



SURFACE PREPARATION AND APPLICATION GUIDE

SERIES 431
PERMA-SHIELD® PL

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1.0 INTRODUCTION

The procedures outlined in this guide are intended to aid in determining proper surface preparation, mixing, application, and inspection methods for Tnemec's Series 431 Perma-Shield PL epoxy lining for severe wastewater environments. Prior to starting work, please read this entire guide carefully. Please contact your Tnemec representative or call Tnemec Technical Service at +1 816-483-3400 for specific recommendations.

2.0 PRODUCT AND PACKAGING

The following contains information on the core components of this product.

2.1 SERIES 431 PERMA-SHIELD PL

Series 431 Perma-Shield PL is a 100% solids, ceramic-modified, abrasion-resistant epoxy lining specifically designed for the interior or exterior corrosion protection of steel pipe and ductile iron pipe and fittings for severe wastewater environments or buried service. Series 431 provides low permeation to sewer gases, protects against microbiologically induced corrosion (MIC), and provides chemical resistance to severe wastewater environments.

2.1.1 SERIES 431 PACKAGING

KIT SIZE	PART A (PARTIALLY FILLED)	PART B (PARTIALLY FILLED)	YIELD (MIXED)
Drum Set†	55 gallon drum	55 gallon drum	100 gallons (378 L)
Large Kit†	5 gallon pail	5 gallon pail	8 gallons (30.28 L)
Small Kit	1 gallon can	1 gallon can	1 gallon (3.8 L)
Touch-Up Kits (per tube) ‡	4 ounces	4 ounces	8 ounces (236 mL)

† Plural-component application only.

‡ Touch-Up Kit consists of one (1) tube along with two (2) disposable static mixers.

2.1.2 SERIES 431 COVERAGE RATES

DRY MILS (MICRONS)	WET MILS (MICRONS)	SQ. FT/GAL (M ² /GAL)
30 (760)	30 (760)	53 (4.9)
40 (1015)	40 (1015)	40 (3.7)
50 (1270)	50 (1270)	32 (3.0)

Note: Recommended DFT will depend on substrate condition and system design. Allow for overspray and surface irregularities. Film thickness is rounded to the nearest 0.5 mil or 5 microns. Application of coating below minimum or above maximum recommended dry film thicknesses may adversely affect coating performance.

2.2 SERIES 431 STORAGE TEMPERATURE

The minimum storage temperature is 25°F (-4°C) and maximum is 110°F (43°C). For optimum handling and application characteristics, both material components should be stored or conditioned to a minimum of 80°F (27°C) or higher 48 hours prior to use.

2.3 SERIES 44-721 THIXOTROPIC ADDITIVE

Series 44-721 Thixotropic Additive increases the film thickness of Series 431 Perma-Shield PL. Refer to Section 4 for mixing instructions and recommended amounts.

3.0 SURFACE PREPARATION

Prior to abrasive blasting, all oil, grease, tar, and other residues or contaminants must be removed from the surface. Solvent cleaning (per SSPC-SP1 or NAPF 500-03-01) and high pressure water or steam cleaning are effective methods for removing hydrocarbon residues and other by-products. Fresh water rinse to ensure complete removal of soluble salts and cleaning chemicals. The surface should be clean, dry, and contaminant free, and be at least 5°F (3°C) above the dew point.

3.1 GRINDING

Grind the interior or exterior surface to remove sharp edges, rough welds, annealing burs, weld spatter, or other protrusions and to reduce roughness.



3.2 ABRASIVE CLEANING

All interior or exterior surfaces shall be uniformly abrasive blasted. Interior pipe surfaces shall be thoroughly blasted using internal pipe blasting equipment (e.g., rotary blaster). The abrasive used should be clean, dry, bagged material that has a hard, angular cutting surface, such as aluminum oxide or copper slag. Abrasive materials should be selected to produce the required minimum angular, anchor pattern. Avoid using abrasive that polishes or peens the surface, such as steel shot.



The compressed air used for blasting shall be free of water and oil. Adequate moisture traps and separators should be used to ensure elimination of all contaminants. Cleanliness of the air supply should be checked daily by operating the line without abrasive media through blotter paper for 30 seconds (reference ASTM D 4285). If oil or water appears on the cloth, the traps and separators should be cleaned until subsequent tests prove satisfactory.

