PIP CTSU1000
Application of Underground Coatings
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

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APPENDIX CTSU1000 – Documentation
   Requirements Sheet

The following data forms shall be part of this
Practice only if indicated on the purchaser’s
completed Documentation Requirements Sheet.

CTSU1000-D001 – Underground Coatings
   Selection Criteria Sheet

CTSU1000-D002 – Underground Coatings
   System Data Sheet - User-Defined

CTSU1000-D010 – Underground Coatings
   System Data Sheet - Fusion-Bonded
   Epoxy (FBE) One-Coat System

CTSU1000-D011 – Underground Coatings
   System Data Sheet – Fusion-Bonded
   Epoxy (FBE) One-Coat System for High
   Temperature

CTSU1000-D012 – Underground Coatings
   System Data Sheet – Fusion-Bonded
   Epoxy (FBE) One-Coat System with ARO

CTSU1000-D013 – Underground Coatings
   System Data Sheet - Fusion-Bonded
   Epoxy (FBE) One-Coat System - User-Defined

CTSU1000-D014 – Underground Coatings
   System Data Sheet - Fusion-Bonded
Epoxy (FBE) One-Coat System with ARO for High Temperature

**CTSU100-D015 – Underground Coatings**
System Data Sheet – Three Layer Polyolefin (MDPE or HDPE)

**CTSU1000-D016 – Underground Coatings**
System Data Sheet – Three Layer Polyolefin (PP)

**CTSU1000-D017 – Underground Coatings**
System Data Sheet – Liquid Epoxy

**CTSU1000-D018 – Underground Coatings**
System Data Sheet - Liquid Epoxy for High Temperature

**CTSU1000-D019 – Underground Coatings**
System Data Sheet - Fusion-Bonded Epoxy (FBE) One-Coat System for Field Welds and Components

**CTSU1000-D020 – Underground Coatings**
System Data Sheet - Heat Shrink Sleeves

**CTSU1000-D021 – Underground Coatings**
System Data Sheet - Viscoelastic Tape System

**CTSU1000-D022 – Underground Coatings**
System Data Sheet - Petrolatum Tape System

**CTSU1000-D023 – Underground Coatings**
System Data Sheet - Petrolatum Tape Wrap System

**CTSU1000-F – Daily Inspection Report**
1. **Scope**

This Practice provides minimum requirements for surface preparation and the application and inspection of shop-applied and field-applied protective coatings on pipe, vessels, equipment, fittings, flanges, field joints, valves, and special fabrications intended for underground/buried service.

This Practice does not cover external coatings for moderate or severe environments or internal linings for tanks and vessels.

This Practice does not cover in situ continuous coating of pipelines.

2. **References**

Applicable parts of the following industry codes and standards shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles will be used where applicable.

**Industry Codes & Standards**

- American Society for Testing and Materials (ASTM)
  - ASTM D4285 - Standard Test Method for Indicating Oil or Water in Compressed Air
  - ASTM D4417 - Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
  - ASTM F21 - Standard Test Method for Hydrophobic Surface Films by the Atomizer Test

- American Water Works Association (AWWA)
  - C203 - Coal-Tar Protective Coatings & Linings for Steel Water Pipelines - Enamel & Tape - Hot Applied
  - C209 - Cold-Applied Tape Coating for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
  - C210 - Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
  - C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
  - C215 - Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
  - C216 - Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
  - C217 - Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines

- International Organization For Standardization (ISO)
  - ISO 2178 - Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method
- ISO 2360 - Non-conductive coatings on non-magnetic electrically conductive basis materials - Measurement of coating thickness - Amplitude-sensitive eddy current method
- ISO 4677-2 - Atmospheres for conditioning and testing - Determination of relative humidity - Part 2: Whirling psychrometer method
- ISO 8501-1 - Preparation of Steel Substrates before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness - Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates after Overall Removal of Previous Coatings
- ISO 8502-6 - Preparation of steel substrates before application of paints and related products -- Tests for the assessment of surface cleanliness -- Part 6: Extraction of soluble contaminants for analysis -- The Bresle method
- ISO 8502-9 - Preparation of steel substrates before application of paints and related products -- Tests for the assessment of surface cleanliness -- Part 9:
- ISO 8503-5 - Preparation of Steel Substrates before Application of Paints and Related Products - Surface Roughness Characteristics of Blast-Cleaned Steel Substrates - Part 5: Replica tape method for the determination of the surface profile
- ISO 8504-2 - Preparation of steel substrates before application of paints and related products - Surface preparation methods - Part 2: Abrasive blast-cleaning
- ISO 8504-3 - Preparation of steel substrates before application of paints and related products - Surface preparation methods - Part 3: Hand- and power-tool cleaning
- ISO 11126 - Preparation of Steel Substrates before Application of Paints and Related Products - Surface Preparation Methods (10 Parts)
- ISO 12944-4 - Paints and Varnishes - Corrosion Protection of Steel Structures by Protective Paint Systems - Part 4: Types of Surface and Surface Preparation
- ISO 12944-7 - Paints and Varnishes - Corrosion Protection of Steel Structures by Protective Paint Systems - Part 7: Execution and Supervision of Paintwork
- ISO 21809-1 - Petroleum and natural gas industries – External coatings for buried or submerged pipelines used in pipeline transportation systems – Part 1: Polyolefin coatings (3 layer PE and 3 layer PP)
- ISO 21809-2 - Petroleum and natural gas industries – External coatings for buried or submerged pipelines used in pipeline transportation systems – Part 2: Fusion-bonded epoxy coatings
- ISO 21809-3 - Petroleum and natural gas industries – External coatings for buried or submerged pipelines used in pipeline transportation systems – Part 3: Field joint coatings

- NACE International
- NACE SP0178 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service
- NACE SP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
3. Definitions

DFT: Dry film thickness

FRP: Fiberglass-reinforced plastic

holiday: Imperfection consisting of cracked, missing, or insufficient coating thickness, and/or a foreign inclusion in the coating that significantly lowers the dielectric strength on a surface that has been coated

nonferrous: Copper, aluminum, and nickel based alloys

owner: Party who owns the facility wherein the coating system will be used

purchaser: Party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.
Purchaser’s inspector: Purchaser’s authorized representative with authority to act in the interest of, and on behalf of, the purchaser in all quality assurance matters

supplier: Party responsible for furnishing and/or installing the coating

4. Requirements

4.1 Conflicts, Exceptions, Deviations, and Substitutions

4.1.1 All conflicts between the referenced documents and this Practice shall be submitted in writing to purchaser for clarification and resolution before proceeding with the coating application.

4.1.2 All exceptions, deviations, and substitutions to the requirements specified herein and in referenced documents shall be approved by the purchaser.

4.2 Regulations and Safety Data Sheets (SDS)

4.2.1 Protective coatings shall comply with all applicable federal, state, and local codes and regulations on surface preparation, coating application, storage, handling, safety, and environmental requirements, including the recommendations of SSPC-PA Guide 10.

4.2.2 The latest issue of the coating manufacturer’s product data sheets, application instructions, and SDS shall be available at the coating site and complied with during painting operations.

4.3 Numerical Values

Observed or calculated values shall be rounded to the nearest unit in the last right-hand place of figures in accordance with ASTM E29.

4.4 Procedures

4.4.1 Uncoated Surfaces

4.4.1.1 Unless specified otherwise, the following surfaces shall not be coated and shall be protected from surface preparation and external coating activities in the area:

a. Interior surfaces of piping and equipment
b. 50 mm (2 inches) from areas to be welded
c. Nonferrous metals
d. Valves located in the valve pit
e. Nonmetallic materials such as fiberglass-reinforced plastic (FRP) and thermoplastics
f. Surfaces included in the cathodic protection system, such as grounding lugs, anodes, or attachment points

4.4.1.2 The following surfaces shall not be coated and shall be protected from surface preparation and painting activities in the area:
a. Valve stems, sealing surface of flange faces, threads, and other machined contact surfaces
b. Electrical contacts
c. Nameplates and identification tags
d. Glass surfaces of gages and sight glasses
e. Resilient seal materials
f. Inspection point identification markers
g. Control Panels, displays, valve operators, instruments. Vents, ports, and other openings shall be protected.

4.4.2 Precautions for Austenitic Stainless Steel and Nonferrous Metals

4.4.2.1 All austenitic stainless steel (SS) and nonferrous metals shall be protected from blasting, overspray, and coatings not intended for SS surfaces, especially coatings containing zinc.

4.4.2.2 Abrasives for use on SS shall be in accordance with SSPC-AB-1 (ISO 11126, natural abrasives [except silica sand] as well as coal furnace slag and fused aluminum oxide) and shall be free of metals.

4.4.2.3 Surface preparation for SS shall be in accordance with SSPC-SP 16.

4.4.2.4 If hand or power tool cleaning is required on SS or nonferrous metals, SS wire brushes that have not been previously used on CS surfaces shall be used.

4.4.2.5 Coatings and solvents for use on SS and nonferrous metals shall be free of substances such as chlorides, sulfur, halogens, or metallic pigments that can harmfully affect SS or nonferrous metals.

4.4.2.6 Color-coding and fabrication markings applied directly on SS and nonferrous metals shall be applied with low-chloride markers.

4.4.3 Precautions for Cathodically Protected Substrates

4.4.3.1 All coatings being used in cathodically protected systems shall be tested and evaluated for cathodic disbondment.

4.4.3.2 Coatings for the cathodically protected systems shall be applied in accordance with this Practice and the coating system data sheet.

4.4.3.3 Where mechanical connections are used, either for shop or field applications, the original coating shall be removed in accordance with SSPC-SP2 or SSPC-SP3 (ISO St 2 or St 3). After all connections are made, coating shall be applied over all connections in accordance with this Practice and the coating system data sheet.

4.4.3.4 Other methods of ensuring electrical continuity through the connection shall be submitted to Purchaser for approval.

4.4.4 Precautions for Heating Pipe

4.4.4.1 If the pipe must be heated, the supplier shall heat the pipe using a gas or electrical heating apparatus that does not leave a residue or contaminant on the pipe surface. Either method shall be applied so that it provides
uniform heating of the entire pipe surface to be coated. During shop coating, pipe temperatures shall be measured every 10 joints to ensure the correct temperatures are maintained. During field coating, temperatures shall be measured every time a coating is applied.

4.4.4.2 If coated pipe is heated, the rate of temperature rise shall not exceed 100°C (212°F) per minute. If the manufacturer has limits on the rate of temperature rise, the supplier shall comply with the more restrictive rate.

4.4.4.3 Temperatures shall be monitored with surface contact pyrometers. Other temperature measuring instruments or methods may be approved by a purchaser representative if the supplier can demonstrate that they provide data equivalent to the surface contact pyrometers.

4.4.4.4 The pipe temperature shall never exceed 275°C (525°F). Pipe heated in excess of 275°C (525°F) shall become the property of the supplier. Oxidation in the form of "bluing" or other apparent oxide formation is unacceptable. If the pipe temperature exceeds 275°C (525°F), the supplier shall reimburse Purchaser for the total cost of the pipe.

4.5 Surface Preparation

4.5.1 Preparation before Blasting

4.5.1.1 All welds shall be smooth, without sharp edges, and free of weld slag and weld spatter before blasting. Purchaser shall be notified of such defects for corrective action before proceeding with work.

4.5.1.2 All visible deposits of oil and grease shall be removed before blasting by using methods defined in SSPC-SP 1 (ISO 12944-4).

4.5.1.3 High-pressure water jetting, as defined in SSPC-SP WJ-3, or steam cleaning may be used to remove oil, grease, and other surface contaminants.

4.5.1.4 Cleaning with solvents shall only be permitted if cleaning by other methods defined in SSPC-SP 1 (ISO 12944-4) is not practical.

4.5.1.5 The presence of oil shall be checked either by rubbing the surface with a clean, white cloth or by ASTM F21.

4.5.1.6 Weld bevels and lands shall be protected from abrasive blasting and coating application.

4.5.2 Abrasive Blasting

4.5.2.1 Abrasive blast cleaning shall be performed with a clean, sharp grade of abrasive.

4.5.2.2 Abrasive mesh size shall be suitable for producing the specified anchor profile.

4.5.2.3 All abrasives shall be free of dust, dirt, and other foreign matter and shall be kept dry at all times.

4.5.2.4 If automatic blasting equipment is used, the abrasive mix shall be maintained to produce a consistently sharp profile.
4.5.2.5 Air-supply compressors shall be equipped with adequately sized and properly maintained oil and water separators.

4.5.2.6 Air compressors shall be capable of maintaining 690 kPa (100 psig) minimum at the nozzle.

4.5.2.7 Air compressors shall be equipped with either dryers or after coolers to remove entrained moisture from the compressed air.

4.5.2.8 Abrasive blast cleaning shall not be performed if the ambient or substrate temperature is less than 3°C (5°F) above the dew point temperature.

4.5.2.9 Dew point temperature shall be determined by sling psychrometer in accordance with ASTM E337 or ISO 4677-2, at the location where work is being performed. Other equivalent temperature, humidity and dew point measuring equipment may be approved if submitted to Purchaser.

4.5.2.10 Substrate temperature shall be determined with a surface thermometer.

4.5.2.11 Blast-cleaned surfaces showing evidence of rust bloom or having been left uncoated overnight shall be recleaned to the specified degree of cleanliness before coating.

4.5.2.12 All visible burrs, laminations, slivers, and scabs shall be removed or repaired after blasting.

4.5.2.13 After blasting and immediately before spraying, dust and loose residues shall be removed by brushing, blowing off with clean dry air, or vacuum cleaning.

4.5.2.14 Inhibitive washes intended to prevent rusting after blasting shall be permitted only if approved by coating manufacturer.

4.5.2.15 Alternative forms of surface preparation shall not be permitted without written approval from the purchaser.

4.5.3 Degree of Cleanliness and Anchor Profile

4.5.3.1 Degree of cleanliness and anchor profile shall be in accordance with the specified coating system.

4.5.3.2 All blast-cleaned surfaces shall be inspected for proper cleaning before painting. SSPC VIS-1 (ISO 8501-1) shall be used as a visual standard for confirming the degree of surface cleanliness.

