeric coating systems include both vapor retarder and non-vapor retarder systems.

Cold tanks require a vapor retarder coating. For further information about perm ratings and coating selection, see "SPFA-118 Moisture Vapor Transmission."

For further information about protective coatings, see SPFA-102, "A Guide for Selection of Protective Coatings Over Sprayed Polyurethane Foam Roofing Systems."

2.03 RELATED PRODUCTS

(1) Flashings and waterproof coverings for flexible joints shall be compatible with the specified polyurethane foam and elastomeric coating system and shall be as recommended by the manufacturers of the systems used.
(2) Miscellaneous materials, such as adhesives, elastomeric caulking compounds, metal, insulation blankets, etc., shall be a composite part of the insulation system and shall be those recommended by the system's manufacturer.
(3) Primers, metal coatings, and thermal barriers shall be as recommended by the respective manufacturers.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION, METAL PRIMING, AND COATING

(1) Ferrous Metal:
   a. Gritblast iron and steel surfaces that are not primed, painted, or otherwise protected in accordance with SSPC SP-6, Commercial Blast Cleaning. This includes stairs, tank connecting nozzles, and other items that are a part of the vessel and will have the polyurethane foam insulation system applied to portions of them.
   b. Remove contaminants from metal surfaces.
   c. Apply primer before the surface rust develops. If surface rust develops, gritblast the surface again.
   d. All bolts, welds, sharp edges, and difficult access areas shall receive a primer spot-coat prior to application of the metal primer/coating system.
   e. Apply the metal primer/coating system according to manufacturer's instructions.

(2) Aluminum, Stainless Steel, and Galvanized Metal:
   a. Clean the surface in accordance with SSPC-1, "Solvent Cleaning or Steam Cleaning." If the polyurethane foam and/or metal primer/coating manufacturer recommends gritblasting, clean the surface in accordance with SSPC-7, "Brush-Off Blast Cleaning."

3.02 PRIMER AND METAL COATING APPLICATION

(1) Inspection
   a. Prior to the application of the metal primer/coating system, the surface shall be inspected to ensure that the conditions required by Section 3.01 have been met.
   b. The metal primer/coating system application shall not proceed during periods of inclement weather. The applicator shall not apply the coatings below the temperature and/or humidity specified by the manufacturer for ambient air and substrate.

(2) Application
   a. The metal primer/coating system shall be applied in accordance with the manufacturer's specification and instructions.
   b. The metal primer/coating shall be allowed to cure sufficiently before subsequent coats or polyurethane foam are applied and will be within the recoat schedule recommended by the respective manufacturers.
   c. Inspect the metal primer/coating system for holidays and adequate dry-film thickness before subsequent coats are applied. Any damage or defects to the metal primer/coating system shall be repaired before the polyurethane foam application.
   d. The metal primer/coating system shall be free of contaminants and holidays before the application of polyurethane foam.

3.03 POLYURETHANE FOAM APPLICATION

(1) Inspection

a. Prior to the application of the polyurethane foam, the surface shall be inspected to ensure that conditions required by Section 3.02 have been met.

b. The polyurethane foam application shall not proceed during periods of inclement weather. The applicator shall apply the polyurethane foam within the temperature and/or humidity limits specified by the manufacturer for ambient air and substrate. Wind barriers should be used if wind conditions could affect the quality of the installation.

(2) Application

a. Prior to spray application, all surfaces not being insulated should be protected from overspray.

b. The SPF shall be applied in accordance with the manufacturer's specification and instructions.

c. The SPF shall be applied with minimal pass thicknesses of 13mm (1/2 inch).

d. SPF thickness shall be a minimum of 25mm (1 inch) or more if specified. The polyurethane foam shall be applied uniformly over the entire surface with a tolerance of plus 6mm per 25mm (1/4 inch per inch) of thickness minus 0mm (0 inches), except where variations are required to ensure proper drainage or to complete a feathered edge.

e. The polyurethane foam shall be uniformly terminated 100mm (4 inches) beyond all projections, nozzles, pipes, flanges, etc.

f. The polyurethane foam shall be applied over vessel roofs in a manner that provides drainage and prevents standing water.

g. When equipment is supported by structural members, the polyurethane foam shall extend at least four times the specified insulation thickness in each direction, measured from the junction of the equipment with insulated support lug. The thickness of the polyurethane foam on steel supports shall be one-half of that specified for the body of the equipment. The thickness of the polyurethane foam over the support lugs will be the same as specified for the body of the equipment. (See Detail 4 and Detail 6, below.)

h. Skirts supporting vertical equipment shall be insulated inside and outside as part of the equipment area. Polyurethane foam is to extend from the junction at the inside of the skirt downward at least one foot. (See Detail 7, below.)

i. Heads, manholes, blind flanges, etc., that must be removed occasionally should be insulated so that they can be removed without damage to the insulation. (See Detail 8, below.)

j. Where temperatures exceed 93°C (200°F), a high-temperature insulation blanket shall be installed prior to the polyurethane foam application.

k. The full thickness of the polyurethane foam in any area shall be completed prior to the end of each day. If more than 24 hours elapse between the polyurethane foam lifts, the polyurethane foam shall be examined for UV degradation, oxidation, or contamination. The surface shall be prepared according to the manufacturer's recommendations.

(3) Surface Finish

a. The final SPF surface shall be “smooth, orange peel, coarse orange peel, or verge of popcorn” in texture. Polyurethane foam surfaces termed “popcorn” or “treebark” are not acceptable and should be corrected. (See Surface Texture Photos.)
b. Any damage or defects to the polyurethane foam shall be repaired prior to the protective coating application.
c. The polyurethane foam surface shall be free of contaminants that would impair adhesion of the protective coating.

3.04 PROTECTIVE COATING APPLICATION

(1) Inspection

Prior to the application of the protective coatings, the polyurethane foam shall be inspected to ensure that the conditions required by Section 3.03 have been met.