Abrasive blasting should not be performed when the surface temperature is less than 5°F (3°C) above the dew point to prevent the formation of rust bloom. Dew point and surface temperature readings should be taken prior to abrasive blasting to ensure this condition. In addition, application should be scheduled so as to immediately follow blasting and cleaning operations. Painting over flash rust or other contaminants is not acceptable. Care should be exercised by all personnel to avoid bare-hand (i.e. oils) or clothing (i.e., lint) contamination of the freshly blasted surface.

Remove any dust and blasting debris by blowing off with dry, compressed air or vacuum cleaning.

3.3 STEEL PIPE

Uniformly abrasive blast interior or exterior surfaces to a SSPC-SP5/ NACE 1/ISO Sa 3 White Metal Blast Cleaning condition with a minimum angular anchor profile of 3.0 mils (76.2 microns).

3.4 DUCTILE IRON PIPE

All surfaces of ductile iron pipe and fittings shall be delivered to the application facility without asphalt or any other protective lining on the surface. All oils, small deposits of asphalt paint and grease shall be removed in accordance with NAPF 500-03-01 Solvent Cleaning prior to abrasive blasting.



Pipe Interior: Uniformly rotary-abrasive blast to a NAPF 500-03-04: Internal Pipe Surface Condition, full removal of annealing oxide layer. When viewed without magnification, the interior surfaces shall be free of all visible dirt, dust, annealing oxide, rust, mold release coating and other foreign matter. Random staining shall be limited to no more than 5% and may consist of light shadows, rust stains, oxide stains, or stains of previously applied coating. Any area where rust reappears before application shall be reblasted. The surface shall contain a minimum angular anchor profile of 3.0 mils (76.2 microns).

Pipe Exterior: Uniformly abrasive blast the entire surface using angular abrasive to an NAPF 500-03-04: “External Pipe Surface Condition”. When viewed without magnification, the exterior surfaces shall be free of all visible dirt, dust, loose annealing oxide, loose mold coating, rust, and other foreign matter. Tightly adherent annealing oxide, mold coating and rust staining may remain the surface provided they cannot be removed by lifting with a dull putty knife. Any area where rust reappears before application shall be re-blasted. The surface shall contain a minimum angular anchor profile of 3.0 mils (76.2 microns). The exterior surfaces shall be primed with Series N140 Pota-Pox Plus at 3-5 mils (76.2 to 127 microns) dry film thickness.

Fittings: Uniformly abrasive blast to a NAPF 500-03-05: Fitting Blast Clean #1 condition, no staining. When viewed without magnification,

the interior surfaces shall be free of all visible dirt, dust, annealing oxide, rust, mold coating, and other foreign matter. The surface shall contain a minimum angular anchor profile of 3.0 mils (76.2 microns).

3.5 COATING PREPARED SURFACES

All prepared surfaces shall be coated before onset of flash rusting, maximum of 8 hours, following abrasive blasting.

4.0 MIXING

4.1 PRE-CONDITIONING

For optimal handling and application characteristics, both material components should be conditioned at a minimum temperature of 80°F (27°C) for 48 hours prior to use.

4.2 MIXING

Series 431 is a two-component epoxy. The Part A contains the amine/ catalyst/activator component. The Part B contains the epoxy/resin/ base component. To avoid cross-contamination of existing plural component equipment, verify which side previously used “amine” and match up accordingly. Avoid using plural component equipment and hoses previously used to spray aromatic polyurethanes. Agitate Parts A and B separately using mechanical drill and a suitably-sized mixing paddle to ensure no pigment remains on the bottom of the cans. Use designated mixing paddles for each component to avoid cross-contamination/catalyzation of the product prior to use. Contact Tnemec Technical Services for additional information.

If using Series 44-721 Thixotropic Additive, stir contents of Series 431 Part A, making sure no pigment remains on the bottom. While Part A is under agitation, accurately add up to 2.5 fluid ounces (74 mL) of Series 44-721 for each gallon of Series 431 Part A. Continue agitation until thoroughly mixed. Series 44-721 should be added to Part A only. **Note:** The use of more than the recommended ratio of 44-721 will adversely affect coating performance.

