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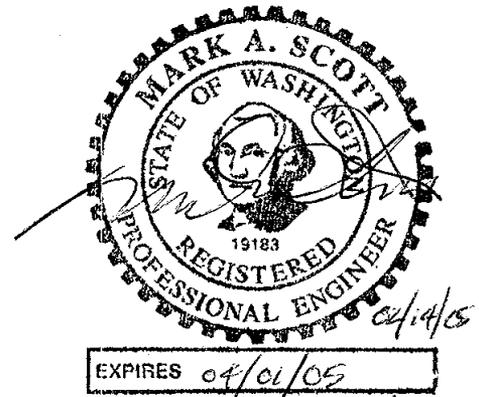
ISSUED BY  
RPP-WTP PDC

**RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT**

**ENGINEERING SPECIFICATION**

FOR

**Shop Applied Fusion Bonded Epoxy Coating for Underground Carbon Steel Pipe**



Content applicable to ALARA?  Yes  No

ADR No.  
N/A

Rev

Quality Designator

CM

DOE Contract No.  
DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	REASON FOR REVISION	BY	CHECK	REVIEW	QA	APEM/DEM
1	2/15/05	Issued for Permitting Use	<i>TRC</i>	<i>LDK</i>	NA	NA	<i>BB</i>
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**SPECIFICATION No.**  
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1

## **Notice**

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

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# 1 Scope

- 1.1 This Specification defines the minimum requirements for surface preparation and the furnishing, application, testing, and inspection of a shop applied fusion bonded epoxy (FBE) coatings used for external coating of underground pipe. This Specification provides for FBE coating materials that are suitable for use on pipe with an operating temperature up to 225°F. Shop applied FBE coated pipe will be installed at the RPP-WTP Project site, located in the 200 East Area of the Hanford Site in Washington State.

## 2 General

### 2.1 Equipment, Material, and Services Required

- 2.1.1 A Procedure Qualification Test (PQT) is required to initially qualify the SUBCONTRACTOR's/SELLER's FBE coating process. The SUBCONTRACTOR/SELLER shall set up the FBE coating line and when ready designate the PQT pipe to be tested. A PQT shall be performed once on each pipe diameter and wall thickness. The CONTRACTOR's/BUYER's representative shall be present during all PQT's. The PQT pipe shall pass all inspection and test requirements of this specification and approved procedures prior to acceptance of the process. All pipe coated prior to the PQT pipe must be stripped and recoated unless the SUBCONTRACTOR/SELLER provides acceptable inspection and test data for each pipe (production inspection and ring samples).
- 2.1.2 Pipe weld ends shall not be coated within Three (3) inches of the end.
- 2.1.3 If pipe is double jointed in the shop after FBE coating, the individual pipe joint coating shall use the same surface preparation, application and inspection criteria of this specification, except no X cut adhesion or ring sample testing is required. Previously applied adjacent FBE coating shall be protected from overheating and physical damage that might occur during FBE coating of the weld joint area. The shop weld FBE coating shall overlap 1"-2" onto the adjacent FBE coating. The overlap area shall be uniformly roughened per SSPC SP7 brush blasting prior to coating. Prior to coating the bare area of a shop welded double joint, a PQT (refer to Section 2.1.1) shall be performed on the process using a section of bare pipe that is the same diameter and wall thickness. The test application shall use the exact equipment and approved surface preparation, preheat and application procedure. The test sample shall be sufficiently large (18" long) to produce a ring sample for all laboratory testing. The test sample must pass all inspection and testing criteria contained in the specification.

### 2.2 Responsibility

- 2.2.1 The SUBCONTRACTOR/SELLER shall supply all personnel, coating materials, and an operational coating facility that includes all necessary application, inspection, and handling equipment.