(2) Application

a. Base Coat
    i. The base coat shall be applied the same day as the polyurethane foam when possible. If more than 24 hours elapse prior to the application of the base coat, the polyurethane foam shall be inspected for UV degradation, oxidation, and contaminants. The manufacturer’s recommendations shall be followed to prepare the foam surface before coating applications.
    ii. The base coat shall be applied at a uniform thickness with the rate of application governed by the polyurethane surface texture. Coatings shall be applied at a rate to achieve the minimum dry-film thickness specified by the protective coating manufacturer.
    iii. The coating shall be allowed to cure and be inspected for pinholes, thinly coated areas, uncured areas, or other defects. Defects shall be repaired prior to subsequent applications.
    iv. The coating will be reinforced in accordance with the manufacturer’s instructions around protrusions, stairs, etc.
    v. The coating application shall not proceed during periods of inclement weather. The applicator shall apply the protective coating within the temperatures and the humidity specified by the manufacturer for ambient air and substrate. Wind barriers should be used if wind conditions could affect the quality of the installation.
b. Topcoat and/or Subsequent Coat
    i. Inspect the base coating for defects and thin coating. Make any repairs before applying subsequent coats.
    ii. Subsequent coating should be applied in a timely manner to ensure proper adhesion between coats.
    iii. The final coat shall be inspected for defects and thin coating. Make any repairs in accordance with the manufacturer’s instructions.

3.05 SAFETY REQUIREMENTS

(1) See CPI Bulletin AX-119, "MDI-Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal."
(2) Refer to the appropriate Materials Safety Data Sheets (MSDS) for additional safety information.
(3) Before applying polyurethane foam and protective coatings, protect adjacent areas and personnel from overspray. Take precautions to avoid the concentration of fumes in occupied areas.

APPENDIX 1

1.0 SCOPE OF WORK

This guide specification covers the repair of spray polyurethane foam insulation applied to metal vessels.

2.0 SURFACE PREPARATION

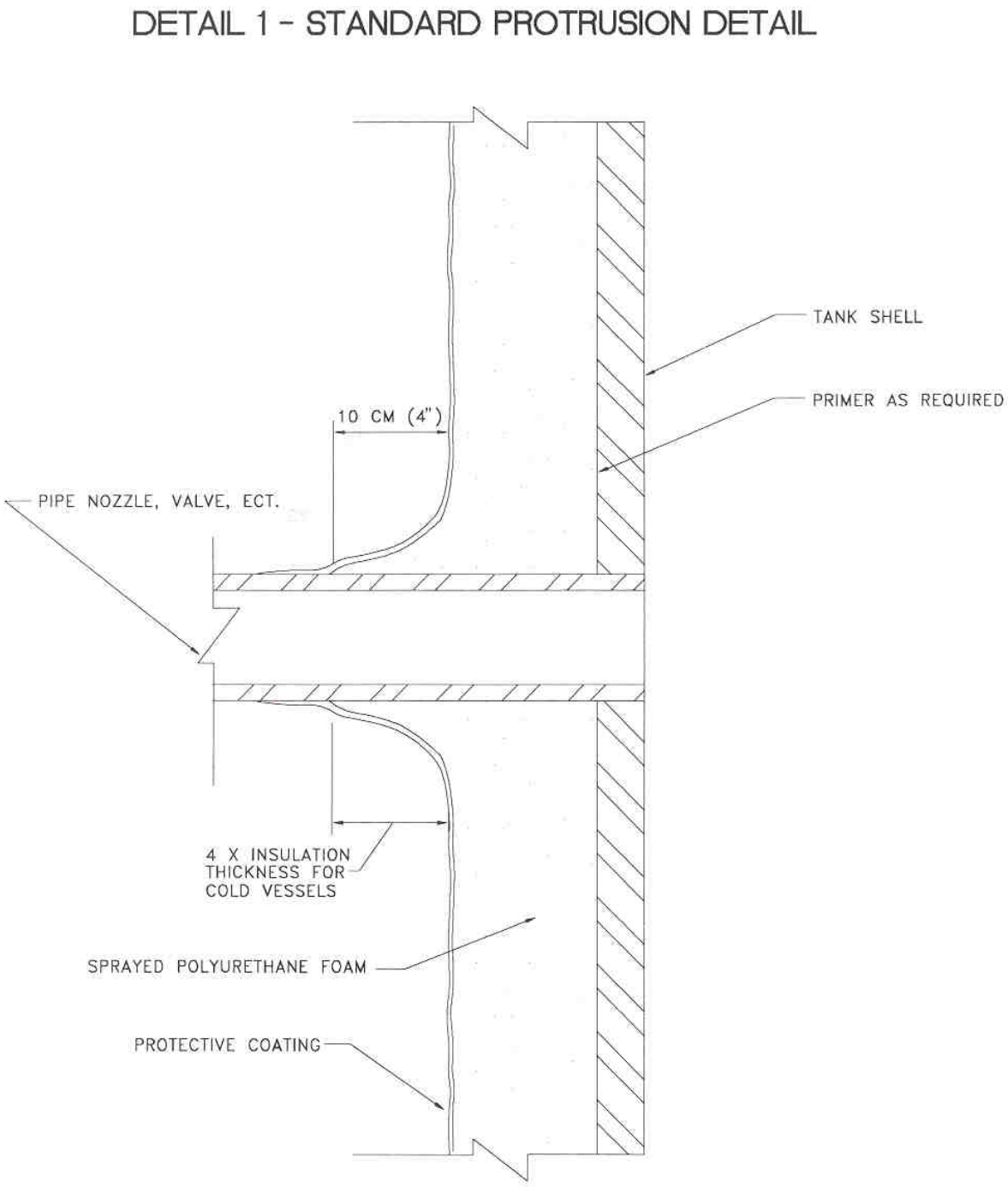
(1) Defective polyurethane foam shall be removed at a 45-degree angle to dry, solidly adhered polyurethane foam in all directions.
(2) If the existing metal primer/coating is damaged, it shall be wire-brushed and recoated according to the manufacturer's instructions.
(3) Protect the surrounding area from overspray.
(4) Vessels in operation may have condensation or ice on the metal substrate. Contact the polyurethane foam manufacturer for instructions if the unit cannot be shut down.