Shake container before adding to ensure complete incorporation. Add measured amount of 44-721 to Series 431 Part A and mix well under low agitation. Recommended levels are:

SERIES 431 PART A	SERIES 44-721 ADDITIVE
Drum Set: Part A 50.0 Gal (189.2 L)	Up to 125 fl oz (3,697 mL)
Large Kit: Part A 4.0 Gal (15.1 L)	Up to 10 fl oz (296 mL)
Small Kit: Part A 0.5 Gal (1.89 L)	Up to 1.25 fl oz (37 mL)

Drum Sets (XKs): For plural component application use a 1 (Part A amine) to 1 (Part B epoxy) mix ratio heated plural component airless spray unit. Place band heaters on drums. Remove the lid and insert the mixing blade shaft through the center two inch bung; reinstall the lid. Mixing blade should be adequately sized to fully agitate material. The material should be 80°-90°F (27°-32°C) before the mixing blade is turned on. Insert 5:1 feed pumps into the outside 2 inch bung. Place the recirculation line in the ¾ inch outside bung. Recirculate the material through the primary heaters and heated hose bundle back into the containers. Continue recirculation under agitation until Part A reaches 110°-120°F (43°-49°C) and Part B reaches 100°-110°F (38°-43°C). Do not exceed 120°F (49°C) for either component.

Large Kits (LKs): For plural component application use a 1 (Part A amine) to 1 (Part B epoxy) mix ratio heated plural component airless spray unit. Agitate Parts A & B separately, making sure no pigment or solids remain on the bottom of the bucket. Scrape all the contents of

Part A (amine) and Part B (epoxy) into the appropriate heated tank using a flexible spatula. Keep containers tightly sealed prior to use. **Note:** Product component A (amine) must be heated to 110°-120°F (43°-49°C) and component B (epoxy) must be heated to 100°-110°F (38°-43°C) prior to and during plural component application. Do not exceed 120°F (49°C) for either component.

Small Kits (SKs): Agitate Parts A & B separately ensuring no pigment or solids remain on the bottom of the can. Scrape all of the Part B into the Part A can using a flexible spatula. Use a variable speed drill with a PS Jiffy blade and mix the blended components for a minimum of two minutes. During the mixing process, scrape the sides and bottom of the container to ensure complete blending of materials. Apply the mixed material within 15 to 20 minutes, or before the material reaches 100°F following agitation. **Note:** A large volume of material will gel quickly if not applied or reduced in volume.

Touch-Up Kits (TKs): For more information please reference Section 8.4 of this guide.

5.0 APPLICATION & EQUIPMENT

5.1 SURFACE TEMPERATURE

The minimum surface temperature is 50°F (10°C) and maximum is 130°F (54°C) during application. The surface should be dry and at least 5°F (3°C) above the dew point. The coating will not cure properly below minimum surface temperature.

5.2 SUBSTRATE CONDITIONING OF DUCTILE IRON

If required to reduce outgassing, the substrate should be conditioned (e.g., furnace) to increase the substrate temperature and then apply the Series 431 lining while the surface temperature decreases. Use only dry heat from an oven or indirect-fired heat sources to increase the substrate temperatures.

5.3 PLURAL COMPONENT SPRAY APPLICATION

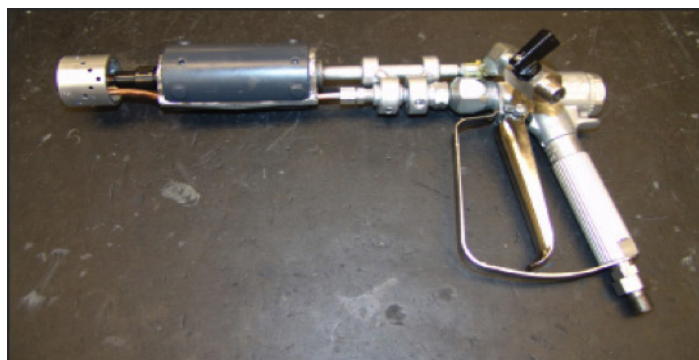
Plural component spray equipment is the preferred application method for Series 431 Perma-Shield PL. Plural component equipment reduces material waste, solvent consumption and reduces material viscosity. Contact Tnemec Technical Services for the complete Series 431 Plural Component Equipment Recommendations.