- 2.2.2 The SUBCONTRACTOR/SELLER shall unload, inspect, and store all inbound bare pipe. Damaged or otherwise unsuitable pipe shall be identified and segregated for evaluation by the CONTRACTOR/BUYER.
- 2.2.3 The SUBCONTRACTOR/SELLER shall store coated pipe and load coated pipe for shipment.
- 2.2.4 The SUBCONTRACTOR/SELLER shall store all coating materials, perform all surface preparation, coating application, and perform inspection in accordance with this specification and CONTRACTOR/BUYER approved procedures.
- 2.2.5 The SUBCONTRACTOR/SELLER shall perform all inspections and tests contained in this specification at their coating plant, or at an independent laboratory when approved by the CONTRACTOR/BUYER, prior to acceptance and shipment of coated pipe.
- 2.2.6 The SUBCONTRACTOR/SELLER shall give the CONTRACTOR/BUYER a minimum of ten (10) working days written notice prior to the start of each production run and at least 24 hours verbal notice thereafter for all inspection witness and hold points.
- 2.2.7 The SUBCONTRACTOR/SELLER shall provide application and inspection documentation for all coated pipe that includes signed certificates of compliance prior to shipment of completed pipe.
- 2.2.8 The SUBCONTRACTOR/SELLER shall only use inspection equipment that is calibrated and controlled by a quality assurance plan, equipment calibration program as approved by the CONTRACTOR/BUYER.
- 2.2.9 The SUBCONTRACTOR/SELLER shall allow the CONTRACTOR's/BUYER's representative to photograph all pipe defects/damage and coating imperfections.

### 2.3 Definitions

- 2.3.1 Approved- An authenticated written statement executed by an authorized CONTRACTOR/BUYER representative.
- 2.3.2 Batch- All FBE powder produced in a 24-hour interval in one (1) continuous run, designated by a specific batch number assigned by the Coating Manufacturer.
- 2.3.3 Barber Poling- A spiral over build or under build in an applied coating.
- 2.3.4 Bubbling- The formation of bubbles during coating application or in a cured, or nearly cured coating film.
- 2.3.5 CONTRACTOR/BUYER- Means BECHTEL NATIONAL, INC. and all of its authorized representatives acting in their professional capacities.
- 2.3.6 ENGINEER- Refers to Owner's or CONTRACTOR/BUYER's appointed technical representatives.
- 2.3.7 Fish Eye- A round or oval depression in coating film with a raised point in center. Has the appearance of a fish eye.

- 2.3.8 Holiday- Pinhole, skips, discontinuity, or void in the applied coating film.
- 2.3.9 Lot- Refers to a group of pipes of the same diameter and wall thickness, which has been fabricated from the same heat of steel.
- 2.3.10 NIST- National Institute of Standards and Technology
- 2.3.11 Non-Regulated- The Special Protective Coating (SPC) quality designation for items that are **“NOT”** located in an area where radioactive material is transported, processed or stored.
- 2.3.12 OWNER- Means the United States Department of Energy (DOE).
- 2.3.13 OWNER’s or CONTRACTOR’s/BUYER’s Representative- Same as Engineer.
- 2.3.14 Pinholes- Minute holes through the entire thickness of the coating film.
- 2.3.15 PQT- Procedure Qualification Testing (Refer to Section 2.1.1)
- 2.3.16 Profile- The surface roughness resulting from surface preparation by abrasive blasting (Refer to Section 7.4.4). The specific angular surface profile can be destroyed by chemical etching, power tool cleaning or other mechanical cleaning methods.
- 2.3.17 Regulated- The Special Protective Coating (SPC) quality designation for items that are located in an area where radioactive material is transported, processed or stored.
- 2.3.18 Sag- The running of freshly applied coating on a vertical surface due to being applied too thick. (Same definition for runs and drips)
- 2.3.19 Skips- Areas where coating was missed.
- 2.3.20 SUBCONTRACTOR/SELLER- Means the company, corporation, partnership, individual, or other entity to which this subcontract (purchase order) is issued, its authorized representatives, successors, and permitted assigns.
- 2.3.21 Tg- Glass transition temperature of the FBE coating material. A Differential Scanning Calorimeter (DSC) is used to perform Tg testing.

## 2.4 Safety

- 2.4.1 All surface preparation and coatings work shall comply with all applicable environmental and safety provisions, laws, regulations, ordinances, etc., of the city, county, state, province, or nation pertaining to the work being performed and the coating materials being used. Work being performed in the United States shall be in strict accordance with OSHA 29 CFR 1910, State, and local safety and environmental requirements.
- 2.4.2 The SUBCONTRACTOR/SELLER shall comply fully with OSHA Hazard Communication Standard 29 CFR 1910.1200. Material Safety Data Sheets (MSDS) shall be provided by the materials manufacturer and available at the place of application for review.