3.0 REPAIR PROCEDURE

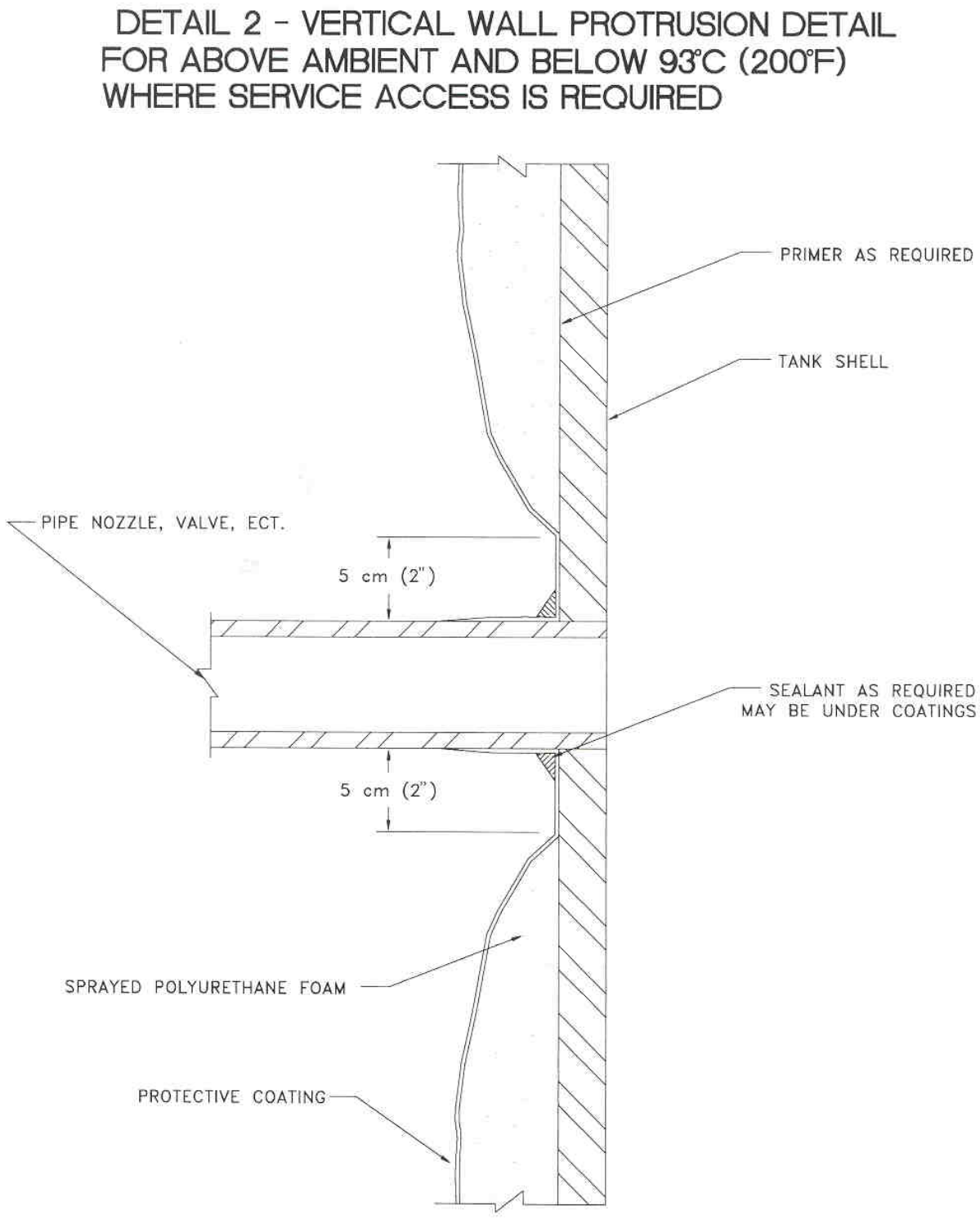
(1) Apply polyurethane foam in the prepared area according to procedure outlined in Section 3.03 so that it conforms to the existing configuration of the vessel.
(2) Apply the subsequent coating according to procedures outlined in Section 3.04. A reinforcing fabric may be installed with the base coat, if desired.
(3) All areas shall be repaired in a manner that prevents standing water and promotes drainage.
(4) All prepared areas shall be repaired the same day or adequately protected against moisture or other contaminants.