4.5.3.3 Anchor profile shall be verified in accordance with ASTM D4417, Method C. Anchor profile may also be verified in accordance with ISO 8503-5, when approved by purchaser.

4.5.3.4 Pipeline components shall be tested for the presence of soluble salts in accordance with the requirements of ISO 8502-6 (Bresle method) or ISO 8502-9 (Conductometric method). The maximum allowable contamination shall be 20 mg/m² immediately prior to applying the coating. For shops or plants using recycled abrasives, the maximum contamination shall be 20 mg/m² immediately prior to abrasive blasting.
4.6 Application

4.6.1 General

Coating orders shall be placed in a timely manner to prevent job delays.

4.6.2 Liquid-Applied Coatings

4.6.2.1 All solvents used for thinning shall be in accordance with the manufacturer’s recommendations.

4.6.2.2 Coating materials shall be furnished in the manufacturer’s unopened containers that are clearly marked, covered, cleaned, and protected.

4.6.2.3 All materials shall be handled, stored, and applied in accordance with the coating manufacturer’s latest published instructions and SSPC-PA 1 (ISO 12944-7) and SSPC-PA Guide 10.

4.6.2.4 Mixing of partial kits shall not be permitted.

4.6.2.5 Thinning shall not exceed the maximum allowable volatile organic compound (VOC) level for the coating being applied.

4.6.3 Shop-Applied Coating on Straight Run Pipe

4.6.3.1 The following requirements, along with the coating system data sheets, coating manufacturer’s recommendation, and other applicable requirements specified herein, shall be the minimum requirements for shop-applied coatings on straight-run pipe sections:

a. Hot-applied coal tar is prohibited.

b. Liquid epoxy coating shall be in accordance with ISO 21809-3 and the applicable PIP Coating System Datasheets (CSDS) that are part of this Standard.

c. Fusion bond epoxy shall be in accordance with ISO 21809-2.

d. Extruded polyolefin coatings shall be in accordance with ISO 21809-1.

e. Plural component urethane coatings shall be in accordance with the coatings manufacturer’s recommendations.

f. Plural component urethane coatings shall only be applied by applicators trained and certified by the coating manufacturer.

4.6.3.2 Minimum coating cutback from field welds shall be 50 mm (2 inches).

4.6.3.3 Fusion Bond Epoxy (FBE) Coatings:

a. The use of recycled, reclaimed or reconditioned FBE powder is prohibited unless approved by both Purchaser and the manufacturer.
b. The cured coating shall have a cutback, measured from the bevel shoulder, of 50 mm (2 in.) minimum and 75 mm (3 in.) maximum for stick welding. When other mechanized welding operations are used, the length of the cutbacks shall be specified by Purchaser. Taping of the ends is an unacceptable method to achieve the cutback in plants where the tape would be subsequently exposed to flames. Cutbacks, lands and bevels, as well as any internal surface within 25 mm (1 in.) of the land, shall be completely free of any coating, including adhesives from possible tape usage.

c. The supplier shall furnish Purchaser with one 100 g (4 oz) sample of each powder batch used for coating of Purchaser pipe. Each sample shall be furnished in a sealed container and identified with the name of the coating manufacturer, the batch number, the date of application and the specific production run to which that batch is applied.

d. Purchaser may use the services of an independent laboratory to monitor the quality of powder(s) by infrared spectroscopy, differential scanning calorimeter analysis or other applicable test methods. In the event that questionable results are found, it will be Purchaser’s prerogative to reject such batches.

4.6.3.4 3-Layer Polyolefin Coating:

a. The epoxy primer shall be removed for a distance of approximately 50 mm (2 in.) at each pipe end. This primer cutback area, as well as lands, bevels and any internal surface within 13 mm (½ in.) of the land shall be completely free of any coating or adhesive.

b. A 100 mm ± 13 mm (4 ± ½ in.) polyolefin cutback, measured from the shoulder of the weld bevel, shall be provided at each pipe end.

c. To achieve this cutback, the topcoat shall be cut just after cooling and removed manually. The stripped ends shall be steel wire brushed clean, leaving the FBE undercoat. The edges of the topcoat shall be tapered to ensure a satisfactory bonding of joints on site. The width of the taper shall be approximately 13 mm (½ in.).

4.6.4 Field Application of Coatings on Connections and Fittings

The following requirements, along with the coating system data sheets, coating manufacturer’s recommendations, and other applicable requirements specified herein, shall be the minimum requirements for coatings applications on girth welds, special sections, other field connections, and fittings:

4.6.4.1 Fusion Bond Epoxy coatings shall be applied in accordance with *PIP CTSU1000-D002 Underground Coatings Selection Criteria* and the appropriate coating system data sheet.

4.6.4.2 Liquid epoxy coatings shall be applied in accordance with *PIP CTSU1000-D002 Underground Coatings Selection Criteria* and the appropriate coating system data sheet.
4.6.4.3 Heat-shrink sleeves (HSS) shall be installed in accordance with ISO 21809-3, PIP CTSU1000-D002 Underground Coatings Selection Criteria, and the appropriate coating system data sheet.

4.6.5 Film Thickness

4.6.5.1 Wet-film thickness shall be checked, if possible, during the application of liquid-applied coatings to assure the specified dry film thickness (DFT).

4.6.5.2 DFT of each coat shall be checked in accordance with the procedures defined by SSPC-PA 2 using a properly calibrated, magnetic gauge.

4.6.5.3 Coating thickness on stainless steel shall be checked using a Type 2 gauge suitable for use on nonmagnetic substrates.

4.6.5.4 Coating thickness may also be measured using ISO 2178 for non-magnetic coatings on magnetic substrates or ISO 2360 for coatings on non-magnetic substrates. However, sampling procedures shall follow SSPC-PA 2.

4.6.5.5 Measurements of DFT shall be taken after removal of dry spray and over spray.

4.6.5.6 All gauges shall be adjusted to compensate for the substrate effect before application of any coating in accordance with SSPC-PA 2.

4.6.6 Defects

4.6.6.1 Each coat of paint shall be of a uniform film, free of defects (e.g., pinholes, voids, bubbles, skips, runs, sags, blisters, wrinkles, and mud cracking) and have a uniform thickness and appearance.

4.6.6.2 Care shall be exercised to prevent over spray, spillage, or application of coatings to unintended surfaces.

4.6.6.3 Dry spray and over spray shall be removed.

4.6.6.4 DFT of each coat shall be in accordance with SSPC-PA 2.

4.6.6.5 The finished fusion bond epoxy or liquid coating system on fittings, pig launchers and receivers, piping spools and other accessories shall be tested for holidays in accordance with the requirements of NACE SP0188. Holidays shall be repaired and the area re-tested to confirm that it is holiday free. Pinholes shall be ground to bare metal prior to the application of the repair coating to ensure a satisfactory repair. Two-component epoxies shall be used for repairs. The use of melt sticks is prohibited.

4.6.6.6 The finished fusion bond epoxy coating system on straight pipe shall be tested for holidays in accordance with the requirements of NACE SP0490. Holidays shall be repaired using two-component epoxies and the area shall be re-tested to confirm that it is holiday free. Pinholes shall be ground to bare metal prior to the application of the repair coating to ensure a satisfactory repair. The use of melt sticks is prohibited. If the defect area exceeds 250 cm² (39 in.²) or the total number of defects exceeds one per meter (3.3 ft) of length, the affected pipe shall be stripped and recoated.
4.6.6.7 The finished polyolefin coating system on straight pipe shall be tested for holidays in accordance with the requirements of NACE RP0274. Holidays shall be repaired using two-component epoxies and Heat Shrink Sleeve. Reference PIP CTSU1000-D015. The area shall be re-tested to confirm that it is holiday free. The use of melt sticks is prohibited. If the defect area exceeds 10 cm² (1.5 in.²) or the total number of defects exceeds one per meter (3.3 ft) of length, the affected pipe shall be stripped and recoated.

4.6.7 Coating Repairs

4.6.7.1 Before application of any coat, all defects and damage to the previous coat(s) shall be repaired.

4.6.7.2 Damage to finished work shall be thoroughly cleaned and recoated.

4.6.7.3 Damaged areas shall be spot blast cleaned or power tool cleaned as necessary to restore any exposed steel to the original degree of cleanliness.

4.6.7.4 All loose, cracked, and damaged coating shall be removed and the adjacent sound coating feathered back approximately 50 mm (2 inches) to form a uniform and smooth surface.

4.6.7.5 Feathering shall be performed by hand or power sanding with a grit wheel or sandpaper.

4.6.7.6 Prepared surface shall be free of loose, burnt, or blistering coating.

4.6.7.7 Unless specified otherwise, the coating used for repair shall be the same as the original, with approximately the same DFT.

4.6.8 Selection Requirements and Coating Systems

4.6.8.1 If selected on purchaser's documentation requirements sheet PIP CTSU1000-D001, data sheet PIP CTSU1000-D002 shall be used for designating the appropriate coating by service or application description.

4.6.8.2 If selected on purchaser's documentation requirements sheet PIP CTSU1000-D001, data sheets PIP CTSU1000-D011 through CTSU1000-D023 shall be used to define specific requirements for each coating system.

4.6.8.3 Coating manufacturer shall confirm suitability of selected coating for intended service.

4.7 Inspection

4.7.1 All inspections and tests necessary to ensure that the surface preparation and coating application are in accordance with the requirements of this Practice shall be performed.

4.7.2 Purchaser’s inspector(s) shall be given adequate notice before the start of surface preparation and coating application for witnessing the work.

4.7.3 Purchaser’s inspector(s) shall have the option to witness or repeat any of the functions as necessary.
4.7.4 Purchaser’s inspector(s) and coating manufacturer’s representative(s) shall have all materials, equipment, and work available at all times.

4.7.5 Purchaser’s inspector(s) and coating manufacturer’s representatives(s) shall have access to the work site during the progress of the work.

4.7.6 Purchaser’s inspector(s) and coating manufacturer’s representative(s) shall have the right to conduct any inspection or testing deemed necessary to ensure the proper application of coatings.

4.7.7 All instruments used in inspection activities (e.g., thermometer, pyrometers, hygrometers, thickness gages, profile gages, and holiday detectors) shall be supplied in proper working order and calibrated before use.

4.7.8 Dew point, relative humidity, and surface temperature shall be determined before surface preparation.
   4.7.8.1 Readings are required at 4-hour intervals or at other timed intervals approved by the purchaser.
   4.7.8.2 Alternatively, continuous monitoring of dew point and relative humidity may be performed using systems established or accepted by the purchaser.
   4.7.8.3 The substrate temperature shall be at least 3°C (5°F) above the dew point.
   4.7.8.4 Work shall not proceed if the ambient temperature or relative humidity is outside the requirements of this Practice.

4.7.9 Air supply for blast cleaning, pneumatic tools, and spray equipment shall be tested for oil and water contamination in accordance with ASTM D4285.
   4.7.9.1 All lines shall be tested separately.
   4.7.9.2 Testing shall be performed at the beginning and end of each work shift and at not less than 4-hour intervals.
   4.7.9.3 If contamination is discovered, all necessary corrective actions shall be made and the air supply retested.
   4.7.9.4 Surfaces blasted with contaminated air shall be cleaned with solvent and reblasted with clean air and abrasive.
   4.7.9.5 Coatings determined to have been applied using contaminated air shall be removed and reapplied using clean air.

4.7.10 Recirculated shot and grit used for abrasive cleaning shall be checked for cleanliness in accordance with SSPC-AB 2.
   4.7.10.1 Tests shall be made at the start of blasting, at 4-hour intervals thereafter, and at the end of blasting.
   4.7.10.2 If oil is evident, contaminated abrasive shall be replaced with clean abrasive and retested before proceeding.
   4.7.10.3 All steel blasted since the last satisfactory test shall be reblasted.

4.7.11 Abrasive-cleaned surfaces shall be inspected for proper cleanliness and anchor profile using SSPC (ISO 8501-1) visual comparators.
4.7.11.1 Surface preparation anchor profile shall be verified using both coarse or extra-coarse replica tape (as required by profile depth) and a spring-loaded micrometer in accordance with ASTM D4417, Method C. Anchor profile may also be verified in accordance with ISO 8503-5, when approved by purchaser.

4.7.11.2 SSPC-VIS 1 (ISO 8501-1) visual standards shall be used for confirming the degree of surface cleanliness if adequacy of cleaning is in question.

4.7.12 Completed paint job shall pass inspection by the purchaser’s inspector(s).

4.7.13 Work found to not be in accordance with the requirements specified herein shall be corrected.

4.7.14 All holidays found shall be marked and repairs made in accordance with the coating manufacturer’s recommendations.

4.7.15 Inspection and testing shall be carried out according to Section 11 of ISO 21809-1 for polyolefin coatings and according to Section 10 of ISO 21809-2 for FBE coatings. The maximum number of holidays allowed and the maximum size of holidays that may be repaired shall meet the requirements of Section 12 of ISO 21809-1 for polyolefin coatings and according to Section 11 of ISO 21809-2 for FBE coatings.

4.8 Inspection Checklist

4.8.1 Precoating Inspection

The following items shall be verified:

a. Coating, thinning, and blasting materials are as specified.

b. Storage conditions for all materials are adequate and properly maintained.

c. Surfaces not to be coated are masked off or otherwise protected before surface preparation and coating application of adjacent surfaces.

4.8.2 Presurface Preparation

The following items shall be verified:

a. Oil and grease are removed before surface preparation.

b. Welds and sharp edges have been suitably prepared.