- 2.4.3 The Volatile Organic Compound (VOC) content of all materials shall meet Federal, State, and Local Regulatory requirements.

### 3 Applicable Documents

#### 3.1 Codes and Standards

The latest applicable edition, as of the date of the purchase order, of the following codes standards and specifications form a part of this Specification.

##### 3.1.1 American Petroleum Institute (API)

API RP-5L1 Recommended Practice for Railroad Transportation of Line Pipe

API RP-5L5 Recommended Practice for Marine Transportation of Line Pipe

##### 3.1.2 American Society for Testing and Materials (ASTM)

ASTM D 4285 Testing for Indicating Oil or Water in Compressed Air

ASTM D 4417 Field Measurement of Surface Profile of Blast Cleaned Steel

ASTM D 4940 Test for Conductimetric Analysis of Water Soluble Ionic Contaminants of Blasting Abrasives

##### 3.1.3 Code of Federal Regulations (CFR)/Occupational Safety and Health Act (OSHA)

29 CFR 1910 Occupational Safety and Health Standards

##### 3.1.4 International Standards Organization (ISO)

8502-6 Preparation of Steel Substrates before Application of Paints and Related Products- Tests for Assessment of Surface Cleanliness- Part 6 Extraction of Soluble Contaminants for Analysis- the Bresle Method

##### 3.1.5 National Association of Corrosion Engineers International (NACE)

NACE RP-0274 High Voltage Electrical Inspection of Pipeline Coatings

##### 3.1.6 Steel Structures Painting Council (SSPC)

SSPC-SP1 Solvent Cleaning

SSPC-SP10 Near-White Blast Cleaning

SSPC-SP11 Power Tool Clean to Bare Metal

SSPC-VIS1 Visual Standards for Abrasive Blast Cleaned Steel

SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gauges

## 4 Submittals

- 4.1 The SUBCONTRACTOR/SELLER shall submit detailed written procedures and proposed documentation forms for material receiving, marking, storage, handling, surface preparation, environmental control, application, touch-up repair, inspection of coating materials and the applied coating system, application personnel qualification and inspection personnel qualification. The final procedures shall be submitted for the CONTRACTOR's/BUYER's review and permission to proceed prior to the start of coating work.
- 4.1.1 The SUBCONTRACTOR's/SELLER's procedures shall identify the specific Fusion Bonded Epoxy (FBE) coating by manufacturer and catalog number and shall submit the coating manufacturer's latest published product data sheet and application instructions. Conflicts, if any, between the SUBCONTRACTOR's/SELLER's normal procedures, the coating manufacturer's recommendations, and this specification shall be brought to the attention of the CONTRACTOR for resolution. The requirements of this specification shall take precedence unless the SUBCONTRACTOR/SELLER is given a specific written waiver by the CONTRACTOR.
- 4.1.2 Coating System Certification- The SUBCONTRACTOR's/SELLER's proposed coating system shall be prequalified for production by testing specimens removed from plant coated pipes. The SUBCONTRACTOR/SELLER must provide documented evidence with the submittals that clearly shows the applied coating system meets or exceeds all the requirements of this specification. This evidence shall be certified independent laboratory test data, in house test data, or test data generated on previous projects that is acceptable to the CONTRACTOR.
- 4.1.3 The SUBCONTRACTOR/SELLER shall provide a detailed procedure for acid washing pipe that is contaminated with soluble salts such as chlorides. This procedure shall meet the requirements of Section 4.1 as a minimum. The SUBCONTRACTOR/SELLER shall detail the process such as identifying the acid manufacturer, product name and number, the acid rinse material, pipe temperature versus acid dwell time and rinse water conductivity verification. Copies of the latest published product data sheets, application instructions, and MSDS forms shall be attached as part of the procedure.
- 4.1.4 The SUBCONTRACTOR/SELLER shall submit original certificates of compliance for each and every batch of coating material intended for use, that confirms compliance with the requirements in Section 6.3. The certificate of compliance shall include test results provided by the coating material manufacturer or from test data provided by an outside independent testing laboratory that is acceptable to the CONTRACTOR.
- 4.1.5 The SUBCONTRACTOR/SELLER shall include pipe coating documentation with each shipment of coated pipe unless given a written waiver by the CONTRACTOR/BUYER. The documentation shall identify by number, each pipe included in the shipment. The SUBCONTRACTOR/SELLER shall include a Certificate of Conformance that itemizes all inspection and testing requirements and clearly state that all the pipe included in a give shipment complies with these requirements. The Certificate of Conformance shall be signed by the Quality Manager or other individual approved by the CONTRACTOR/BUYER. For pipe that will be

installed in "Regulated" areas, the SUBCONTRACTOR/SELLER shall also provide, with the shipment, copies of all the actual quality documentation for each and every pipe being shipped.