DETAIL ILLUSTRATIONS

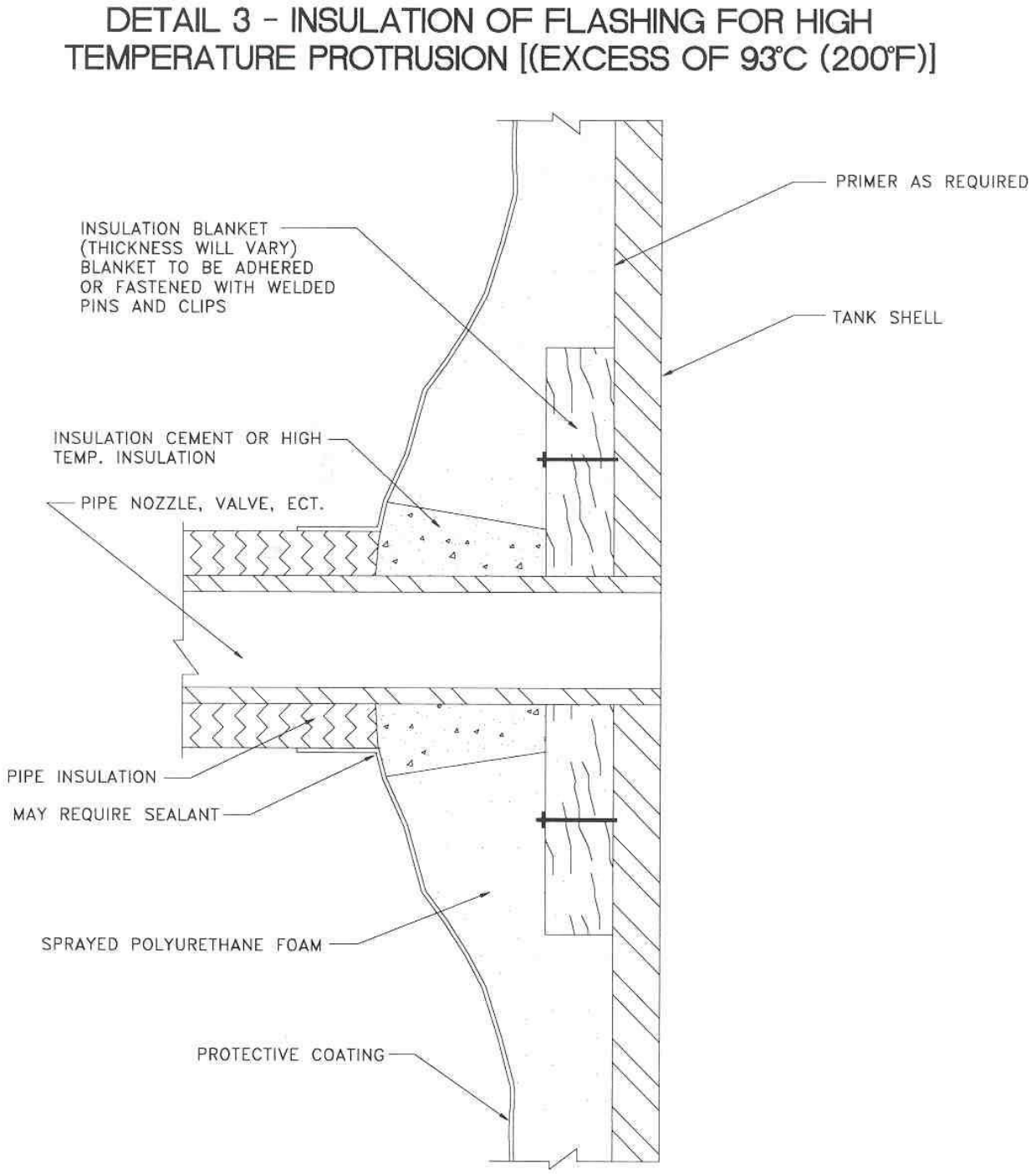
DETAIL DRAWING 1: STANDARD PROTRUSION DETAIL



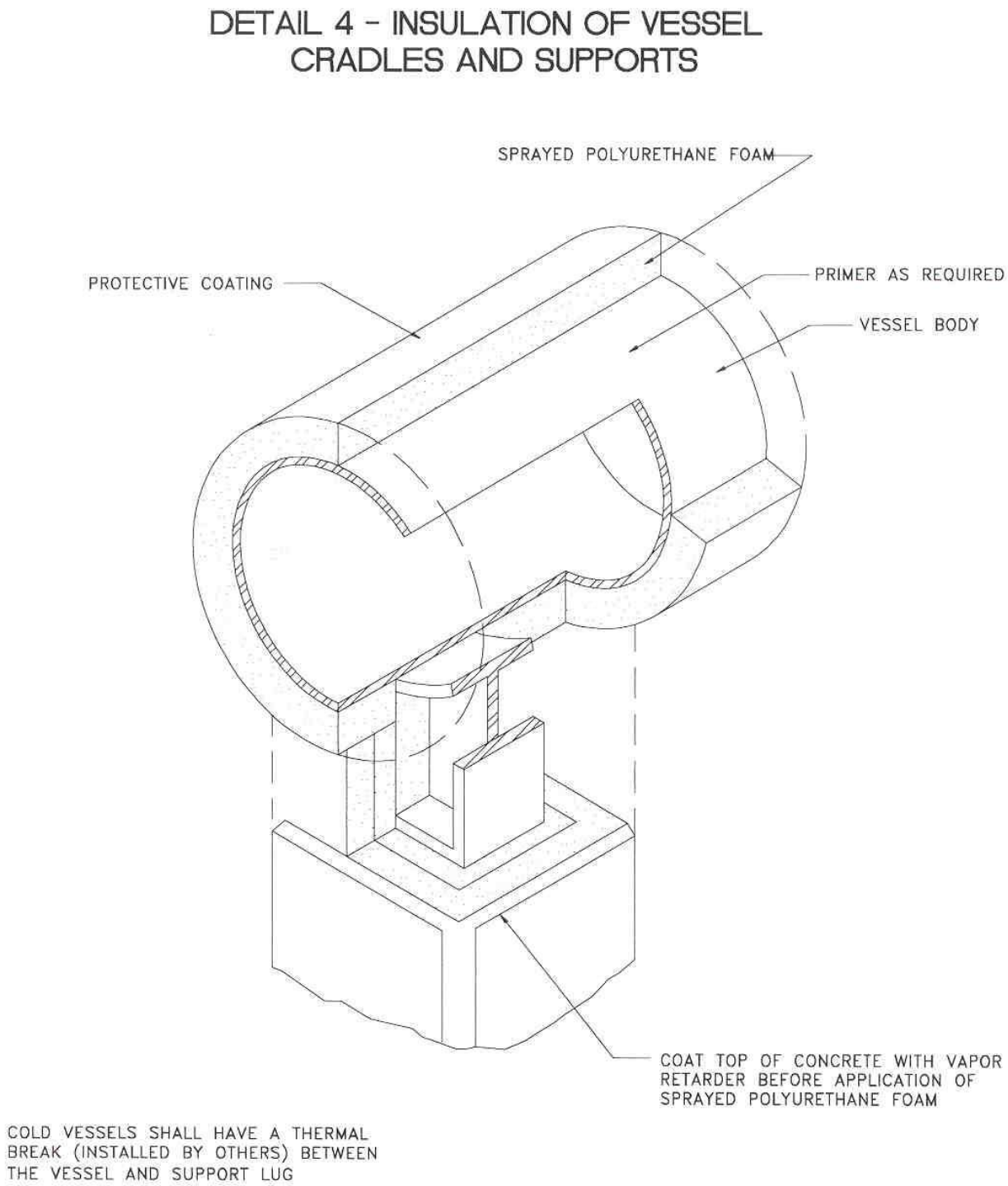
DETAIL DRAWING 2: VERTICAL WALL PROTRUSION DETAIL FOR ABOVE AMBIENT AND BELOW 93°C (200°F) WHERE SERVICE ACCESS IS REQUIRED



DETAIL DRAWING 3: INSULATION OF FLASHING FOR HIGH TEMPERATURE PROTRUSION [(EXCESS OF 93°C (200°F)]