4.8.3 Surface Preparation

The following items shall be verified:

a. Cleanliness of air supply (free of oil and moisture)

b. Cleanliness and dryness of abrasives

c. Adequacy of cleaning and blasting equipment, hoses, etc.

d. Appropriate ambient, substrate, and dew point temperatures for proper surface preparation

e. Removal of visible burrs, slivers, scabs, and weld spatter after blasting

f. Degree of surface cleanliness and removal of contaminants
g. Anchor profile as specified by using appropriate instruments

4.8.4 Coating Application

The following items shall be verified:

a. Materials are as specified, are properly labeled, and the shelf life has not been exceeded.

b. Mixing, thinning, and induction times are in accordance with the coating manufacturer’s instructions for liquid-applied coatings.

c. Proper application equipment is being utilized for each type of coating being applied.

d. Air supply is clean and free of oil and moisture.

e. Ambient, substrate, and dew point temperatures are appropriate.

f. Applicator is checking wet-film thickness during application for liquid-applied coatings.

g. Coating manufacturer’s requirements regarding recoat time are observed.

h. Previous coat is sufficiently cured before application of topcoats.

i. Each coat has been visually inspected for defects and uniform appearance.

j. DFT is within the specified range after each coat is applied.

k. All fusion-bonded epoxy, high-density polyethylene, FBE, HDPE, hot tar, and wrap systems are applied in accordance with the coating manufacturer.

4.8.5 Final Acceptance

The following items shall be verified:

a. Coated surface has been visually inspected for defects and uniform appearance.

b. Total DFT is within the specified range in accordance with SSPC-PA 2.

c. All identified repairs have been completed in accordance with the manufacturer’s recommendations.

d. Coating systems are properly cured.

4.9 Documentation – Reporting and Record Keeping

4.9.1 Prior to the start of work the supplier shall provide to the purchaser an Inspection and Test Plan (ITP) for review and approval.

4.9.2 If selected on purchaser’s documentation requirements sheet PIP CTSU1000-D001, Daily Inspection Report, PIP CTSU1000-F, shall be prepared for each work shift to document completion of each specified requirement.

Comment: The supplier’s forms may be used with prior approval from the purchaser.

4.9.3 A log shall be maintained of all reports, inspections, and tests (including date, time, and results of instrument calibrations).
4.9.4 The supplier shall provide Purchaser with daily production tallies. Daily production tallies will contain the following information for each length of pipe:

1) Date and coating sequence number
2) Joint length
3) Average coating thickness
4) Number of holidays
5) Disposition (accepted, rejected, cut off for test ring, re-beveled)
6) Pipe manufacturer's joint/heat number

4.10 **Shipping, Handling, and Storage**

4.10.1 Coated items shall not be handled or moved until all coatings have been properly dried or cured in accordance with the coating manufacturer.

4.10.2 Coated items shall be handled with equipment such as stout, wide-belt slings, web belts, and wide-padded skids selected to prevent damage to the coating.

4.10.3 Handling equipment likely to cause damage to the coating shall not be permitted.

4.10.4 Items such as chains, cables, hooks, tongs, metal bars, and narrow skids shall not be permitted to come in contact with the coating.

4.10.5 Dragging or skidding coated pipe shall not be permitted.

4.10.6 Coated items shall be loaded, padded, and secured for transport in a manner to prevent damage in transit to the coating.

4.10.7 Coated items shall be separated to prevent items from bearing against each other.

4.10.8 Coated items shall be stacked off the ground using suitable means (e.g., parallel height ridges of rock-free sand, wooden timbers placed under the uncoated pipe ends) to avoid damages to the coating.

4.10.9 Coated pipe shall not be permitted to rest directly on rocky or gravelly ground.
APPENDIX A – PLANT QUALIFICATIONS

The following minimum equipment requirements are prerequisites for the application of coatings. Failure to comply with any portion of this section is potential cause for cessation of coating operations or non-award of a bid. However, meeting these plant qualifications for application of FBE and/or abrasion resistant overcoat to Purchaser’s pipe and fittings does not imply that a coating plant is automatically acceptable to Purchaser.

1. The contractor shall have a detailed standard coating procedure documented and available to Purchaser.

2. The contractor shall obtain certifications for each batch or lot of material used to coat Purchaser’s line pipe and fittings from the coating manufacturer. A batch shall be defined by the coating manufacturer but it cannot exceed the quantity produced by the coating manufacturer in an 8-hour period from one production line.

3. Certification shall include a statement from the coating manufacturer that no changes have been made in the formulation, raw materials, origin or manufacturing procedure since the product was last tested and/or approved by Purchaser. When advised of any such changes, Purchaser shall promptly review and/or test the product for re-approval.

4. All plant equipment shall be in a safe operating mode, in good working condition and staffed by knowledgeable personnel.

5. The plant shall have an operational system to remove moisture from the surface of pipe or fittings. Preheating shall be sufficient to ensure that the pipe temperature is at least 5°F (3°C) above the dew point temperature during abrasive blast cleaning and inspection.

6. Any air lines supplying air knives, lances or other air impingement implements shall have operative condensate traps to ensure that no moisture, oil or other contaminants are deposited on the pipe or fitting. The contractor shall blow the trap twice per shift.

7. The powder system shall have a source of clean, dry air and the dew point temperature must be no higher than -20°F (-29°C). The air dryer shall have instrumentation to monitor dryness or the contractor shall arrange for a testing company to proof test air dryness at the contractor’s expense.

8. Fluidized beds shall have magnets adequate to remove iron and steel shaving contamination from the virgin and recycled powder.

9. The powder system shall have an operational automatic fire suppressant system.

10. The plant shall have the means, such as a water truck, to suppress dust in the yard.

11. The contractor shall have a laboratory or testing facility at the plant site for performing all production quality-control tests. The laboratory shall have the following test equipment for such tests:
   - Equipment for preparing test rings and a power saw for cutting straps from the test rings.
   - Refrigeration equipment that can achieve -10°F (-23°C).
   - A strap-bending apparatus (either a four-point or mandrel style).
   - Microscope of at least 30x power or greater.
   - Equipment for cathodic disbondment testing according to the applicable section(s) of ISO 21809.
   - Equipment for measuring coating thickness, temperature and anchor pattern profile.
A full set of coating thickness calibration standards for twice-daily calibration of coating thickness gauges. The calibration standards shall be free of corrosion, nicks and scratches, which may create false readings.

- Ultrasonic thickness gauge with a steel calibration block approximating the thickness of the pipe or fitting to be coated.
- Holiday detector with visual and audible alarms and a visual voltage output meter.
- Visual standards for contamination, voids and matching curves for bending.
- SS gel plate.

12. The powder shall be delivered to the plant in a refrigerated container.

13. The plant shall have a powder storage room capable of storing the coating materials according to the coating manufacturer’s recommendations.

14. The plant shall have an internal blowout and debris collection system to remove loose scale, dirt and abrasive from the pipe interior. Abrasive materials shall not be recycled unless automatic reclamation equipment is used.

15. Powder system shall be automated and shall have the means to filter virgin and recycled powder through a 70-mesh screen. Reworked powder shall not be used.

16. Spider grinders or facing machines shall be available at the plant site for re-facing cutoffs or damaged bevels with Purchaser’s approval.
APPENDIX B – RECOMMENDED SHIPPING, HANDLING AND STORAGE REQUIREMENTS

- **Contaminated Pipe:** Pipe arriving by barge or other means of transportation that could hold liquid should be unloaded immediately upon arrival at the coating yard. If evidence of contamination is found upon arrival or during unloading, the pipe shall be segregated and brought to the attention of Purchaser.

- **Pipe Storage:** Pipe that is stored in the supplier’s yard shall be separated by size, wall thickness and grade. The pipe shall be stored in a way that is clearly identifiable at all times. Pipe that cannot be identified as purchased by Purchaser will not be accepted and shall be replaced at the supplier’s expense.

- **Pipe Unloading:** Pipe arriving in gondolas may be unloaded only by overhead means (crane or forklift with spreader bars). Pipe hooks or non-metallic slings are permissible. Wire rope slings may not be used.
  - Forklift forks do not need to be padded for handling bare pipe but they must be free of burrs or projections that could gouge or scratch pipe. They must also be free of oil, lacquer, etc. that could contaminate the pipe surface.
  - Bare pipe shall be racked off the ground in a manner and location to prevent damage to and/or contamination of the pipe interior or exterior. Racks or berms shall be free of debris or projections that could damage the pipe.
  - Stacking height and number/size of support racks are subject to the acceptance of Purchaser.

- **Pipe Receipt Verification:** The supplier shall furnish a tally sheet to Purchaser, verifying receipt of the pipe.

- **Weld Bevels and Lands:** Weld bevels and lands shall be protected from damage at all times. The supplier is responsible for any damage to pipe weld bevels and lands. Any spacer devices used during the coating process between joints of pipe shall not damage the joint ends or contaminate the ends with any foreign material that would adversely affect pipe welding.

  Bevels, lands and internal coating shall be protected from the abrasive blast cleaning medium and impact at all times. Any abrasive blast media entering the pipe or fittings shall be removed prior to coating application.

  Short joints may be tack-welded before abrasive blast cleaning and coating application only when authorized by Purchaser. Tack-welded pipe shall be cut off and a new bevel established at a position at least ½ in. (12 mm) back from the tacked area.

- **Padding and Handling of Coated Pipe:** Externally coated pipe and fittings shall be cured and cooled to permit handling.

- **Separators:** Before handling, protective separators shall be attached to each joint. Separators shall be of the loop type or they shall be attached to the pipe by non-metallic strapping. Non-
metallic strap that becomes brittle with cold or age shall not be used. Crimps used to bind strapping shall be of a material that avoids damage on adjacent pipe when joints are stored or loaded. The following separator types are approved and considered acceptable. Separators other than those listed below are subject to the approval of inspector(s).

<table>
<thead>
<tr>
<th>Separator Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cardboard sleeves, single piece, waterproofed, ⅛ in. (3.2 mm) minimum thickness, 2 in. (50 mm) minimum width</td>
</tr>
<tr>
<td>B</td>
<td>Dense rubber, ¼ in. (6 mm) minimum thickness, 3 in. (75 mm) minimum width</td>
</tr>
<tr>
<td>C</td>
<td>Dense rubber, ¼ in. (6 mm) minimum thickness, 1.5 in. (38 mm) minimum width</td>
</tr>
<tr>
<td>D</td>
<td>Dense rubber, 0.6 in. (15 mm) minimum thickness, 3 in. (75 mm) minimum width</td>
</tr>
<tr>
<td>E</td>
<td>Rope, polypropylene (PP), tight weave, 3/8 in. (9.5 mm) diameter</td>
</tr>
<tr>
<td>F</td>
<td>Rope, PP, tight weave, ½ in. (13 mm) diameter</td>
</tr>
<tr>
<td>G</td>
<td>Rope, PP, tight weave, 5/8 in. (16 mm) diameter</td>
</tr>
<tr>
<td>H</td>
<td>Rope, PP, tight weave, ¾ in. (19 mm) diameter</td>
</tr>
<tr>
<td>J</td>
<td>Rope, PP, tight weave, 1 in. (25 mm) diameter</td>
</tr>
</tbody>
</table>

The number of separators for each pipe shall be determined by the incremental length of (or fraction of) the longest pipe to be coated. In no case shall any length of pipe have fewer than four separators. Coated pipe destined to be loaded on barges is subject to special requirements, depending on the loading arrangement and as approved by Purchaser.

Separators shall be evenly spaced along the pipe and shall be applied to the pipe before interim storage and before loading on trucks, rail cars, barges or other transportation. Outermost separators, within 2 ft (610 mm) of pipe ends, but no closer than 1 ft (305 mm) from the pipe end shall be secured to prevent fall-off during handling and transportation.

Pipe shall be handled, loaded and stacked in a way that prevents damage to pipe walls, beveled ends and both internal and external coatings.

Solid wood racks or steel racks with wood runners and/or earthen berm covered with plastic shall be used. Racks shall be free of any gravel, nails, grit or other material that could damage the pipe or coating.

Coated pipe may be stacked in layers only if they are separated on wood runners of 2 in. (50 mm) minimum thickness.

NOTE: Coated pipe may be nested if handling is by overhead means, and all pipe hooks, cable and vacuum lifters are properly padded and suitable to handle pipe safely.

Stacking arrangement is subject to the acceptance of the inspector(s). The contractor is responsible for any damage or distortion to the pipe caused by stack load or inadequate bearing surface.

- **Padding of Handling Equipment:** Forks handling coated pipe shall have dense rubber or polyurethane padding, at least 3/16 in. (5 mm) thick, on areas of potential pipe contact. If any portion
of the load is nested, both the top and bottom sides (including the tips) of the forks shall also be padded. The use of forks shall be discontinued and the balance of the order shall be loaded by crane if any damage to pipe or coating occurs.

Coated pipe that is stored at the contractor’s yard before loadout is subject to additional electrical inspection (jeeping) by the contractor if the inspector(s) judges that handling damage has occurred.

- **Separator Chart**: This chart does not apply to barge loadout.

<table>
<thead>
<tr>
<th>Pipe Outside Diameter</th>
<th>Maximum Nominal Weight/Unit Length of Pipe</th>
<th>Acceptable Separator Types</th>
<th>Maximum Incremental Distance Between Separators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lb/ft</td>
<td>kg/m</td>
<td>A, B, C, E or F</td>
</tr>
<tr>
<td>Up to 4½ in.</td>
<td>All</td>
<td>30</td>
<td>B, F or G</td>
</tr>
<tr>
<td>All</td>
<td>45</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>All</td>
<td>104</td>
<td></td>
<td>E</td>
</tr>
<tr>
<td>All</td>
<td>100</td>
<td></td>
<td>G or H</td>
</tr>
<tr>
<td>All</td>
<td>149</td>
<td></td>
<td>B</td>
</tr>
<tr>
<td>All</td>
<td>224</td>
<td></td>
<td>D, H or J</td>
</tr>
<tr>
<td>All</td>
<td>298</td>
<td></td>
<td>G</td>
</tr>
<tr>
<td>All</td>
<td>373</td>
<td></td>
<td>D or J</td>
</tr>
<tr>
<td>All</td>
<td>447</td>
<td></td>
<td>H</td>
</tr>
<tr>
<td>All</td>
<td>597</td>
<td></td>
<td>D or J</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>% Nominal Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seamless</td>
<td>90%</td>
</tr>
<tr>
<td>Welded</td>
<td>92%</td>
</tr>
</tbody>
</table>

The contractor shall be responsible for repairing any damaged bevels. If the inspector(s) determine that a bevel cannot be repaired, the contractor shall be required to use a cutting torch beveling apparatus and a spider grinder to produce a bevel of near-factory quality.