- 4.1.6 The SUBCONTRACTOR/SELLER shall submit a Quality Assurance Plan outline that addresses the quality elements listed in Appendix 1 (refer to Section 5.0) prior to the start of work. Prior to the start of work, the SUBCONTRACTOR/SELLER shall submit a copy of their QA Plan including copies of all procedures referenced in the QA Plan outline for review and approval by the CONTRACTOR/BUYER.
- 4.2 The SUBCONTRACTOR/SELLER shall supply with the quotation a list of case histories where they supplied a fusion bonded epoxy external pipe coating system. This list shall include project name; pipe size(s) and total length of project and shall include a project client contact name and phone number for verification.

## 5 Quality Assurance

### 5.1 General

- 5.1.1 The SUBCONTRACTOR/SELLER shall control the quality of items and services to meet the requirements of this Specification, applicable codes and standards, and other procurement documents. Prepare and maintain documentation to provide evidence of compliance with approved procedures and this Specification. A copy of the coating inspection documentation shall be included in the shipping documentation.
- 5.1.2 The SUBCONTRACTOR/SELLER, including any lower-tier organizations engaged by him, shall be subject to surveillance inspection by the CONTRACTOR's representative until completion or termination of the procurement. This surveillance inspection does not relieve the SUBCONTRACTOR/SELLER from the responsibility for conformance to the requirements of procurement documents and procedures.
- 5.1.3 The CONTRACTOR's representative shall be provided with a schedule and shall be notified of all required inspection points prior to the scheduled date for coating activities.
- 5.1.4 If the requirements of this Specification differ from the SUBCONTRACTOR's/SELLER's proposed work plan or procedures, the SUBCONTRACTOR/SELLER shall specifically identify and explain all differences in writing at the time of quotation. Deviations from the specified requirements must be specifically approved by the CONTRACTOR/BUYER.
- 5.1.5 All pre-established hold points shall be witnessed by the CONTRACTOR/BUYER unless a written waiver is issued.
- 5.1.6 All personnel shall receive training in the specific project coating requirements and the associated approved work procedures that are relevant to their individual work assignments.
- 5.1.7 SUBCONTRACTOR/SELLER coating inspectors shall have previous experience on at least one project in FBE pipe coating inspection and shall receive documented training in the specific

project coating requirements, ASTM standards and other relevant standards including the approved work procedures.

5.1.8 The SELLER shall maintain a quality assurance plan for items designated Commercial Material (CM) that addresses as a minimum the elements and implementing procedures called for in Appendix 1.

**5.1.8.1 Quality Assurance Program (QAP)**

5.1.8.1.1 A written QAP must be developed, implemented, and maintained.

5.1.8.1.2 The QAP must describe the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the Work.

5.1.8.1.3 The QAP must describe management processes, including planning, scheduling, and resource considerations.

**5.1.8.2 Personnel Training and Qualification.**

5.1.8.2.1 Personnel must be trained and qualified to ensure they are capable of performing their assigned Work.

5.1.8.2.2 Personnel must be provided continuing training to ensure that job proficiency is maintained.

**5.1.8.3 Quality Improvement.**

5.1.8.3.1 Processes to detect and prevent quality problems must be established and implemented.

5.1.8.3.2 Items, services, and processes that do not meet the established requirements must be identified, controlled, and corrected according to the importance of the problem and the Work affected.

5.1.8.3.3 Correction must include identifying the causes of problems and working to prevent recurrence.

5.1.8.3.4 Item characteristics, process implementation, and other quality-related information must be reviewed and the data analyzed to identify items, services, and processes needing improvement.

**5.1.8.4 Documents and Records.**

5.1.8.4.1 Documents must be prepared, reviewed, approved, issued, used, and revised to prescribe processes, specify requirements, or establish design.