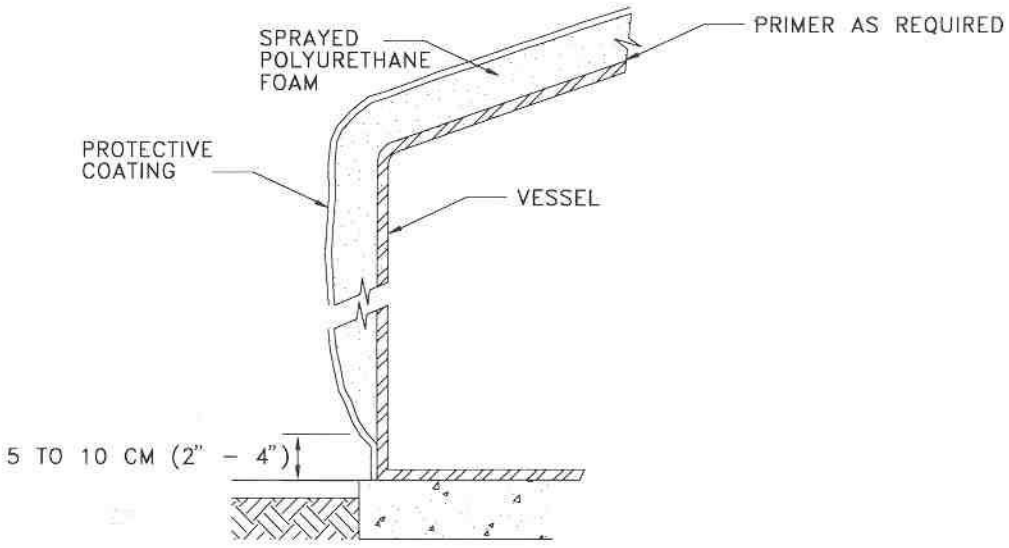


DETAIL DRAWING 4: INSULATION OF VESSEL CRADLES AND SUPPORTS

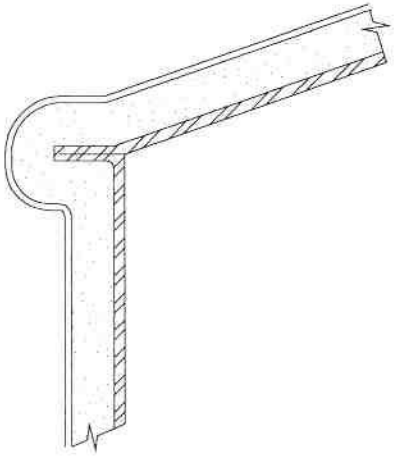


DETAIL DRAWING 5: TYPICAL INSTALLATIONS – SHELL, ROOF JUNCTION AND BASE

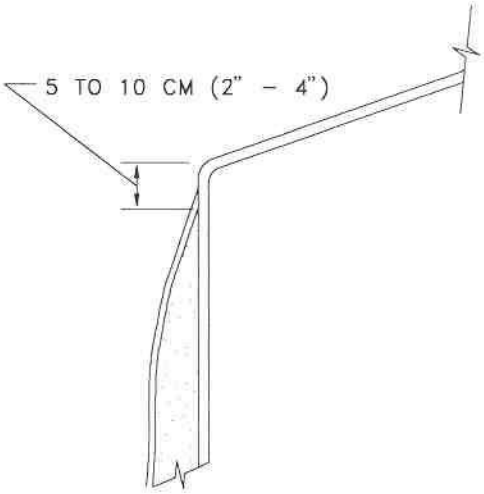
DETAIL 5 - TYPICAL INSTALLATIONS - SHELL, ROOF JUNCTION AND BASE