5.4 AIRLESS SPRAY EQUIPMENT

Airless spray application is recommended for short pieces (e.g., fittings, spools, etc.) and will require frequent pump flushing with Tnemec's No. 4 Thinner (or similar). For complete instructions on how to apply Series 431 Perma-Shield PL using airless spray equipment, please contact your Tnemec representative or Tnemec Technical Services.

Pump Size	Graco 45:1 or 56:1
Rotary Gun †	Model 712-216
Mat'l Hose ID	3/8" (9.5mm)
Manifold Filter	30 Mesh

† **Rotary Spray Gun:** Series 431 shall be applied to the interior surfaces of pipe or fittings using a rotary coaster pistol spray gun. Use Spray-Quip (Houston, TX) Model 712-216, or similar rotary lance, to produce a monolithic and level film. Contact Tnemec Technical Services for additional information.



Note: Pump assembly should include a moisture trap and oiler, air regulator with gauge and fluid outlet drain valve and outfitted with a gravity fed material hopper (material will not feed through a suction tube).

5.5 APPLICATION THICKNESS

Steel: 30-50 mils (762 to 1270 microns) dry film thickness in one or more coats.

Ductile Iron: 40 mils (1015 microns) nominal dry film thickness in one or more coats.

The number of coats and thickness requirements will vary with substrate roughness, application method and exposure. Refer to Section 6 for set-to-touch, maximum recoat, and place-in-service times. **Note:** Use Series 44-721 Thixotropic Additive to increase film build. Amounts vary by kit size, refer to Section 2 for recommended usage.

5.6 BELL SOCKET AND SPIGOT ENDS

Due to sensitive tolerances of push pipe and mechanical joint fittings, the gasket area of the bell socket and six inches (152 mm) back from end of spigot end must be coated with a maximum 10 mils (250 microns) dry film thickness or as recommended by the pipe or fitting producer. A brush application is recommended in these areas to control the film thickness.



6.0 CURE SCHEDULE

Temperature	90°F (32°C)	75°F (24°C)	55°F (13°C)
Set to Touch	1-2 hrs	2-3 hrs	8-9 hrs
Maximum Recoat	7 days	7 days	7 days
Place in Service	24 hours	2 days	3 days

Note: If more than 7 days have elapsed between coats, the Series 431 coated surface must be mechanically abraded (scarified) before topcoating. Curing time varies with surface temperature, air movement, humidity, and film thickness.

7.0 INSPECTION

7.1 BLAST PROFILE

The degree of surface cleanliness shall be as recommended in Section 3. The entire surface shall be subjected to the abrasive blast using internal pipe blasting equipment (e.g., rotary blaster) as needed to completely and uniformly contact the surface. The abrasive used should be clean, dry, bagged material that has a hard, angular cutting surface, such as aluminum oxide or copper slag. Abrasive materials should be selected to produce the required minimum 3.0 mils (76.2 microns) anchor pattern and generate no evidence of a polished or peened surface.

Depth of anchor pattern is suggested to be measured by using Testex-Replica profile tape prior to the application of the prime coat. Profile readings should be recorded on Testex-Replica tape and retained by the applicator for verification as part of the quality assurance file (reference NACE RP0287 or ASTM D4417, Method C).



7.2 WET FILM THICKNESS MEASUREMENTS

Wet film thickness readings should be taken as soon as possible at a frequency of at least one per 100 sq. ft. (9.2 m²). Readings on fittings should be taken at least every 10 sq. ft. (0.92 m²) to ensure proper wet coverage.

7.3 DRY FILM THICKNESS MEASUREMENTS

All steel, and ductile iron pipe and fitting linings shall be checked for thickness using a magnetic dry film thickness gauge. The thickness testing shall be in accordance with SSPC-PA 2 film thickness rating.

7.4 VISUAL INSPECTION

All lined pipe and fittings must be visually examined for film defects, including any runs, sags, holidays or debris in the film. Repairs shall be made in accordance with Section 8.

7.5 HIGH-VOLTAGE DISCONTINUITY TESTING

High voltage discontinuity (spark) testing is recommended to determine the presence and number of discontinuities in the nonconductive Series 431 applied to a conductive surface.

If required by the project specifications, all high voltage discontinuity (spark) testing shall be performed in accordance with the latest version of NACE SP0188.