If the inspector(s) determines that an excessive number of bevels are damaged and cannot be repaired, the contractor shall use a facing apparatus to produce a bevel equal in quality to an original factory bevel. The inspector(s)’ judgment about the methods required for satisfactory repairing or re-beveling shall be final.
## APPENDIX C – INSPECTION CHECKLIST

The following items shall be verified:

<table>
<thead>
<tr>
<th>Pre-Coating Inspection</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating, thinning and blasting materials are as specified.</td>
<td></td>
</tr>
<tr>
<td>Storage conditions for all materials are adequate and properly maintained.</td>
<td></td>
</tr>
<tr>
<td>Surfaces not to be coated are masked off or otherwise protected before surface preparation and coating application of adjacent surfaces.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-Surface Preparation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil and grease are removed before surface preparation.</td>
<td></td>
</tr>
<tr>
<td>Welds and sharp edges have been suitably prepared.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surface Preparation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanliness of air supply (free of oil and moisture)</td>
<td></td>
</tr>
<tr>
<td>Cleanliness and dryness of abrasives</td>
<td></td>
</tr>
<tr>
<td>Adequacy of cleaning and blasting equipment, hoses, etc.</td>
<td></td>
</tr>
<tr>
<td>Appropriate ambient, substrate and dew point temperatures for proper surface preparation</td>
<td></td>
</tr>
<tr>
<td>Removal of visible burrs, slivers, scabs and weld spatter after blasting</td>
<td></td>
</tr>
<tr>
<td>Degree of surface cleanliness and removal of contaminants</td>
<td></td>
</tr>
<tr>
<td>Anchor profile as specified by using appropriate instruments</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coating Application</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials are as specified, properly labeled and the shelf life has not been exceeded.</td>
<td></td>
</tr>
<tr>
<td>Mixing, thinning and induction times are in accordance with the coating manufacturer’s instructions for liquid-applied coatings.</td>
<td></td>
</tr>
<tr>
<td>Proper application equipment is being used for each type of coating applied.</td>
<td></td>
</tr>
<tr>
<td>Air supply is clean and free of oil and moisture.</td>
<td></td>
</tr>
<tr>
<td>Ambient, substrate and dew point temperatures are appropriate.</td>
<td></td>
</tr>
<tr>
<td>Applicator is checking wet-film thickness during application for liquid-applied coatings.</td>
<td></td>
</tr>
<tr>
<td>Coating manufacturer’s requirements regarding recoat time are observed.</td>
<td></td>
</tr>
<tr>
<td>Previous coat is sufficiently cured before application of topcoats.</td>
<td></td>
</tr>
<tr>
<td>Each coat has been visually inspected for defects and a uniform appearance.</td>
<td></td>
</tr>
<tr>
<td>DFT is within the specified range after each coat is applied.</td>
<td></td>
</tr>
<tr>
<td>All FBE, polyolefin liquid coatings and heat-shrink sleeve (HSS) external pipe coating systems are applied in accordance with the coating manufacturer’s requirements.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Final Acceptance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coated surface has been visually inspected for defects and uniform appearance.</td>
<td></td>
</tr>
<tr>
<td>Total DFT is within the specified range in accordance with SSPC-PA 2.</td>
<td></td>
</tr>
<tr>
<td>All identified repairs have been completed in accordance with the manufacturer’s recommendations.</td>
<td></td>
</tr>
<tr>
<td>Coating systems are properly cured.</td>
<td></td>
</tr>
<tr>
<td>The applied external coating shall be holiday free. FBE applied to straight pipe shall be tested in accordance with NACE SP0490-2007. Polyolefin coatings shall be tested in accordance with NACE SP0274-2011. Shop and field-applied, FBE and liquid coatings to fittings and other pipeline components shall be tested in accordance with NACE SP0188-2006.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D – BEDDING AND TRENCH BACKFILL

1.1 Backfilling shall be performed in a manner that avoids abrasion or other damage to both factory and field-applied coatings. Unless otherwise specified by the purchaser, the following requirements shall be met:

1.2 Where the trench traverses rocky ground containing hard objects that could penetrate the protective coating, a layer of screened earth, sand, or rounded river-run gravel no less than 6-in. (150-mm) thick with a maximum particle size of 0.75 in. (19 mm) shall be placed in the bottom of the trench prior to installation of the coated article.

1.3 Backfill shall be placed around the exterior of the coated pipe only after the purchaser has made the final inspection and has accepted the exterior coating. If rocks or other hard objects are present in the backfill material along any section of the pipeline, screened backfill shall be placed around the coated pipe to a minimum depth of 6 in. (150 mm) above the coated pipe before backfilling the remainder of the trench. Other rock-shield materials approved by the purchaser may be used.
<table>
<thead>
<tr>
<th>PIP DOC NUMBER/PROJ DOC NUMBER</th>
<th>TITLE</th>
<th>REV</th>
<th>DATE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTSU1000</td>
<td>APPLICATION OF UNDERGROUND COATINGS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D001</td>
<td>DOCUMENTATION REQUIREMENTS SHEET</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D002</td>
<td>UNDERGROUND COATINGS SELECTION CRITERIA SHEET</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D010</td>
<td>UNDERGROUND COATINGS SYSTEM DATA SHEET – USER DEFINED</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D011</td>
<td>UNDERGROUND COATING SYSTEM NO.: 011 SYSTEM DESCRIPTION: FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D012</td>
<td>UNDERGROUND COATING SYSTEM NO.: 012 SYSTEM DESCRIPTION: FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM FOR HIGH TEMPERATURE</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D013</td>
<td>UNDERGROUND COATING SYSTEM NO.: 013 SYSTEM DESCRIPTION: FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM WITH ARO</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D014</td>
<td>UNDERGROUND COATING SYSTEM NO.: 014 SYSTEM DESCRIPTION: FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM WITH ARO FOR HIGH TEMPERATURE</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D015</td>
<td>UNDERGROUND COATING SYSTEM NO.: 015 SYSTEM DESCRIPTION: THREE LAYER POLYOLEFIN (MDPE OR HDPE)</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D016</td>
<td>UNDERGROUND COATING SYSTEM NO.: 016 SYSTEM DESCRIPTION: THREE LAYER POLYOLEFIN (PP)</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D017</td>
<td>UNDERGROUND COATING SYSTEM NO.: 017 SYSTEM DESCRIPTION: LIQUID EPOXY</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D018</td>
<td>UNDERGROUND COATING SYSTEM NO.: 018 SYSTEM DESCRIPTION: LIQUID EPOXY FOR HIGH TEMPERATURE</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D019</td>
<td>UNDERGROUND COATING SYSTEM NO.: 019 SYSTEM DESCRIPTION: FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM FOR FIELD WELDS AND COMPONENTS</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D020</td>
<td>UNDERGROUND COATING SYSTEM NO.: 020 SYSTEM DESCRIPTION: HEAT SHRINK SLEEVES</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTSU1000-D021</td>
<td>UNDERGROUND COATING SYSTEM NO.: 021 SYSTEM DESCRIPTION: VISCOELASTIC TAPE SYSTEM</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROJECT NO.</td>
<td>FACILITY NAME</td>
<td>LOCATION</td>
<td>PROJECT DOCUMENT NO.</td>
<td>UNDERGROUND COATING SYSTEM NO.:</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------</td>
<td>----------</td>
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<td>---------------------------------</td>
</tr>
<tr>
<td>CTSU1000-D022</td>
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<td>NO</td>
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NOTES:
<table>
<thead>
<tr>
<th>SERVICE OR ITEM DESCRIPTION</th>
<th>OPERATING TEMPERATURE °C</th>
<th>SYSTEM NUMBER</th>
<th>REMARKS</th>
</tr>
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<tbody>
<tr>
<td>Straight CS pipe - shop or plant coated</td>
<td>≤65 (≤150)</td>
<td>011</td>
<td>Single Layer FBE</td>
</tr>
<tr>
<td>Straight CS pipe - shop or plant coated</td>
<td>≤110 (≤230)</td>
<td>012</td>
<td>Single Layer High Temperature FBE</td>
</tr>
<tr>
<td>Straight CS pipe - shop or plant coated</td>
<td>≤65 (≤150)</td>
<td>013</td>
<td>Single Layer FBE with ARO (Abrasion Resistant Overcoat)</td>
</tr>
<tr>
<td>Straight CS pipe - shop or plant coated</td>
<td>≤110 (≤230)</td>
<td>014</td>
<td>Single Layer High Temperature FBE with ARO (Abrasion Resistant Overcoat)</td>
</tr>
<tr>
<td>Straight CS pipe - shop or plant coated</td>
<td>-40 to +80 (-40 to +176)</td>
<td>015</td>
<td>Three Layer Polyolefin (MDPE or HDPE)</td>
</tr>
<tr>
<td>Straight CS pipe - shop or plant coated</td>
<td>-20 to +110 (-4 to +230)</td>
<td>016</td>
<td>Three Layer Polyolefin (PP)</td>
</tr>
<tr>
<td>Straight or fabricated CS pipe, fittings, spools, pig launchers and all components - shop or field coated</td>
<td>≤65 (≤150)</td>
<td>017</td>
<td>Liquid coating that can be applied in a shop or in the field. Application does not require heating of components above 40°C (104°F) to be coated. May be used as an optional liquid abrasion resistant overcoat (ARO) for FBE or liquid coatings.</td>
</tr>
<tr>
<td>Straight or fabricated CS pipe. Includes all steel components that can be heated to 250°C (480°F) for FBE coating application. Spools, fittings, pig launchers and receivers, etc. System 019 may also be applied in the field to girth welds.</td>
<td>≤110 (≤230)</td>
<td>019</td>
<td>FBE powder coating. Excludes items that are too big for ovens and items that contain components that can be damaged by 250°C (480°F) heat such as valves and pumps.</td>
</tr>
<tr>
<td>U/G CS girth welds - field coated</td>
<td>≤65 (≤150)</td>
<td>017 or 019 or 020</td>
<td>Straight pipe that was shop coated with FBE for 65°C (150°F) Service</td>
</tr>
<tr>
<td>U/G CS girth welds - field coated</td>
<td>≤110 (≤230)</td>
<td>018 or 019 or 020</td>
<td>Straight pipe that was shop coated with FBE for 110°C (230°F) Service</td>
</tr>
<tr>
<td>U/G CS girth welds - field coated</td>
<td>≤80 (≤176)</td>
<td>020</td>
<td>Straight pipe that was shop coated with three layer polyolefin for 80°C (176°F) Service</td>
</tr>
<tr>
<td>U/G CS girth welds - field coated</td>
<td>≤110 (≤230)</td>
<td>020</td>
<td>Straight pipe that was shop coated with three layer polyolefin for 110°C (230°F) Service</td>
</tr>
<tr>
<td>Viscoselastic Tape</td>
<td>≤71 (≤160)</td>
<td>021</td>
<td>Higher temperature version available. For small projects where abrasive blasting is not practical or possible.</td>
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<tr>
<td>Petrolatum Tape</td>
<td>≤40 (≤104)</td>
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<td>Higher temperature version available. For small projects where abrasive blasting is not practical or possible.</td>
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<tr>
<td>Petrolatum Tape Wrap System</td>
<td>By Manufa</td>
<td>By Manufac</td>
<td>023</td>
</tr>
</tbody>
</table>
NOTES:

1. FBE powder may mean epoxy powder, epoxy phenolic powder or epoxy novolac powder. See Coating System Data Sheet (CSDS) for specific manufacturer names and numbers. FBE powder used in this standard shall be qualified according to the requirements of ISO 21809-2, Table 2 for the service temperature category shown on the CSDS.

2. The term "ARO" means "abrasion resistant overcoat." A FBE ARO or liquid ARO may be applied to protect the primary corrosion barrier FBE on pipes that are pulled through bore holes, under roadways or installed in rocky soil or used for horizontal directional drilling (HDD).

3. Liquid epoxy may mean liquid epoxy, liquid epoxy phenolic, liquid epoxy novolac or liquid modified epoxy. See CSDS for specific manufacturer names and numbers. Liquid coatings used in this standard shall be qualified according to the performance requirements of ISO 21809-2 for the service temperature category shown on the CSDS.

4. Liquid Coating Systems 017 and 018 and FBE Coating System 019 are performance equivalent protective coatings for the same service as Coating Systems 011 and 012. The choice of which system to select depends on the item to be coated, whether the item will be coated in a shop or plant or in the field, and the capabilities of the available coating applicators. Items such as valves and pumps that have bi-metallic components or non-metallic components such as seals and packing that can be damaged by the metal temperature (250°C or 480°F) necessary to apply FBE coatings should be coated with the liquid coating system 017 or 018, depending on the operating temperature.

5. The term "operating temperature" as used in this selection guide means the temperature of the product being transported in the pipeline. If steam-out or hot oil is used to treat the pipeline occasionally, then the higher temperature of the steam or oil shall be used.

6. The operating temperatures shown in the second column of this selection guide designate the normal upper service temperature limit of the type of coating shown. Specific coating materials from different coating manufacturers may have maximum service temperatures that are slightly different from the temperature shown in the second column. See the CSDS or the manufacturer product literature for details on specific products. The coating manufacturers listed in the CSDS have reviewed these documents and have approved the use of their product as described herein.

7. Coatings for the service category ≤65°C (≤150°F) shall be qualified by testing according to ISO 21809-2, Table 2. Coatings for the coating category ≤80°C (≤176°F) shall be qualified by performing the hot water adhesion and hot cathodic disbonding testing at 80°C (176°F) instead of at 65°C (150°F). Coatings for the coating category ≤110°C (≤230°F) shall be qualified by performing the hot water adhesion and hot cathodic disbonding testing at 110°C (230°F) instead of at 65°C (150°F). This includes FBE coatings, liquid coatings, polyolefin coatings and heat shrink sleeves (HSS).
UNDERGROUND COATINGS SYSTEM DATA SHEET – USER DEFINED

ASSOC. PIP: CTSU1000

UNDERGROUND COATINGS
SYSTEM DATA SHEET

PROJECT NO.*

FACILITY NAME

LOCATION

COATINGS SYSTEM NO.:

SYSTEM DESCRIPTION:

SURFACES:

SURFACE PREPARATION:

REFERENCES

The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)

The Society for Protective Coatings (SSPC)

SYSTEM

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
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<tr>
<td>2.</td>
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<td>3.</td>
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<tr>
<td>4.</td>
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<tr>
<td>5.</td>
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<tr>
<td>Total:</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

* Application Method: B = Brush; R = Roller; S = Spray

Apply in accordance with manufacturer’s instructions.