ROOF AND WALL INSULATED

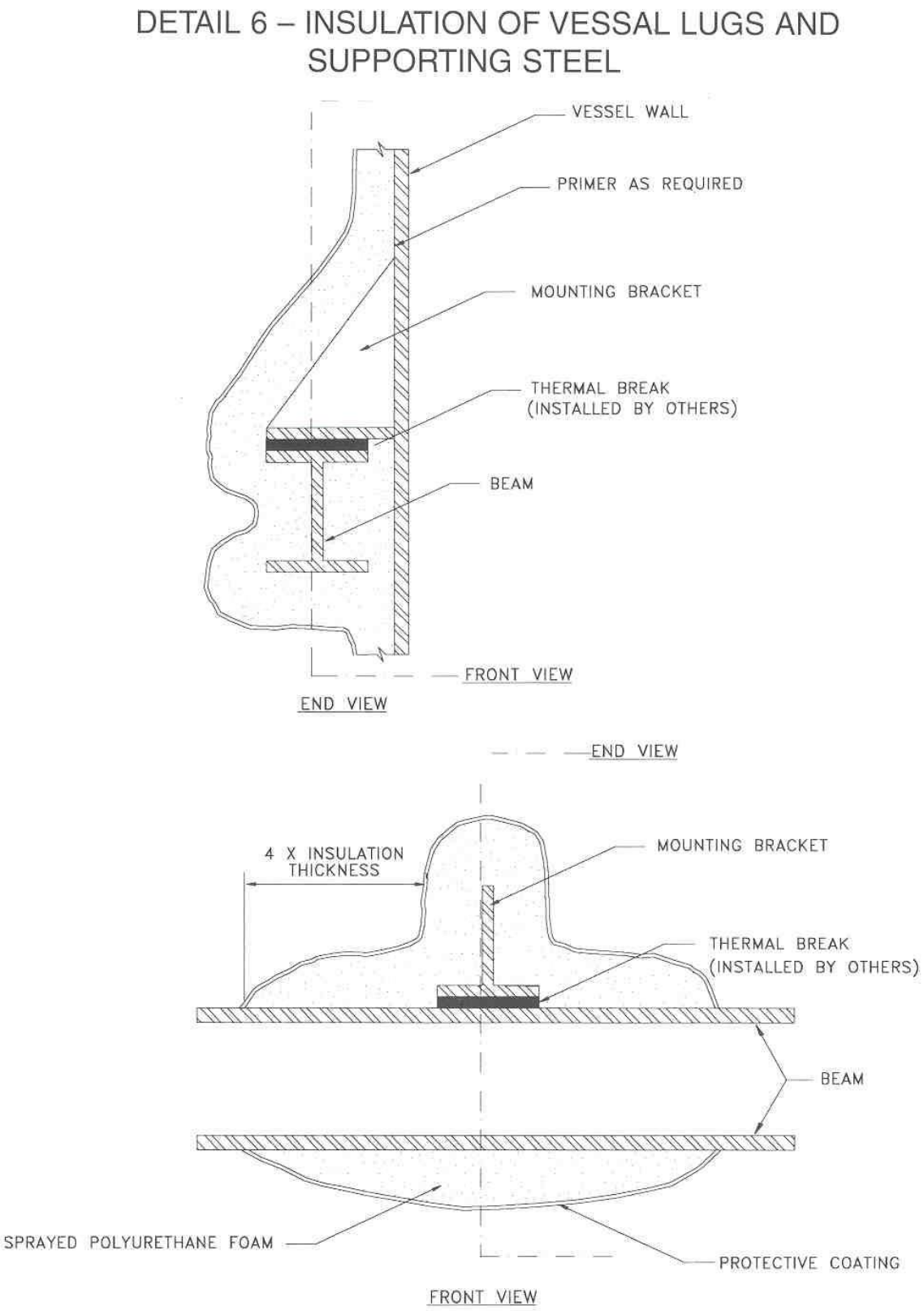


TANK WITH FLANGE AT ROOF AND WALL JUNCTURE

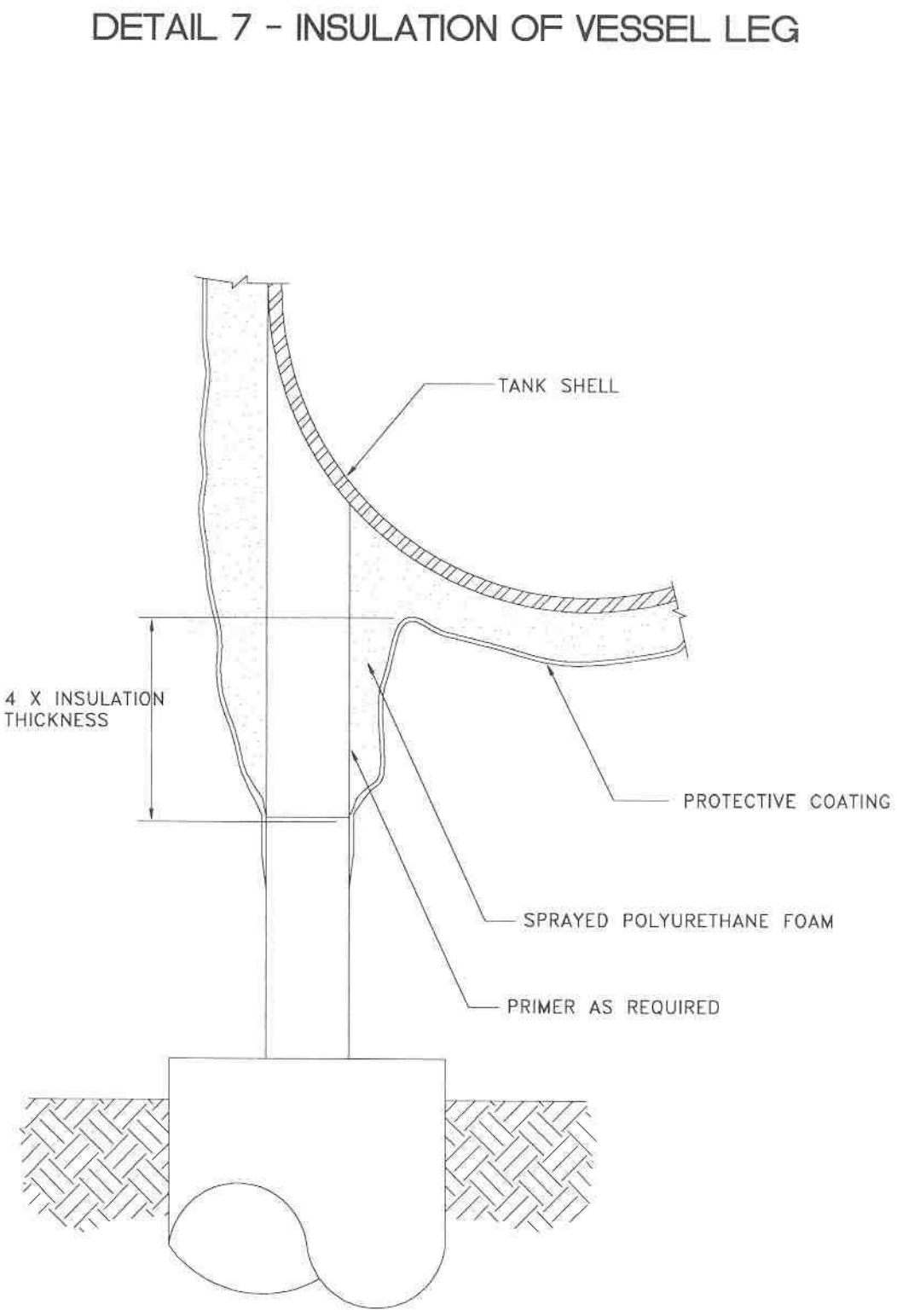


ROOF NOT INSULATED

DETAIL DRAWING 6: INSULATION OF VESSEL LUGS AND SUPPORTING STEEL

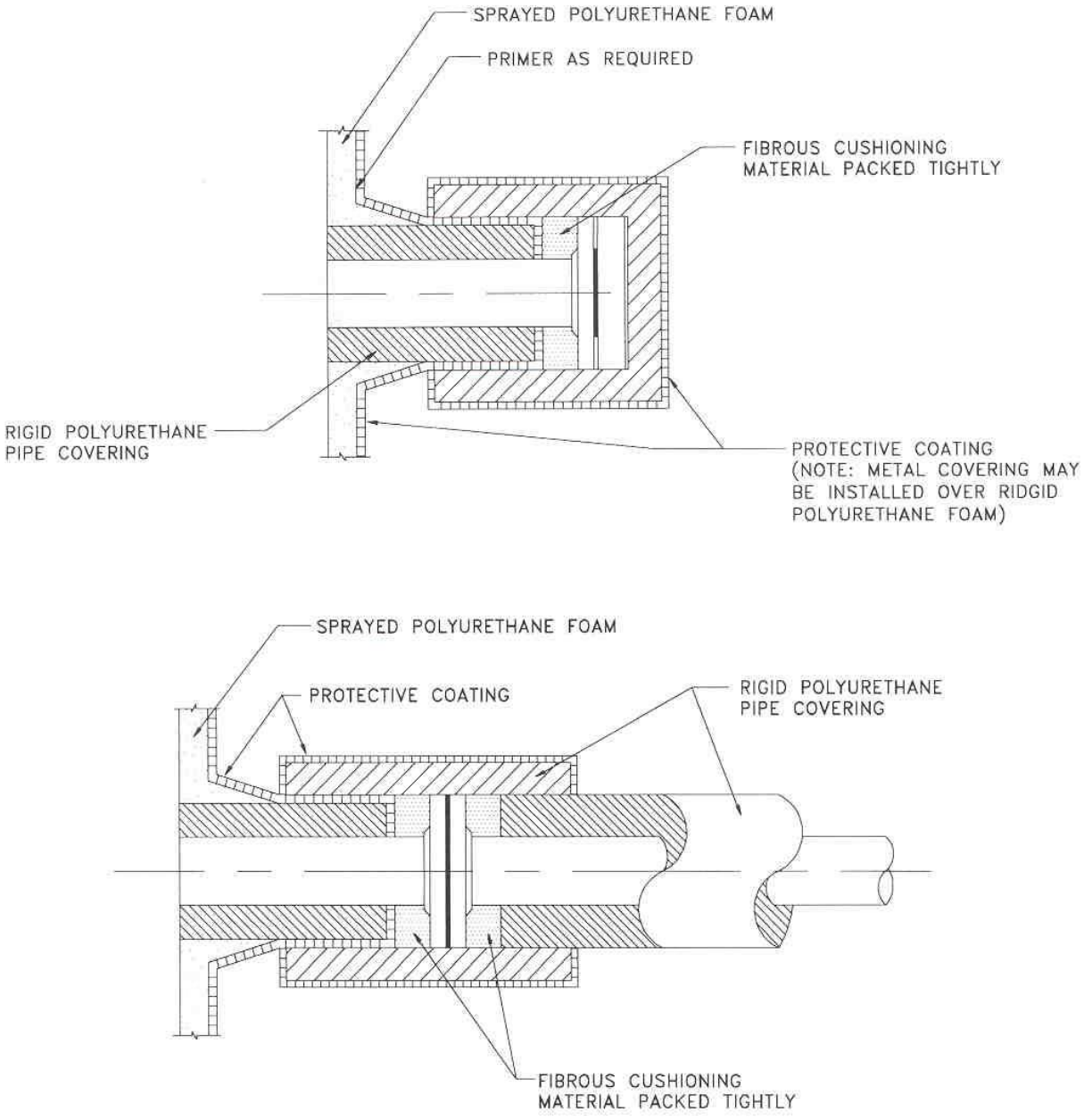


DETAIL DRAWING 7: INSULATION OF VESSEL LEG

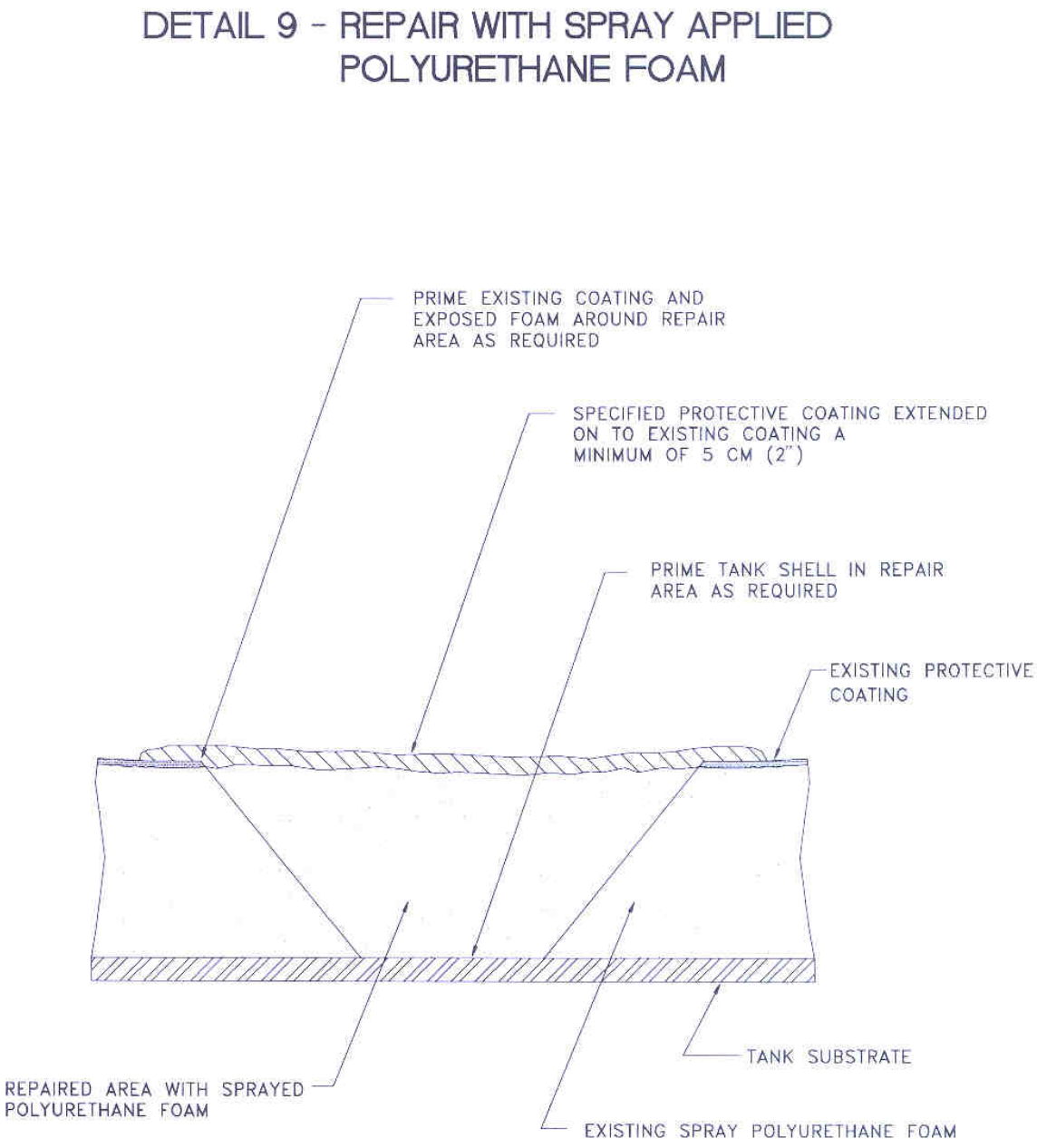