5.1.8.4.2 Records must be specified, prepared, reviewed, approved, and maintained.

**5.1.8.5 Work Processes.**

5.1.8.5.1 Work must be performed to established technical standards and administrative controls using approved instructions, procedures, or other appropriate means.

- 5.1.8.5.2 Items must be identified and controlled to ensure their proper use.
- 5.1.8.5.3 Items must be maintained to prevent their damage, loss, or deterioration.
- 5.1.8.5.4 Equipment used for process monitoring or data collection must be calibrated and maintained.
- 5.1.8.6 Design.**
- 5.1.8.6.1 Not applicable
- 5.1.8.7 Procurement.**
- 5.1.8.7.1 Procured items and services must meet established requirements and perform as specified.
- 5.1.8.7.2 Prospective suppliers must be evaluated and selected on the basis of specified criteria.
- 5.1.8.7.3 Processes to ensure that approved suppliers continue to provide acceptable items and services must be established and implemented.
- 5.1.8.8 Inspection and Acceptance Testing.**
- 5.1.8.8.1 Inspection and testing of specified items, services, and processes must be conducted using established acceptance and performance criteria.
- 5.1.8.8.2 Equipment used for inspections and tests must be calibrated and maintained.
- 5.1.8.9 Management Assessment.**
- 5.1.8.9.1 Not applicable

## 6 Materials

### 6.1 Piping

- 6.1.1 Piping shall be supplied to the SUBCONTRACTOR/SELLER without varnish or mill lacquers. If the SUBCONTRACTOR/SELLER receives pipe from the mill with varnish or lacquer, the SUBCONTRACTOR/SELLER shall reject and segregate the pipe using a non-conformance report. All rejected pipe shall be evaluated and dispositioned by the CONTRACTOR/BUYER. Surface preparation of the affected pipe shall not proceed until agreement is reached on the removal of the mill varnish or lacquers.

### 6.2 FBE Coating Materials

- 6.2.1 Approved FBE coatings up to 140°F line operating temperature:

NAP-GARD 7-2500	Dupont Powder Coatings
NAP-GARD 7-2501	Dupont Powder Coatings

NAP-GARD 7-2502	Dupont Powder Coatings
Scotchkote 206N	Minnesota Mining & Manufacturing (3M)
Scotchkote 226N	Minnesota Mining & Manufacturing (3M)
Scotchkote 6233	Minnesota Mining & Manufacturing (3M)
Valspar D1003 LD	Valspar, Inc.
Basepox PE50-1080	BASF

Note: Patch stick materials and 100% solids catalyzed epoxy for repairs shall be products of the FBE coating manufacturer that have been reviewed and approved by the CONTRACTOR/BUYER.

6.2.2 Approved FBE coatings up to 225°F line operating temperature:

NAP-GARD 7-2501	DuPont Powder Coatings
Scotchkote 226N	Minnesota Mining & Manufacturing (3M)
Scotchkote 6233	Minnesota Mining & Manufacturing (3M)

Note: Patch stick materials and 100% solids catalyzed epoxy for repairs shall be products of the FBE coating manufacturer that have been reviewed and approved by the CONTRACTOR/BUYER.

6.2.3 All FBE coating material shall be stored in an enclosed cold storage area that is temperature and humidity controlled. The maximum storage temperature shall be 75°F and the maximum relative humidity shall be 50%. The coating manufacturer's recommendations shall be used if their temperature or humidity storage requirements are more restrictive (lower) than specified herein.

### 6.3 Batch Information

6.3.1 Each container of coating materials used by the SUBCONTRACTOR/SELLER shall be marked with the following information:

- The manufacturer's name
- The product designation
- Location and date of manufacturer
- The shelf life expiration date and storage temperature limits

6.3.2 The SUBCONTRACTOR/SELLER shall obtain from the fusion bond epoxy manufacturer the information listed below for each batch of powder. Standards for comparison shall also be provided for each item. This information will be used by the CONTRACTOR/BUYER to verify that no changes have been made in the epoxy formulation.

- Infrared scan of each batch of powder and, for comparison, infrared scans of at least four (4) batches of the same formulation powder previously manufactured for other projects.
- Gel time at recommended application temperature.
- Particle size distribution.