System Notes:

Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.
Mixing and Thinning: Mix in accordance with manufacturer’s instructions

Application: Apply in accordance with manufacturer’s instructions and PIP CTSU1000.

Job Stencil Required: Yes ☐ No ☐

Repair: 

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>COAT 1</th>
<th>COAT 2</th>
<th>COAT 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(      )</td>
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</tbody>
</table>

Material Notes:
ASSOC. PIP: CTSU1000 UNDERGROUND COATINGS SYSTEM DATA SHEET PIP CTSU1000-D011

FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM PAGE 1 OF 2 JULY 2018

PROJECT NO. PROJECT DOCUMENT NO. FACILITY NAME LOCATION

COATINGS SYSTEM NO.: 011

SYSTEM DESCRIPTION: Fusion-Bonded Epoxy (FBE) Single Coat External Pipe System. A system of thermosetting epoxy powder for below ground service at temperatures ≤65°C (150°F).

SURFACES: Carbon steel

SURFACE PREPARATION: Abrasive blast per SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

REFERENCES
The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)
ISO 8504-2, Preparation of Steel Substrates Before Application of Paints and Related Products - Surface Preparation Methods - Part 2: Abrasive Blast-Cleaning-second edition Near White Metal Sa 2½
ISO 21809-2, Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

NACE International
NACE SP0490-2007, Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760 µm (10 to 30 mil).

The Society for Protective Coatings (SSPC)
SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 11, Power Tool Cleaning to Bare Metal

SYSTEM

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/ Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>FBE</td>
<td>Epoxy</td>
<td>S</td>
<td>375 (15.0)</td>
<td>600 (24.0)</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
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<td>3.</td>
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<td></td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td></td>
<td></td>
<td>375 (15.0)</td>
<td>600 (24.0)</td>
<td></td>
</tr>
</tbody>
</table>

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

System Notes:
Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

Cutback - The pipe surface within 50 mm (2 in.) plus or minus 13 mm (½ in.) of the weld bevel shall not be coated. The weld bevel and the land shall be protected from abrasive blast and from coating. Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. The use of recycled powder (powder which is automatically and continuously recycled from the coating hood back into the powder supply) will only be allowed if permitted by the coating manufacturer. If permitted, these guidelines shall be followed: (a) The ratio of recycled powder to virgin powder shall not exceed 20%. (b) Recycled powder shall be subjected to magnetic separators and particle size screening with sieves of 80 mesh U.S. sieve size or finer. Magnets shall be inspected and cleaned a minimum of twice per shift. (c) Recycled coating powder shall be uniformly distributed among coating spray heads. Cured coating shall be tested for holidays in accordance with NACE SP0490-2007.

Mixing and Thinning: Mix in accordance with manufacturer’s instructions.

Application: Apply in accordance with manufacturer’s instructions and ISO 21809-2.
**Repair:**

All coating defects and damage found by visual and holiday inspection, including defects produced by tests, shall be recoated or repaired. Material for coating repairs shall be a two-component liquid epoxy furnished by the FBE manufacturer or listed on CSDS 017 (See material notes below.) The maximum size of holiday that may be repaired and the maximum number of holidays that may be repaired shall be in accordance with ISO 21809-2, Section 10.2.3.6.2, Acceptance Criteria. Patched areas shall overlap the parent coating a minimum of 25 mm (1 in.). Remove pinholes by sanding to bare metal. If damaged area is down to bare steel, power tool clean to bare metal per SSPC-SP 11. Feather edges and apply liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. Small areas can be touched up using a bristle brush. On larger areas, spray application will be required. Application of repair coating shall conform to the manufacturer’s instructions. If the damaged area does not penetrate the epoxy and expose bare metal, abrade the surface per SSPC-SP 2 and/or SSPC-SP 3, feather edges, and apply the liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. All repairs are subject to holiday testing at the discretion of the purchaser’s inspector. Minimum thickness of coating in the repair area is 625 µm (25 mils).

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>COAT 1 (Epoxy Powder)</th>
<th>COAT 2 (Liquid Epoxy Repair)</th>
<th>COAT 3</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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</tr>
</tbody>
</table>

**Material Notes:**

Coating material epoxy powders shall be qualified for this service per ISO 21809-2. The terms “epoxy” and “FBE” as used in this data sheet shall mean a powder coating material that has been qualified per ISO 21809-2 for continuous service at 65 °C (150 °F). It may actually be an epoxy, epoxy novolac, epoxy phenolic or some other hybrid of generic types. The liquid coatings listed on CSDS 017 may be used for repair of any of the powder coatings listed on CSDS 011 for service up to 65 °C (150 °F).
FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM FOR HIGH TEMPERATURE

SYSTEM DESCRIPTION: Fusion-Bonded Epoxy (FBE) Single Coat External Pipe Coating System. A system of thermosetting epoxy powder for below ground service at temperatures up to 110°C (230°F).

SURFACES: Carbon steel

SURFACE PREPARATION: SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 20 mg/m² (2 µg/cm²) chlorides.

REFERENCES
The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)
ISO 8504-2, Preparation of Steel Substrates Before Application of Paints and Related Products - Surface Preparation Methods
- Part 2: Abrasive Blast-Cleaning-second edition Near White Metal Sa 2½
ISO 21809-2, Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

NACE International
NACE SP0490-2007, Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760 µm (10 to 30 mil)
The Society for Protective Coatings (SSPC)
SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 11, Power Tool Cleaning to Bare Metal

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>FBE</td>
<td>Epoxy</td>
<td>S</td>
<td>375 (15.0)</td>
<td>600 (24.0)</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
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<td></td>
<td>Total: 375 (15.0)</td>
<td>600 (24.0)</td>
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</tr>
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</table>

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

**System Notes:**
Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

Cutback - The pipe surface within 50 mm (2 in.) plus or minus 13 mm (½ in.) of the weld bevel shall not be coated. The weld bevel and the land shall be protected from abrasive blast and from coating. Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. The use of recycled powder (powder which is automatically and continuously recycled from the coating hood back into the powder supply) will only be allowed if permitted by the coating manufacturer. If permitted, these guidelines shall be followed: (a) The ratio of recycled powder to virgin powder shall not exceed 20%. (b) Recycled powder shall be subjected to magnetic separators and particle size screening with sieves of 80 mesh U.S. sieve size or finer. Magnets shall be inspected and cleaned a minimum of two times per shift. (c) Recycled coating powder shall be uniformly distributed among coating spray heads. Cured coating shall be tested for holidays in accordance with NACE SP0490-2007.

Mixing and Thinning: Mix in accordance with manufacturer’s instructions.

Application: Apply in accordance with manufacturer’s instructions and ISO 21809-2.
Repair:

All coating defects and damage found by visual and holiday inspection, including defects produced by tests, shall be recoated or repaired. Material for coating repairs shall be a two-component liquid epoxy furnished by the FBE manufacturer or listed on CSDS 018. (See material notes below.) The maximum size of holiday that may be repaired and the maximum number of holidays that may be repaired shall be in accordance with ISO 21809-2, Section 10.2.3.6.2, Acceptance Criteria. Patched areas shall overlap the parent coating a minimum of 25 mm (1 in.). Remove pinholes by sanding to bare metal. If damaged area is down to bare steel, power tool clean to bare metal per SSPC-SP 11. Feather edges and apply liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. Small areas can be touched up using a bristle brush. On larger areas, spray application will be required. Application of repair coating shall conform to the manufacturer’s instructions. If the damaged area does not penetrate the epoxy and expose bare metal, abrade the surface per SSPC-SP 2 and/or SSPC-SP 3, feather edges, and apply the liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. All repairs are subject to holiday testing at the discretion of the purchaser's inspector. Minimum thickness of coating in the repair area is 625 µm (25 mils).

MANUFACTURER | COAT 1 (Epoxy Powder) | COAT 2 (Epoxy Powder) | COAT 3 (Liquid Epoxy Repair)
--- | --- | --- | ---

Material Notes:

Coating material epoxy powders shall be qualified for this service per ISO 21809-2, Table 2. Coatings for the coating category ≤110°C (≤230°F) shall be qualified by performing the hot water adhesion and hot cathodic disbonding testing at 110°C (230°F) instead of at 65°C (150°F). This includes FBE coatings, liquid coatings, polyolefin coatings and heat shrink sleeves (HSS). Cathodic disbondment at 110°C (230°F), 28 days, -1.5 Volts shall be less than 25 mm (1 in.). The terms epoxy and FBE as used in this data sheet shall mean a powder coating material that has been qualified per ISO 21809-2 for continuous service at 110°C (230°F). It may actually be an epoxy, epoxy novolac, epoxy phenolic or some other hybrid of generic types. The liquid coatings listed on CSDS 018 may be used for repair of any of the powder coatings listed on this CSDS 012 for service up to 110°C (230°F).
FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM WITH ARO

SYSTEM DESCRIPTION: Fusion-Bonded Epoxy (FBE) Two Coat External Pipe Coating System with Abrasion Resistant Overcoat (ARO). A system of thermosetting epoxy powder for below ground service at temperatures up to 65°C (150°F).

SURFACES: Carbon steel

SURFACE PREPARATION: Abrasive blast per SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

REFERENCES

The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)
ISO 8504-2, Preparation of Steel Substrates Before Application of Paints and Related Products - Surface Preparation Methods - Part 2: Abrasive Blast-Cleaning-second edition Near White Metal Sa 2½
ISO 21809-2, Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

NACE International
NACE SP0394-2013, Application, Performance, and Quality Control of Plant-Applied, Fusion-Bonded Epoxy External Pipe Coating
NACE SP0490-2007, Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760 µm (10 to 30 mil)

The Society for Protective Coatings (SSPC)
SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 11, Power Tool Cleaning to Bare Metal

SYSTEM

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/ Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>FBE</td>
<td>Epoxy</td>
<td>S</td>
<td>200 (8)</td>
<td>300 (12)</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>ARO</td>
<td>Abrasion resistant overcoat</td>
<td>S</td>
<td>200 (8)</td>
<td>750 (30.0)</td>
<td>S</td>
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<tr>
<td>Total:</td>
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<td></td>
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<td>400 (16)</td>
<td>1050 (42)</td>
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</tr>
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</table>

*Application Method: B= Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

System Notes:

Unless otherwise specified, refer to the coating manufacturer's data sheet(s) for information on the recommended application temperature and other technical information.

Cutback - The pipe surface within 50 mm (2 in.) plus or minus 13 mm (½ in.) of the weld bevel shall not be coated. The weld bevel and the land shall be protected from abrasive blast and from coating. Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. Cured coating shall be tested for holidays in accordance with NACE RP0490. If more than 200 µm (8.0 mils) minimum is required for the second coat, the required minimum thickness will be specified in the procurement documents. It may be impossible to bend pipe with a total coating thickness of 500 µm (20 mils) or more, especially at lower temperatures. Consult coating manufacturer for details.

Mixing and Thinning: Mix in accordance with manufacturer's instructions.

Application: Apply in accordance with manufacturer’s instructions and ISO 21809-2.
Repair:

All coating defects and damage found by visual and holiday inspection, including defects produced by tests, shall be recoated or repaired. Material for coating repairs shall be a two-component liquid epoxy furnished by the FBE manufacturer or listed on CSDS 017. (See material notes below.) The maximum size of holiday that may be repaired and the maximum number of holidays that may be repaired shall be in accordance with ISO 21809-2, Section 10.2.3.6.2, Acceptance Criteria. Patched areas shall overlap the parent coating a minimum of 25 mm (1 in.). Remove pinholes by sanding to bare metal. If damaged area is down to bare steel, power tool clean to bare metal per SSPC-SP 11. Feather edges and apply liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. Small areas can be touched up using a bristle brush. On larger areas, spray application will be required. Application of repair coating shall conform to the manufacturer’s instructions. If the damaged area does not penetrate the epoxy and expose bare metal, abrade the surface per SSPC-SP 2 and/or SSPC-SP 3, feather edges, and apply the liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. All repairs are subject to holiday testing at the discretion of the purchaser’s inspector. Minimum thickness of coating in the repair area is 625 µm (25 mils).

Material Notes:

Coating material epoxy powders shall be qualified for this service per ISO 21809-2. The terms "epoxy" and "FBE" as used in this data sheet shall mean a powder coating material that has been qualified per ISO 21809-2 for continuous service at 65°C (150°F). It may actually be an epoxy, epoxy novolac, epoxy phenolic or some other hybrid of generic types. The first layer of FBE shall be with 100% virgin powder and shall have a porosity rating of 2 or better per NACE SP0394, Appendix G. The use of recycled powder (powder which is automatically and continuously recycled from the coating hood back into the powder supply) will only be allowed if permitted by the coating manufacturer. If permitted, these guidelines shall be followed: (a) The ratio of recycled powder to virgin powder shall not exceed 20%. (b) Recycled powder shall be subjected to magnetic separators and particle size screening with sieves of 80 mesh U.S. sieve size or finer. Magnets shall be inspected and cleaned a minimum of two times per shift. (c) Recycled coating powder shall be uniformly distributed among coating spray heads. The liquid coatings listed on CSDS 017 may be used for repair of any of the powder coatings listed on this CSDS 013 for service up to 65°C (150°F).
**ASSOC. PIP: CTSU1000**

**UNDERGROUND COATINGS SYSTEM DATA SHEET**

**PIP CTSU1000-D014**

**FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM WITH ARO FOR HIGH TEMPERATURE**

**PAGE 1 OF 2**

**JULY 2018**

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**PROJECT NO.**

**PROJECT DOCUMENT NO.**

**FACILITY NAME**

**LOCATION**

**COATINGS SYSTEM NO.:** 014

**SYSTEM DESCRIPTION:** Fusion-Bonded Epoxy (FBE) Two Coat External Pipe Coating System with Abrasion Resistant Overcoat (ARO). A system of thermosetting epoxy for below ground or submerged service at temperatures up to 110°C (230°F).