DETAIL DRAWING 8: INSULATION OF VESSEL NOZZLES

DETAIL 8 - INSULATION OF VESSEL NOZZLES



DETAIL DRAWING 9: REPAIR WITH SPRAY APPLIED POLYURETHANE FOAM



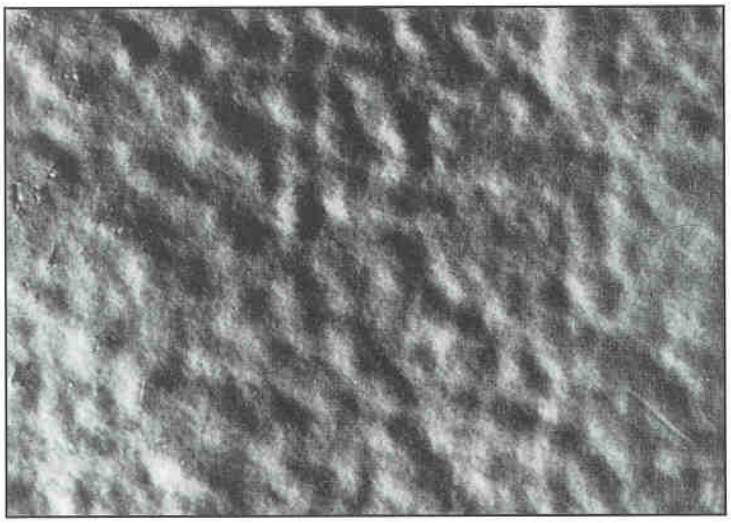


Photo 1
Polyurethane
Foam Texture
Smooth

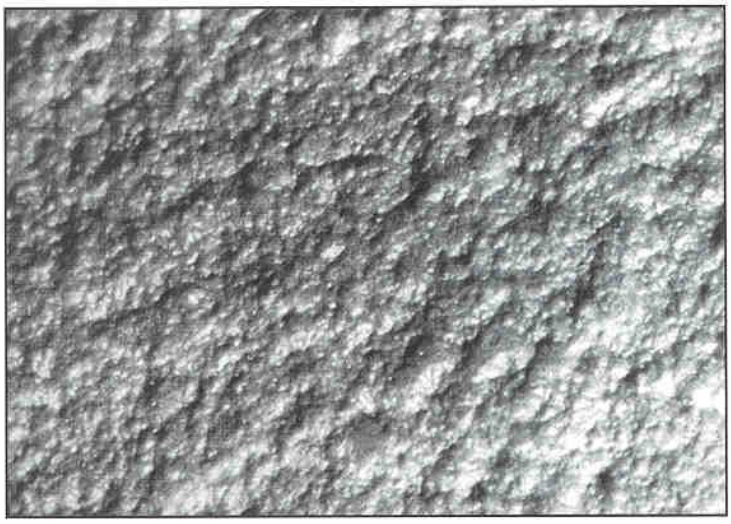


Photo 2
Polyurethane
Foam Texture