6.3.3 Coating powder shall be segregated by batch numbers during shipment, storage, and handling. Batches shall be used consecutively during coating application and shall not be mixed except when necessary to keep the coating process continuous.

- 6.3.4 No powder stored beyond the manufacturer's recommended shelf life expiration shall be used for coating pipe.
- 6.3.5 The SUBCONTRACTOR/SELLER shall maintain one-quarter (1/4) pint samples of the coating manufacturer's batches of powder, as received and reclaimed powder mix being applied. Each sample shall be identified by material, batch number, source, sampling, date and time. Samples shall be segregated in the same cold storage area as the production FBE powder.
- 6.3.6 All samples shall be promptly subjected to analysis by the SUBCONTRACTOR/SELLER and witnessed by the CONTRACTOR's/BUYER's Representative to assure that coating materials consistently conform to this specification, without variance in composition of formulation from the previously tested and approved materials. No batch of powder shall be applied prior to the SUBCONTRACTOR/SELLER submitting all of the required batch information to the CONTRACTOR/BUYER.
- 6.3.7 Materials not conforming, or with significant variance, shall not be used.
- 6.3.8 FBE powder and repair materials shall be stored, handled, and applied in strict accordance with the manufacturer's specifications or as directed in writing by an authorized manufacturer's representative except where the CONTRACTOR's/BUYER's specifications require otherwise.
- 6.3.9 Reclaimed powder shall not be used except that which has not been contaminated or has not been heat affected. Reclaimed powder must be automatically and continuously recovered and reprocessed through magnetic separators and sieves no coarser than 80 mesh U.S. Sieve Size. Reclaimed powder shall be uniformly mixed with virgin powder in an amount not exceeding 25 percent reclaim in the mix and shall be applied through a separate spray system. The reclaim powder mix shall be applied over 100% virgin powder and shall be confined to the top 25% of the total FBE film thickness.
- 6.4 Abrasives**
- 6.4.1 Abrasives for blast cleaning shall be clean, free of oil or contaminants, and dry. The particle size shall be capable of producing the specified angular surface profile (minimum 50% steel grit in original mix and all adds shall be 100% grit (Refer to Sections 7.4.4 and 7.4.5). All reclaimed abrasives shall be tested for water-soluble contaminants and conductivity. Conductivity shall not exceed 1000 microsiemens when tested in accordance with ASTM D 4940.

## 7 Application

### 7.1 General

- 7.1.1 It shall be the SUBCONTRACTOR's/SELLER's responsibility to stop the surface preparation and coating process at any time when conditions exist that will adversely affect the coating quality. The CONTRACTOR's/BUYER's representative may reject any process or material not proven by the SUBCONTRACTOR/SELLER to be in compliance with this specification.
- 7.1.2 Proper equipment for the handling, unloading, and temporary storage of bare pipe shall be used to avoid any damage to bare pipe and pipe ends, or obliteration of necessary pipe markings.

## 7.2 Pre Surface Preparation

- 7.2.1 Pipe shall be visually inspected for dents, bevel damage or other damage. The SUBCONTRACTOR/SELLER shall isolate all damaged pipe in a hold area and issue a nonconformance report. Nonconformance reports shall be evaluated and dispositioned by the CONTRACTOR/BUYER. Corrective Action shall be taken and each corrected pipe shall be re-inspected prior to accepting the pipe for surface preparation. Pipe damaged beyond repair shall be removed from the site as soon as practical.
- 7.2.2 All debris inside pipe shall be removed. All oil, grease, dirt, crayon marks, soapstone marks or other contamination shall be removed from the exterior and interior of pipe by solvent cleaning with a non-oily solvent in accordance with SSPC SP1 or by detergent washing or steam cleaning. No residue that will affect adhesion shall be left on the surface. Interior pipe cleanliness is important when using re-circulated abrasive system.
- 7.2.3 Pipe that has a surface temperature less than 5°F above the dew point temperature shall be visibly dry and preheated prior to abrasive blasting.
- 7.2.4 Pipe ends shall be protected from damage and suitably sealed to minimize abrasive from entering the interior of the pipe during external abrasive blasting. On pipe that has received an internal lining the pipe ends shall be sealed sufficiently to prevent damage to the lining during the surface preparation and coating application.