Series 431 Perma-Shield PL shall be applied and allowed to cure within the parameters of the corresponding Product Data Sheets. Sufficient curing time of the coating system shall be allowed prior to conducting a holiday test, as indicated by the "To Place in Service" or "Return to

Service" duration on the Product Data Sheets. Curing time will vary with surface temperature, air movement, humidity, and film thickness.

For more information on voltage recommendations and curing parameters, reference Tnemec Technical Bulletin No. 03-42 or contact Tnemec Technical Services.

8.0 REPAIR

8.1 CUTTING PIPE

Cutting shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the ends of the pipe shall be dressed with a power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitably beveled. Existing Series 431 on the exterior surface of this new spigot end should be ground down to approximately 10 mils (250 microns) or removed and repaired to accommodate the bell socket. Refer to Section 5.6.

8.2 REMOVING CROSS BRACING

While protecting the lining from sparks, embers, or other deleterious materials, remove cross-bracing and grind the weld flush to the pipe wall within a 2-4 inch (5-10 cm) diameter area.

8.3 TOUCH-UP

Any film imperfections, discontinuities, surface defects, or damaged lining shall be repaired. Thoroughly scarify the steel or ductile iron to remove any welding products, rust or other contaminants in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal and produce a minimum 3.0 mil (76.2 micron) anchor profile. Feather the edge of the Series 431 perimeter to form a smooth transition and scarify onto the existing, tightly adhered lining 1-3 inches (2.5-7.6 cm) to de-gloss the surface. Re-apply Series 431 to the specified thickness.

8.4 SERIES 431 TOUCH-UP KIT

Series 431 Touch-Up Kits (TKs) are available for fast and convenient repairs. The TKs are available in a tube configuration and sold in quantities of one tube (including two static mixing elements).

Equipment: A 26:1 high thrust ratio applicator is required (Tnemec Part F100-TKAP). Material tube must be used in conjunction with provided static mixing elements (Tnemec Part FLT055) in order to ensure proper mixing. Other applicators or static mixing tips cannot be substituted and may result in improperly mixed material.

Usage: Unscrew retaining ring and remove plug. Save plug in case entire tube is not used. Install new static mixing element, replace retaining screw ring, and place tube in applicator. Point assembly up and slowly pull the trigger to remove air. Dispense approximately 1 fluid ounce (30 mL) of material to waste and continue to pump until material is of uniform color with the Part A completely blended with the Part B. Use a putty knife or spatula to ensure adequate coverage and mixing.

Once repairs are completed, remove the retaining nut. Remove static mixing tip and discard. If the tube contains unused material, clean the end of any excess material, correctly position and reinstall plug, and press firmly into place, and reinstall the retaining nut. The tube is now ready for future use. Additional static mixing elements are available upon request.



Curing Time: Refer to the curing schedule in Section 6. Lower temperatures or greater film thickness may require longer curing time.

9.0 HANDLING

Series 431 Perma-Shield PL lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, or hooks shall be placed inside the pipe and fittings for the purposes of lifting, positioning, or laying. The pipe shall not be dropped or unloaded by rolling. Care should be taken not to let the pipe and fittings strike objects while swinging or off-loading. Pipe or fittings should never be placed to grade by use of hydraulic pressure from an excavator bucket or banging/striking with heavy hammers.

Pipe and fitting exterior coated with Series 431 Perma-Shield PL shall not be handled or secured with any metallic devices such as forks, chains, cables, etc. Only nylon straps or similar lifting or securing devices are to be used.

Each spigot end shall be suitably beveled to facilitate assembly. All joint surfaces shall be lubricated as recommended by the pipe manufacturer immediately before the joint is assembled. Piping shall be installed without springing or forcing the pipe in a manner which would induce stresses in the pipe or lining. Installers should follow guidelines established by the pipe manufacturer and not exceed the manufacturer's recommended amount of insertion force. At no time should pipe be inserted beyond its home position.

All materials shall be stored in a sheltered location above the ground and shall be supported to prevent sagging or bending.

10.0 HEALTH & SAFETY

Series 431 Perma-Shield PL is for industrial use only and installed by qualified coating and lining application specialists. Paint products contain chemical ingredients which are considered hazardous. Read container label warning and material safety data sheet for important health and safety information prior to the use of this product. Keep out of reach of children.