**SURFACES:** Carbon steel

**SURFACE PREPARATION:** Abrasive blast per SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

**REFERENCES**

The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

**International Organization for Standardization (ISO)**

- ISO 8504-2 Preparation of Steel Substrates Before Application of Paints and Related Products - Surface Preparation Methods - Part 2: Abrasive Blast-Cleaning-second edition Near White Metal Sa 2½
- ISO 21809-2 Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

**NACE International**

- NACE SP0394-2013 Application, Performance, and Quality Control of Plant-Applied, Fusion-Bonded Epoxy External Pipe Coating
- NACE SP0490-2007 Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760 µm (10 to 30 mil)

**The Society for Protective Coatings (SSPC)**

- SSPC-SP 2, Hand Tool Cleaning
- SSPC-SP 3, Power Tool Cleaning
- SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
- SSPC-SP 11, Power Tool Cleaning to Bare Metal

**SYSTEM**

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/ Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>FBE</td>
<td>Epoxy</td>
<td>S</td>
<td>200 (8)</td>
<td>300 (12)</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>ARO</td>
<td>Abrasion resistant overcoat</td>
<td>S</td>
<td>200 (8)</td>
<td>750 (30)</td>
<td>S</td>
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<td><strong>Total:</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>400 (16)</strong></td>
<td><strong>1050 (42)</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

**System Notes:**

Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

- **Cutback** - The pipe surface within 50 mm (2 in.) plus or minus 13 mm (½ in.) of the weld bevel shall not be coated. Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. Cured coating shall be tested for holidays in accordance with NACE RP0490. If more than 200 µm (8.0 mils) minimum is required for the second coat, the required minimum thickness will be specified in the procurement documents. It may not be possible to bend pipe with a total coating thickness of 500 µm (20 mils) or more, especially at lower temperatures. Consult coating manufacturer for details.

**Mixing and Thinning:** Mix in accordance with manufacturer’s instructions.

**Application:** Apply in accordance with manufacturer’s instructions and ISO 21809-2.
**Repair:**

All coating defects and damage found by visual and holiday inspection, including defects produced by tests, shall be recoated or repaired. Material for coating repairs shall be a two-component liquid epoxy furnished by the FBE manufacturer or listed on CSDS 017. (See material notes below.) The maximum size of holiday that may be repaired and the maximum number of holidays that may be repaired shall be in accordance with ISO 21809-2, Section 10.2.3.6.2, Acceptance Criteria. Patched areas shall overlap the parent coating a minimum of 25 mm (1 in.). Remove pinholes by sanding to bare metal. If damaged area is down to bare steel, power tool clean to bare metal per SSPC-SP 11. Feather edges and apply liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. Small areas can be touched up using a bristle brush. On larger areas, spray application will be required. Application of repair coating shall conform to the manufacturer’s instructions. If the damaged area does not penetrate the epoxy and expose bare metal, abrade the surface per SSPC-SP 2 and/or SSPC-SP 3, feather edges, and apply the liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. All repairs are subject to holiday testing at the discretion of the purchaser’s inspector. Minimum thickness of coating in the repair area is 625 µm (25 mils).

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>COAT 1 (Epoxy Powder)</th>
<th>COAT 2 (Epoxy Powder)</th>
<th>COAT 3 (Liquid Epoxy Repair)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Material Notes:**

Coating material epoxy powders shall be qualified for this service per ISO 21809-2, Table 2. Coatings for the coating category ≤110°C (≤230°F) shall be qualified by performing the hot water adhesion and hot cathodic disbonding testing at 110°C (230°F) instead of at 65°C (150°F). This includes FBE coatings, liquid coatings, polyolefin coatings, and heat shrink sleeves (HSS). Cathodic disbondment at 110°C (230°F), 28 days, -1.5 Volts shall be less than 25 mm (1 in.). The terms “epoxy” and “FBE” as used in this data sheet shall mean a powder coating material that has been qualified per ISO 21809-2 for continuous service at 110°C (230°F). It may actually be an epoxy, epoxy novolac, epoxy phenolic or some other hybrid of generic types. The first layer of FBE shall be with 100% virgin powder and shall have a porosity rating of 2 or better per NACE SP0394, Appendix G. The use of recycled powder (powder which is automatically and continuously recycled from the coating hood back into the powder supply) will only be allowed if permitted by the coating manufacturer. If permitted, these guidelines shall be followed: (a) The ratio of recycled powder to virgin powder shall not exceed 20%. (b) Recycled powder shall be subjected to magnetic separators and particle size screening with sieves of 80 mesh U.S. sieve size or finer. Magnets shall be inspected and cleaned a minimum of two times per shift. (c) Recycled coating powder shall be uniformly distributed among coating spray heads. The liquid coatings listed on CSDS 018 may be used for repair of any of the powder coatings listed on this CSDS 014 for service up to 110°C (230°F).
ASSOC. PIP: CTSU1000
UNDERGROUND COATINGS SYSTEM DATA SHEET
PIP CTSU1000-D015
THREE LAYER POLYOLEFIN (MDPE OR HDPE)

NO. DATE REVISION DESCRIPTION BY CHECKED APPROVED

PROJECT NO. PROJECT DOCUMENT NO.
FACILITY NAME LOCATION

COATINGS SYSTEM NO.: 015

SYSTEM DESCRIPTION: Three layer polyolefin system as an external pipe coating system for straight pipe. A system consisting of a thermosetting epoxy powder layer, an adhesive layer, and a polyolefin layer. The polyolefin layer may be Medium Density Polyethylene (MDPE) or High Density Polyethylene (HDPE) for below ground service at temperatures up to 80°C (176°F).

SURFACES: Carbon steel

SURFACE PREPARATION: Abrasive blast per SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

REFERENCES
The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)
ISO 21809-1 Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 1: Polyolefin coatings (3-layer PE and 3-layer PP)
The Society for Protective Coatings (SSPC)
SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 11, Power Tool Cleaning to Bare Metal

SYSTEM

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>FBE</td>
<td>Epoxy</td>
<td>S</td>
<td>150 (6)</td>
<td>300 (12)</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>ADH</td>
<td>Adhesive</td>
<td></td>
<td>251 (10)</td>
<td>380 (15)</td>
<td>S</td>
</tr>
<tr>
<td>3.</td>
<td>PE</td>
<td>MDPE or HDPE</td>
<td></td>
<td>** (**)</td>
<td>** (**)</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total: ** (**)</td>
<td>** (**)</td>
<td></td>
</tr>
</tbody>
</table>

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer's instructions.

System Notes:
Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

**The total thickness shall be determined according to ISO 21809-1 Table 2 - Minimum total coating thickness shall be determined for each project using the recommendations for Class B for MDPE or HDPE polyolefin. Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. A 100 mm ± 13 mm (4 ± ½ in.) cutback, measured from the shoulder of the weld bevel, shall be provided at each pipe end. To achieve this cutback, the topcoat shall be cut just after cooling and removed manually. The stripped ends shall be steel wire brushed clean, leaving the FBE undercoat. The edges of the topcoat shall be tapered in order to ensure a satisfactory bonding of joints on site. The width of the taper shall be approximately 13 mm (½ in.). The epoxy primer shall be removed for a distance of approximately 50 mm (2 in.) at each pipe end. This primer cutback area, as well as lands, bevels, and any internal surface within 13 mm (½ in.) of the land, shall be completely free of any coating or adhesive.

Mixing and Thinning: Mix in accordance with manufacturer’s instructions.

Application: Apply in accordance with manufacturer’s instructions and ISO 21809-1.
Repair:

All coating defects and damages found by visual and holiday inspection, including defects produced by tests, shall be recoated or repaired. All repairs are subject to holiday testing at the discretion of the purchaser's inspector. The damaged three-layer coating shall be repaired with System 020 heat shrink sleeve (HSS) or equal. The epoxy primer furnished by the HSS manufacturer shall be used to repair the FBE epoxy primer. Remove pinholes in the FBE epoxy primer by sanding to bare metal. SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides. Installation shall comply with the requirements contained in the HSS manufacturer's product data sheets and the HSS manufacturer's installation guide. The bristle blaster is the only alternative to abrasive blasting that may be approved for surface preparation for repairs and girth welds. If used, the bristle blaster must produce the same level of cleanliness and density and depth of profile produced by the abrasive blasting process.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>COAT 1</th>
<th>COAT 2</th>
<th>COAT 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Epoxy Powder)</td>
<td>(Adhesive Layer)</td>
<td>(Liquid Epoxy Repair)</td>
</tr>
</tbody>
</table>

Material Notes:

Coating material epoxy powders, adhesives, and polyolefins shall be qualified for this service per ISO 21809-1. The use of recycled powder (powder which is automatically and continuously recycled from the coating hood back into the powder supply) will only be allowed if permitted by the coating manufacturer. If permitted, these guidelines shall be followed: (a) The ratio of recycled powder to virgin powder shall not exceed 20%. (b) Recycled powder shall be subjected to magnetic separators and particle size screening with sieves of 80 mesh U.S. sieve size or finer. Magnets shall be inspected and cleaned a minimum of two times per shift. (c) Recycled coating powder shall be uniformly distributed among coating spray heads. Girth welds shall be coated with System 020 heat shrink sleeve (HSS) or equal. SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides. Installation shall comply with the requirements contained in the HSS Manufacturer's Installation Guide. The liquid coatings listed on CSDS 018 may be used for repair of any of the powder coatings listed on this CSDS 015 for service up to 80°C (176°F).
**SYSTEM DESCRIPTION:** Three layer polyolefin system as an external pipe coating system for straight pipe. A system consisting of a thermostetting epoxy powder layer, an adhesive layer, and a polyolefin layer. The polyolefin layer shall be Polypropylene (PP) for below ground service at temperatures up to 110°C (230°F).

**SURFACES:** Carbon steel

**SURFACE PREPARATION:** Abrasive blast per SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

**REFERENCES**

The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

**International Organization for Standardization (ISO)**


ISO 21809-2 Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

**The Society for Protective Coatings (SSPC)**

SSPC-SP 2, Hand Tool Cleaning

SSPC-SP 3, Power Tool Cleaning

SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning

SSPC-SP 11, Power Tool Cleaning to Bare Metal

**SYSTEM**

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/ Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>FBE</td>
<td>Epoxy</td>
<td>S</td>
<td>150 (6)</td>
<td>300 (12)</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>ADH</td>
<td>Adhesive</td>
<td></td>
<td>250 (10.0)</td>
<td>380 (15.0)</td>
<td>S</td>
</tr>
<tr>
<td>3.</td>
<td>PP</td>
<td>Polypropylene</td>
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<td>** (**)</td>
<td>** (**)</td>
<td>** (**)</td>
</tr>
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<td><strong>Total:</strong></td>
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<td></td>
<td></td>
<td>** (**)</td>
<td>** (**)</td>
<td>** (**)</td>
</tr>
</tbody>
</table>

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

**System Notes:**

Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

**The total thickness shall be determined according to ISO 21809-1, Table 2 - Minimum total coating thickness for each project shall be determined using the recommendations for Class C for PP.**

Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. A 100 mm ± 13 mm (4 ± ½ in.) cutback, measured from the shoulder of the weld bevel, shall be provided at each pipe end. To achieve this cutback, the topcoat shall be cut just after cooling and removed manually. The stripped ends shall be steel wire brushed clean, leaving the FBE undercoat. The edges of the topcoat shall be tapered in order to ensure a satisfactory bonding of joints on site. The width of the taper shall be approximately 13 mm (½ in.). The epoxy primer shall be removed for a distance of approximately 50 mm (2 in.) at each pipe end. This primer cutback area, as well as lands, bevels, and any internal surface within 13 mm (½ in.) of the land, shall be completely free of any coating or adhesive.

**Mixing and Thinning:** Mix in accordance with manufacturer’s instructions.

**Application:** Apply in accordance with manufacturer’s instructions and ISO 21809-1.
Repair:
All coating defects and damages found by visual and holiday inspection, including defects produced by tests, shall be recoated or repaired. All repairs are subject to holiday testing at the discretion of the purchaser's inspector. The damaged three layer coating shall be repaired with System 020 heat shrink sleeve (HSS) or equal. The epoxy primer furnished by the HSS manufacturer shall be used to repair the FBE epoxy primer. Remove pinholes in the FBE epoxy primer by sanding to bare metal. SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides. Installation shall comply with the requirements contained in the HSS manufacturer's product data sheets and the HSS manufacturer's installation guide. The bristle blaster is the only alternative to abrasive blasting that may be approved for surface preparation for repairs and girth welds. If used, the bristle blaster must produce the same level of cleanliness, and density and depth of profile produced by the abrasive blasting process.

Material Notes:
Coating material epoxy powders, adhesives, and polyolefins shall be qualified for this service per ISO 21809-1. The use of recycled powder (powder which is automatically and continuously recycled from the coating hood back into the powder supply) will only be allowed if permitted by the coating manufacturer. If permitted, these guidelines shall be followed: (a) The ratio of recycled powder to virgin powder shall not exceed 20%. (b) Recycled powder shall be subjected to magnetic separators and particle size screening with sieves of 80 mesh U.S. sieve size or finer. Magnets shall be inspected and cleaned a minimum of two times per shift. (c) Recycled coating powder shall be uniformly distributed among coating spray heads. Girth welds shall be coated with System 020 heat shrink sleeve (HSS) or equal. SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides. Installation shall comply with the requirements contained in the HSS Manufacturer's Installation Guide. The liquid coatings listed on CSDS 018 may be used for repair of any of the powder coatings listed on this CSDS 016 for service up to 110°C (230°F).
LIQUID EPOXY

**SYSTEM DESCRIPTION:** A system of liquid coating for below-ground service at temperatures up to 65°C (150°F). These liquid coatings may be used over bare steel for straight or fabricated carbon steel pipe, fittings, spools, valves, pumps, pig launchers and receivers, pipe to soil penetrations, and other miscellaneous equipment that may be wholly or partially buried and all components - shop or field coated. This liquid coating may also be used for coating girth welds and it may be used as an abrasion resistant overcoat (ARO) over fusion-bonded epoxy (FBE) or an existing liquid coating.