Orange Peel

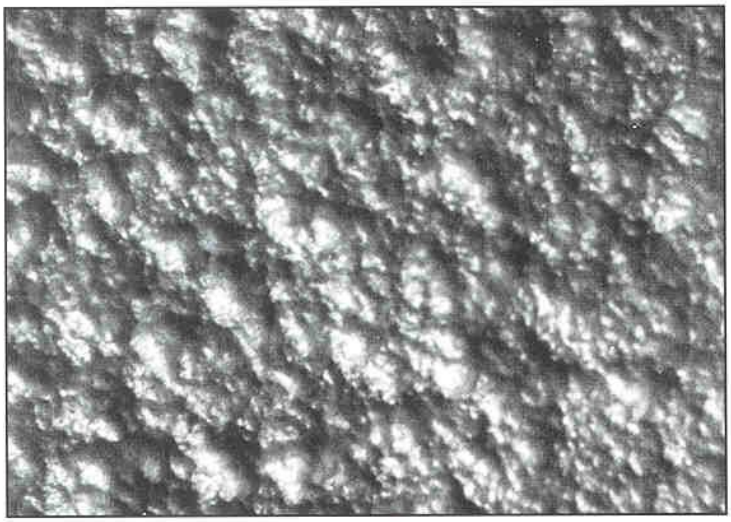
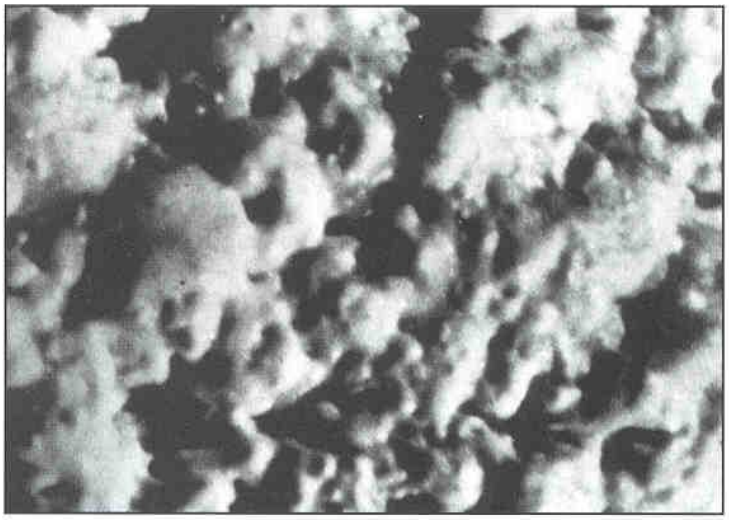


Photo 3
Polyurethane
Foam Texture
Coarse Orange Peel

Photo 4
Polyurethane
Foam Texture
Rippling – Verge
of Popcorn

Photo 5
Polyurethane
Foam Texture
Popcorn



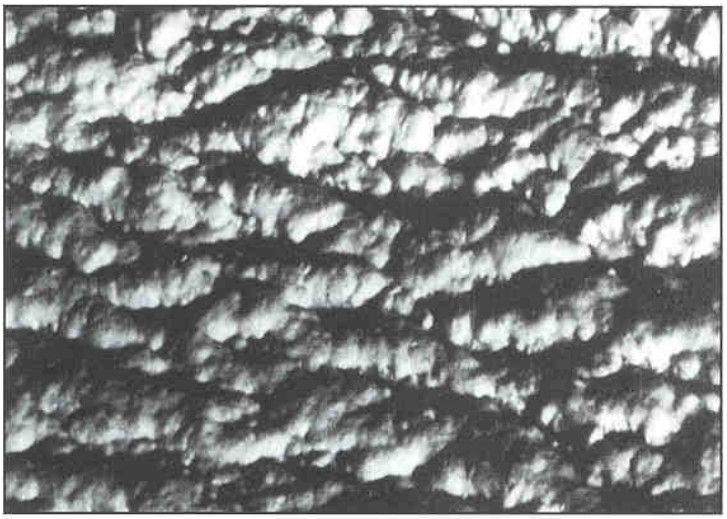


Photo 6
Polyurethane
Foam Texture
Treebark