**SURFACES:** Carbon steel, may also be used on other metals.

**SURFACE PREPARATION:** For Bare Steel: SSPC-SP 10 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils).
For FBE or Galvanized Steel: SSPC-SP 16 with a fine (40 to 100 mesh) abrasive.
For Stainless Steel: SSPC-SP 16 with a garnet abrasive that will produce a profile of 25 to 50 µm (1 to 2 mils).
The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

**REFERENCES**
The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

**International Organization for Standardization (ISO)**
ISO 21809-2 Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

**NACE International**
NACE SP0188-2006, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE SP0178, Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service

**The Society for Protective Coatings (SSPC)**
SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 11, Power Tool Cleaning to Bare Metal
SSPC-SP 16, Brush-Off Blast Cleaning

**SYSTEM**

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>LE</td>
<td>Epoxy</td>
<td>S,B,R</td>
<td>625 (25)</td>
<td>1000 (40)</td>
<td>S,B,R</td>
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<td>2.</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total: 625 (25) 1000 (40)

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.
PROJECT NO.  
PROJECT DOCUMENT NO.  
FACILITY NAME  
LOCATION  
COATINGS SYSTEM NO.: 017

System Notes: Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information. This liquid coating may be applied to an existing FBE coating or it may be applied directly to bare steel. This liquid coating may be applied in one or more coats according to the specific product properties and the complexity of the part to be coated. Cutback - The pipe surface within 50 mm (2 in.) of the weld bevel shall not be coated unless the girth weld has already been performed. Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. Corners, edges, bolts, welds, and other irregularities shall be stripe coated. Corners and edges of metal to be coated shall be rounded to a minimum of 3 mm (0.12 in.) radius prior to abrasive blasting. The coating shall be tested for holidays per NACE SP0188. Any holidays found shall be repaired and re-tested to confirm that the repair eliminated the holiday. If this coating system is used as a girth weld coating, or if it is used as a coating for fabricated pipeline components, the welds shall be prepared in accordance with NACE SP0178, Weld Designation D for liquid applied linings. If abrasive blasting is prohibited, SSPC-SP 11 shall be performed using a bristle blaster to produce a minimum 25 µm (1 mil) dense, angular profile.

Mixing and Thinning: Mix in accordance with manufacturer’s instructions.

Application: Apply in accordance with manufacturer’s instructions and this standard.

Repair: All coating defects and damage, including defects produced by tests, shall be recoated or repaired. Material for coating repairs shall be the same liquid epoxy from the same manufacturer as the liquid epoxy coating. Patched areas shall overlap the parent coating a minimum of 25 mm (1 in.). If damaged area is down to bare steel, power tool clean to bare metal per SSPC-SP 11. Feather edges and apply liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. If the liquid epoxy is used as an ARO over FBE, apply liquid coating in one or more coats to establish a minimum dry film thickness (DFT) of 1,000 µm (40 mils). Small areas can be touched up using a bristle brush. On larger areas, spray application will be required. Application of repair coating shall conform to the coating manufacturer’s instructions. If damaged area does not penetrate the epoxy and expose bare metal, abrade the surface per SSPC-SP 2 and/or SSPC-SP 3, feather edges, and apply the liquid epoxy coating to establish a minimum thickness 625 µm (25 mils) in the repair area. All repairs are subject to holiday testing at the discretion of the purchaser’s inspector. Minimum thickness of the protective coating in the repair area is 625 µm (25 mils). Minimum total thickness of the coating for ARO service is 1,000 µm (40 mils).

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>(Bare Steel or Epoxy Powder)</th>
<th>COAT 2 (if over FBE)</th>
<th>COAT 3 (if over FBE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>COAT 1 (if over Bare Steel) (Liquid Epoxy)</td>
<td>COAT 2 (if over Bare Steel) (Liquid Epoxy)</td>
</tr>
</tbody>
</table>

Material Notes: Coating material liquid epoxies shall be qualified for application to bare pipe per ISO 21809-2 using the same performance criteria as FBE powders. Multiple coats of the liquid epoxy coating may be required to achieve the minimum specified (DFT). Multiple coats may be required to achieve uniform thickness on irregular shapes such as valve bodies, pumps, piping spools, etc. This liquid coating may be used as an abrasion resistant overcoat on FBE when FBE is abrasive blasted per SSPC-SP16 using a fine abrasive.
SYSTEM DESCRIPTION: A system of liquid coating for below ground service at temperatures up to 110°C (230°F). These liquid coatings may be used on bare steel for straight or fabricated carbon steel pipe, fittings, spools, valves, pumps, pig launchers and receivers, pipe to soil penetrations, other miscellaneous equipment that may be wholly or partially buried, and all components - shop or field coated. This liquid coating may also be used for coating girth welds and it may be used as an abrasion resistant overcoat (ARO) over fusion-bonded epoxy (FBE) or an existing liquid coating.

SURFACES: Carbon steel, may also be used on other metals.

SURFACE PREPARATION: For Bare Steel: SSPC-SP 10 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils).
For FBE or Galvanized Steel: SSPC-SP 16 with a fine (40 to 100 mesh) abrasive.
For Stainless Steel: SSPC-SP 16 with a garnet abrasive that will produce a profile of 25 to 50 µm (1 to 2 mils).

The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

REFERENCES
The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)
ISO 21809-2 Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

NACE International
NACE SP0178 Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service
NACE SP0188-2006 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
The Society for Protective Coatings (SSPC)
SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 11, Power Tool Cleaning to Bare Metal
SSPC-SP 16, Brush-Off Blast Cleaning

SYSTEM
Coat No.  Type Code  Generic Type  Application Method  Minimum DFT, µm (mils)  Maximum DFT, µm (mils)  Shop (S)/ Field (F)
1.        HTE  Epoxy  S,B,R  625 (25)  1000 (40)  S,B,R
2.        ( )  ( )  ( )
Total:    625 (25)  1000 (40)

System Notes: Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

This liquid coating may be applied to an existing FBE coating or it may be applied directly to bare steel. This liquid coating may be applied in one or more coats according to the specific product properties and the complexity of the part to be coated. Cutback - The pipe surface within 50 mm (2 in.) of the weld bevel shall not be coated unless the girth weld has already been performed. Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. Corners, edges, bolts, welds, and other irregularities shall be stripe coated. Corners, edges, bolts, welds, and other irregularities shall be stripe coated. Corners, edges, bolts, welds, and other irregularities shall be stripe coated. Corners, edges, bolts, welds, and other irregularities shall be stripe coated. Corners, edges, bolts, welds, and other irregularities shall be stripe coated. Corners, edges, bolts, welds, and other irregularities shall be stripe coated.

Mixing and Thinning: Mix in accordance with manufacturer’s instructions.

Application: Apply in accordance with manufacturer’s instructions and this standard.
**Repair:** All coating defects and damage, including defects produced by tests, shall be recoated or repaired. Material for coating repairs shall be the same liquid epoxy from the same manufacturer as the liquid epoxy coating. Patched areas shall overlap the parent coating a minimum of 25 mm (1 in.). If damaged area is down to bare steel, power tool clean to bare metal per SSPC-SP 11. Feather edges and apply liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. If the liquid epoxy is used as an ARO over FBE, apply liquid coating in one or more coats to establish a minimum dry film thickness (DFT) of 1,000 µm (40 mils). Small areas can be touched up using a bristle brush. On larger areas, spray application will be required. Application of repair coating shall conform to the coating manufacturer’s instructions. If damaged area does not penetrate the epoxy and expose bare metal, abrade the surface per SSPC-SP 2 and/or SSPC-SP 3, feather edges, and apply the liquid epoxy coating to establish a minimum thickness 625 µm (25 mils) in the repair area.

All repairs are subject to holiday testing at the discretion of the purchaser’s inspector. Minimum thickness of the protective coating in the repair area is 625 µm (25 mils). Minimum total thickness of the coating for ARO service is 1,000 µm (40 mils).

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>(Bare or Epoxy Powder)</th>
<th>COAT 2 (if over FBE)</th>
<th>COAT 3 (if over FBE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Lot 1)</td>
<td>(Liquid Epoxy)</td>
<td>(Liquid Epoxy)</td>
</tr>
<tr>
<td></td>
<td>(Lot 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Lot 3)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(Lot 4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Lot 5)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Material Notes:**

Liquid coating materials shall be qualified for this service per ISO 21809-2, Table 2 using the same acceptance criteria as FBE powders. Coatings for the coating category ≤110°C (≤230°F) shall be qualified by performing the hot water adhesion and hot cathodic disbonding testing at 110°C (230°F) instead of at 65°C (150°F). This includes FBE coatings, liquid coatings, polyolefin coatings, and heat shrink sleeves (HSS). Cathodic disbondment at 110°C (230°F), 28 days, -1.5 Volts shall be less than 25 mm (1 in.). Multiple coats of the liquid epoxy coating may be required to achieve the minimum specified DFT. Multiple coats may be required to achieve uniform thickness on irregular shapes such as valve bodies, pumps, piping spools, etc. This liquid coating may be used as an abrasion resistant overcoat on FBE when FBE is abrasive blasted per SSPC-SP16 using a fine abrasive.
ASSOC. PIP: CTSU1000

UNDERGROUND COATINGS SYSTEM DATA SHEET

FUSION-BONDED EPOXY (FBE) ONE-COAT SYSTEM FOR FIELD WELDS AND COMPONENTS

PAGE 1 OF 2

JULY 2018

FUSION-
BONDED EPOXY (FBE) ONE-COAT SYSTEM

SYSTEM DESCRIPTION: Fusion-bonded epoxy (FBE) single coat System. May be used for coating girth welds of pipe that was shop coated with FBE. May also be used for straight or fabricated carbon steel pipe. Includes all steel components that can safely be heated to 250°C (480°F) so FBE coating can be applied. Spools, fittings, pig launchers and receivers, etc. A system of thermosetting epoxy powder for below ground service at temperatures up to 110°C (230°F).

SURFACES: Carbon steel

SURFACE PREPARATION: Abrasive blast per SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 60 to 100 µm (2.5 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

REFERENCES

The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)

ISO 8504-2 Preparation of Steel Substrates Before Application of Paints and Related Products - Surface Preparation Methods - Part 2: Abrasive Blast-Cleaning second edition Near White Metal Sa 2½

ISO 21809-2 Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

NACE International

NACE SP0178 Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service

NACE SP0188-2006 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

The Society for Protective Coatings (SSPC)

SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 11, Power Tool Cleaning to Bare Metal
SSPC-SP 16, Brush-Off Blast Cleaning

SYSTEM

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>FBE</td>
<td>Epoxy</td>
<td>S</td>
<td>375 (15)</td>
<td>600 (24)</td>
<td>S</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Total: 375 (15)</td>
<td>Total: 600 (24)</td>
<td></td>
</tr>
</tbody>
</table>

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

System Notes:

Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

Cutback - The pipe surface within 50 mm (2 in.) plus or minus 13 mm (½ in.) of the weld bevel shall not be coated. Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. The use of recycled powder (powder which is automatically and continuously recycled from the coating hood back into the powder supply) will only be allowed if permitted by the coating manufacturer. If permitted, these guidelines shall be followed: (a) The ratio of recycled powder to virgin powder shall not exceed 20%. (b) Recycled powder shall be subjected to magnetic separators and particle size screening with sieves of 80 mesh U.S. sieve size or finer. Magnets shall be inspected and cleaned a minimum of two times per shift. (c) Recycled coating powder shall be uniformly distributed among coating spray heads. Cured coating shall be tested for holidays in accordance with NACE SP0188.

Mixing and Thinning: Mix in accordance with manufacturer’s instructions.

Application: Apply in accordance with manufacturer’s instructions and this standard.
Repair:
All coating defects and damage found by visual and holiday inspection, including defects produced by tests, shall be recoated or repaired. Material for coating repairs shall be a two component liquid epoxy furnished by the FBE manufacturer or listed on CSDS 018. (See material notes below.) If the epoxy is damaged and bare metal is exposed, power tool clean to bare metal per SSPC-SP 11 to create a dense, angular profile with a minimum depth of 25 µm (1 mil). If damaged area does not penetrate the epoxy and expose bare metal, abrade the surface per SSPC-SP 2 and/or SSPC-SP 3. Feather edges and apply liquid epoxy coating to establish a minimum thickness of 625 µm (25 mils) in the repair area. Small areas can be touched up using a bristle brush. On larger areas, spray application will be required. Application of repair coating shall conform to the manufacturer’s instructions. Repaired areas shall overlap the parent coating a minimum of 25 mm (1 in.). All repairs are subject to holiday testing at the discretion of the purchaser's inspector. Minimum thickness of the protective coating in the repair area is 625 µm (25 mils). Minimum total thickness of the coating for ARO service is 1,000 µm (40 mils). If this coating system 019 is used as a girth weld coating for fusion-bonded epoxy, or if it is used as a coating for fabricated pipeline components, the welds shall be prepared in accordance with NACE SP0178, Weld Designation D for liquid applied linings. If abrasive blasting is prohibited, SSPC-SP 11 shall be performed using a bristle blaster to produce a minimum 25 µm (1 mil) dense, angular profile.

MANUFACTURER

<table>
<thead>
<tr>
<th>COAT 1</th>
<th>COAT 2</th>
<th>COAT 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Epoxy Powder)</td>
<td>(Liquid Epoxy Repair)</td>
<td>(            )</td>
</tr>
</tbody>
</table>

Material Notes:
Coating material epoxy powders and liquids shall be qualified for this service per ISO 21809-2, Table 2. Coatings for the coating category ≤110°C (≤230°F) shall be qualified by performing the hot water adhesion and hot cathodic disbonding testing at 110°C (230°F) instead of at 65°C (150°F). The terms "epoxy" and "FBE" and "liquid epoxy" as used in this CSDS shall mean a coating material that has been qualified per ISO 21809-2 for continuous service at 110°C (230°F). It may actually be an epoxy, epoxy novolac, epoxy phenolic, or some other hybrid of generic types. The liquid coatings listed on CSDS 018 may be used for repair of any of the powder coatings listed on this CSDS 019 for service up to 110°C (230°F). If this coating system 019 is used for coating girth welds and abrasive blasting is impossible, power tool clean to bare metal per SSPC-SP 11 using a bristle blaster to create a dense, angular profile with a minimum depth of 25 µm (1 mil). SSPC-SP 11 may be used only with a bristle blaster and only if written approval is obtained from the Purchaser.)
ASSOC. PIP: CTSU1000

UNDERGROUND COATINGS SYSTEM DATA SHEET

PIO CTSU1000-D020

HEAT SHRINK SLEEVES

PAGE 1 OF 2

JULY 2018

PROJECT NO. PROJECT DOCUMENT NO.

FACILITY NAME

LOCATION

COATINGS SYSTEM NO.: 020

SYSTEM DESCRIPTION: Heat-Shrink Sleeve (HSS) with epoxy primers as an external coating system for girth welds on below ground or submerged pipe and piping components. HSS systems consisting of a liquid epoxy primer layer, an adhesive layer, and a polyolefin layer. The polyolefin layer may be Medium Density Polyethylene (MDPE) or High Density Polyethylene (HDPE) for underground service at temperatures up to 80°C (176°F). The polyolefin layer shall be Polypropylene (PP) for underground service at temperatures up to ≤110°C (230°F).

SURFACES: Carbon steel

SURFACE PREPARATION: SSPC-SP 10/NACE NO. 2 (Sa 2½) with a profile of 50 to 100 µm (2 to 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

REFERENCES

The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)


ISO 21809-2 Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

The Society for Protective Coatings (SSPC)

SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 11, Power Tool Cleaning to Bare Metal

SYSTEM

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSS</td>
<td>Heat shrink sleeve</td>
<td>See system notes below</td>
<td>* (*)</td>
<td>* (*)</td>
<td>S or F</td>
</tr>
<tr>
<td>2.</td>
<td></td>
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<td>( )</td>
<td>( )</td>
<td>S or F</td>
</tr>
<tr>
<td>Total:</td>
<td></td>
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<td>* (*)</td>
<td>* (*)</td>
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</tr>
</tbody>
</table>

*Application Method: B= Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

System Notes:

Unless otherwise specified, refer to the coating manufacturer's data sheet(s) for information on the recommended application temperature and other technical information.

*The thickness of the epoxy primer, the adhesive, and the polyolefin layers shall be in accordance with the approved manufacturer's specific product data identified on Page 2 of this CSDS for each service temperature.

Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. Installation of HSS shall be performed in accordance with the sleeve manufacturer's written product data sheets and application instructions (installation guide). If SSPC-SP 11 is approved by the owner as an alternate to SSPC-SP 10, a bristle blaster shall be used to produce a uniform, dense profile at least one mil in depth.

Mixing and Thinning: Mix in accordance with manufacturer’s instructions.

Application: Apply in accordance with manufacturer’s instructions and ISO 21809-3.
Repair:
All repairs, including complete removal and re-installation shall be performed in accordance with the sleeve manufacturer's written application instructions (product data sheets and installation guide).

MANUFACTURER | HSS for 110°C Service | HSS for 80°C Service | HSS for 65°C Service
--- | --- | --- | ---

Material Notes:
The use of HSS not listed above requires written authorization from the owner. Heat shall be applied with a device that increases and holds the temperature of the pipe and the sleeve in a uniform and controlled manner. The calibration of clam shell heaters shall be confirmed at the beginning of each day and every 4 hours thereafter. Equipment capable of quick up-heat, such as induction coils, shall be regulated so that the rate of temperature increase of the girth weld steel and the adjacent coating does not exceed 100°C (212°F) per minute to heat the girth weld steel from ambient to the recommended application temperature.
**VISCOELASTIC TAPE SYSTEM**

**SYSTEM DESCRIPTION:** Viscoelastic Tapes for services up to ≤71°C (160°F) as an external coating system for below ground or submerged pipe and piping components. High temperature version available up to ≤100°C (212°F). Viscoelastic Tapes with a flexible backing of PVC, PE, or fiber and a Viscoelastic adhesive layer. An outer wrap may be added to provide additional protection from mechanical damage.

**SURFACES:** Carbon steel

**SURFACE PREPARATION:** SSPC-SP 15 Commercial Grade Power Tool Cleaning with a profile of 25 µm (1.0 4 mils). The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

**REFERENCES**
The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

**International Organization for Standardization (ISO)**
ISO 21809-2 Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 2: Fusion-bonded epoxy coatings

**The Society for Protective Coatings (SSPC)**
SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 15, Commercial Grade Power Tool Cleaning

**SYSTEM**

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
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<tbody>
<tr>
<td>1.</td>
<td>VET</td>
<td>Viscoelastic Tape</td>
<td>See system notes below</td>
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<td>* (*)</td>
<td>S or F</td>
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<td>2.</td>
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<td>Total:</td>
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</tbody>
</table>

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

**System Notes:**
Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

*The thickness of the adhesive, and the polyolefin layers shall be in accordance with the approved manufacturer’s specific product data identified on Page 2 of this CSDS for each service temperature.

Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. Installation shall be performed in accordance with the manufacturer’s written product data sheets and application instructions (installation guide). A bristle blaster may be used to produce a uniform, dense profile at least one mil in depth.

**Mixing and Thinning:** Mix in accordance with manufacturer’s instructions.

**Application:** Apply in accordance with manufacturer’s instructions.
**Repair:**

All repairs, including complete removal and re-installation shall be performed in accordance with the sleeve manufacturer's written application instructions (product data sheets and installation guide).

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>VET for 71°C Service</th>
<th>VET for 100°C Service</th>
<th>Optional Outer Wrap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

**Material Notes:**
ASSOC. PIP: CTSU1000
UNDERGROUND COATINGS SYSTEM DATA SHEET
PETROLATUM TAPE SYSTEM

PETROLATUM TAPE SYSTEM

<table>
<thead>
<tr>
<th>NO.</th>
<th>DATE</th>
<th>REVISION DESCRIPTION</th>
<th>BY</th>
<th>CHECKED</th>
<th>APPROVED</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

PROJECT NO. | PROJECT DOCUMENT NO.
FACILITY NAME
LOCATION

COATINGS SYSTEM NO.: 022

SYSTEM DESCRIPTION: Petrolatum Tapes for services up to ≤40°C (104°F) as an external coating system for below ground or submerged pipe and piping components. High temperature version available for service up to ≤83°C (180°F). Petrolatum Tapes with a non-woven synthetic fabric carrier, fully impregnated with a neutral compound based on saturated petrolatum and inert siliceous fillers.

SURFACES: Carbon steel

SURFACE PREPARATION: Minimum SSPC-SP 2, Hand Tool Cleaning and/or SSPC-SP 3, Power Tool Cleaning. The maximum allowable surface contamination immediately prior to application of the coating shall be 2 µg/cm² (20 mg/m²) chlorides.

REFERENCES
The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)

The Society for Protective Coatings (SSPC)
SSPC-SP 2, Hand Tool Cleaning
SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10/NACE NO. 2, Near White Metal Blast Cleaning
SSPC-SP 15, Commercial Grade Power Tool Cleaning

SYSTEM

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PES</td>
<td>Petrolatum Tape</td>
<td>See system notes below</td>
<td>* (*)</td>
<td>* (*)</td>
<td>S or F</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>S or F</td>
</tr>
<tr>
<td>TOTAL:</td>
<td></td>
<td></td>
<td></td>
<td>* (*)</td>
<td>* (*)</td>
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</tr>
</tbody>
</table>

*Application Method: B = Brush; R = Roller; S = Spray. Apply in accordance with manufacturer’s instructions.

System Notes:
Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

*The thickness of the adhesive, and the polyolefin layers shall be in accordance with the approved manufacturer’s specific product data identified on Page 2 of this CSDS for each service temperature.
Pipe shall be dry and the metal temperature shall be a minimum of 3°C (5°F) above the dew point prior to mechanical surface preparation. Installation shall be performed in accordance with the manufacturer’s written product data sheets and application instructions (installation guide). A bristle blaster may be used to produce a uniform, dense profile at least one mil in depth.

Mixing and Thinning: Mix in accordance with manufacturer’s instructions.

Application: Apply in accordance with manufacturer’s instructions.

Repair:
All repairs, including removal and re-installation, shall be performed in accordance with the sleeve manufacturer’s written application instructions (product data sheets and installation guide).
Material Notes:
Service temperature up to 230°F (110°C) for above ground (180°F / 83°C for below ground). Petrolatum tape is available with a high density polyethylene backing for additional mechanical strength.
ASOC. PIP: CTSU1000

UNDERGROUND COATINGS SYSTEM DATA SHEET

PETROLATUM TAPE WRAP SYSTEM

ASSOC. PIP: CTSU1000

UNDERGROUND COATINGS SYSTEM DATA SHEET

PETROLATUM TAPE WRAP SYSTEM

PAGE 1 OF 2
JULY 2018

NO. DATE REVISION DESCRIPTION BY CHECKED APPROVED

PROJECT NO. PROJECT DOCUMENT NO.

FACILITY NAME LOCATION

COATINGS SYSTEM NO.: 023

SYSTEM DESCRIPTION: A system of petrolatum-based tape for piping and piping components, and for complex surfaces and configurations such as valve bodies, flanges, and couplings.

SURFACES:
Carbon steel

SURFACE PREPARATION: Commercial grade power tool cleaning in accordance with SSPC-SP 15.

REFERENCES
The latest edition (or edition indicated) of the following industry standards and references shall be considered an integral part of this External Coating System.

International Organization for Standardization (ISO)
There is no ISO equivalent to SSPC-SP 15

The Society for Protective Coatings (SSPC)
SSPC-SP 15

SYSTEM

<table>
<thead>
<tr>
<th>Coat No.</th>
<th>Type Code</th>
<th>Generic Type</th>
<th>Application Method</th>
<th>Minimum DFT, µm (mils)</th>
<th>Maximum DFT, µm (mils)</th>
<th>Shop (S)/Field (F)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>PETROLATUM PRIMER</td>
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<td>( )</td>
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<td>PETROLATUM MASTIC</td>
<td>H</td>
<td>( )</td>
<td>( )</td>
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<tr>
<td>3.</td>
<td>PLT</td>
<td>PETROLATUM TAPE</td>
<td>H</td>
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Total: ( ) ( )

* Application Method: H= Hand
Apply in accordance with manufacturer’s instructions.

System Notes:
Unless otherwise specified, refer to the coating manufacturer’s data sheet(s) for information on the recommended application temperature and other technical information.

Mixing and Thinning: Mix in accordance with manufacturer's instructions

Application: Apply in accordance with manufacturer’s instructions and PIP CTSU1000.

Job Stencil Required: Yes ☐ No ☐
# PETROLATUM TAPE WRAP SYSTEM

## COATINGS SYSTEM NO.: 023

### Repair:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>COAT 1 (PETROLATUM PRIMER)</th>
<th>COAT 2 (PETROLATUM MASTIC)</th>
<th>COAT 3 (PETROLATUM TAPE)</th>
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### Material Notes:
INSTRUCTIONS:
THIS FORM SHALL BE COMPLETED FOR EACH WORK SHIFT TO VERIFY COMPLIANCE WITH PIP CTSU1000.
UNSATISFACTORY WORK, CONDITIONS CAUSING UNSATISFACTORY WORK, AND CORRECTIVE ACTION SHALL BE RECORDED.
COPIES OF ALL REPLICA TAPE READINGS TAKEN SHALL BE ATTACHED.
ADDITIONAL SHEETS, NOTES OF MEETINGS, OR REPORTS AS NECESSARY FOR BACKUP SHALL BE ATTACHED.
COPIES OF ALL FORMS AND BACK-UP DOCUMENTS SHALL BE SUBMITTED TO THE PURCHASER’S INSPECTOR(S).

<table>
<thead>
<tr>
<th>SUPPLIER:</th>
<th>REPORT DATE:</th>
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<tbody>
<tr>
<td>ITEM NO.:</td>
<td>MATERIAL COATED:</td>
<td>☐ CARBON OR LOW ALLOY STEEL</td>
<td>☐ AUSTENITIC STAINLESS STEEL</td>
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<thead>
<tr>
<th>CONDITION</th>
<th>START OF BLASTING</th>
<th>START OF WORK</th>
<th>MIDPOINT OF WORK</th>
<th>END OF WORK</th>
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<tbody>
<tr>
<td>TIME</td>
<td>AMBIENT TEMPERATURE, °C °F</td>
<td>RELATIVE HUMIDITY (%)</td>
<td>DEW TEMPERATURE, °C °F</td>
<td>SUBSTRATE TEMPERATURE, °C °F</td>
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<tr>
<td>WEATHER CONDITIONS</td>
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SURFACE PREPARATION:
CONDITION OF SURFACE BEFORE BLASTING:
METHOD OF REMOVING CONTAMINATION BEFORE BLASTING:
METHOD OF BLASTING: ABRASIVE TYPE: GRADE:
DEGREE OF CLEANLINES OBTAINED:
ANCHOR PROFILE: µm mills METHOD OF MEASURING ANCHOR PROFILE:

APPLICATION INFORMATION:
METHOD OF SPRAYING:
DFT GAGE TYPE AND MODEL: DATE CALIBRATED:
PREHEAT TEMP: APPLICATION TEMP: GEL TIME:
HOLIDAY DETECTION VOLTAGE: HOLIDAY REPAIR METHOD:

<table>
<thead>
<tr>
<th>COATINGS</th>
<th>COATING APPLIED</th>
<th>BATCH NO.</th>
<th>COATING COLOR</th>
<th>THINNER NO./TYPE USED</th>
<th>DFT SPECIFIED, µm mils</th>
<th>DFT OBTAINED</th>
<th>ACTUAL OVERCOAT INTERVAL (HRS)</th>
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<tr>
<td>PRIMER</td>
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COMMENTS: ________________________________________________________________
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CONTRACTOR’S SIGNATURE: ___________________________ (PRINTED)
INSPECTOR’S SIGNATURE: ___________________________ (PRINTED)