## 7.3 Soluble Salt Test

- 7.3.1 At the start of the coating work, the first ten (10) pipe then every twentieth (20th.) pipe shall be tested for soluble chloride salt contamination. This test frequency may be reduced or even eliminated at some later date after full review by the CONTRACTOR/BUYER. The test shall be run in accordance with the following silver nitrate testing procedure for determining the presence of soluble chloride salts on the steel.
- 7.3.1.1 After the pre-surface preparation required in Section 7.2, apply several drops of distilled water to the surface of the pipe after wire brushing to remove the heavy loose rust. Attach a ten (10) ml Bresle sampler onto the test area in accordance with Section 5.0 of ISO 8502-6 to keep the surface wet for a minimum of ten (10) minutes. Use a ten (10) ml syringe to inject, remove, and re-inject the same demineralized/distilled water several times as a flushing action. The Bresle sampler patch shall be installed in a diamond orientation on the side of the pipe, not the top or bottom of pipe, to facilitate air removal.
- 7.3.1.2 Transfer the ten (10) ml of demineralized/distilled water from the Bresle sampler to a clean test tube or other small clean glass vessel using the ten (10) ml syringe.
- 7.3.1.3 Add five (5) drops of a 10% silver nitrate solution and shake. A milky precipitate indicates the presence of halogen salts or chlorides on the pipe surface.
- 7.3.1.4 Document test results in accordance with Section 6 of ISO 8502-6.

- 7.3.2 If the results of the test in Section 7.3.1 are negative, no milky precipitate observed in good lighting, the normal surface preparation may proceed as specified in Section 7.4 and phosphoric acid washing per Section 7.5 will not be a requirement of this specification.
- 7.3.3 If the results of the test in Section 7.3.1 are positive, a milky precipitate observed in good lighting, the pipe shall be abrasive blasted in accordance with Section 7.4, then phosphoric acid washed in accordance with Section 7.5.
- 7.3.4 The SUBCONTRACTOR/SELLER shall submit a detailed procedure for salt contamination testing and for its subsequent removal. Once a contaminated pipe is found, twenty consecutive additional pipes shall be found free of salt contamination prior to returning to the five (5) percent inspection criteria. Reducing the test frequency or eliminating the test may be considered by the CONTRACTOR/BUYER based on initial and production test results.
- 7.3.5 Alternate salt contamination tests may be considered if the SUBCONTRACTOR/SELLER submits detailed procedures for review and possible acceptance by the CONTRACTOR/BUYER.

#### **7.4 Surface Preparation**

- 7.4.1 All external surfaces to be coated shall be pre-cleaned per SSPC SP 1 where oil, grease, and other contaminants are present.
- 7.4.2 The pipe shall be preheated prior to blast cleaning to a temperature at least 5°F above the dew point or higher when recommended by the coating manufacturer. Preheating shall be performed in a uniform manner to avoid distortion or hot spots.
- 7.4.3 Pipe shall be handled so as to prevent any damage to bevels. Ends shall be closed to prevent any abrasives and/or foreign material from entering the pipe's interior during blasting. Any abrasive and/or foreign material entering the pipe shall be removed before and after subsequent coating. Special precautions shall be taken to protect internal linings from damage if the pipe was internally lined prior to undertaking external coating work. Preventative measures shall be addressed in detail in the procedures required by Section 4.1.
- 7.4.4 All external surfaces to be coated shall be cleaned to a near-white metal finish in accordance with Specification SSPC-SP10 as verified through the use of SSPC VIS1. All parameters for abrasive cleaning of steel pipe surfaces shall be adjusted as necessary to obtain an angular surface profile. Particle size distribution of the grit employed shall be continually controlled by screening to ensure that the surface profile after cleaning shall have a nominal height of 2.5 mils, with a minimum height of 2.0 mils, and a maximum height of 3.9 mils as measured by Testex Press-O-Film replication tape in accordance with ASTM D 4417. All cleaning shall be done in such a manner that beveled ends and any internal coating will not be damaged.
- 7.4.5 For consistent surface finish, a stabilized working abrasive mix shall be maintained by frequent small additions of new grit abrasive commensurate with consumption; infrequent large additions shall be avoided.
- 7.4.6 The working abrasive mix shall be maintained clean of contaminants by continuous effective operations of cleaning machine scalping and air wash separators. Re-circulated grit used for abrasive cleaning shall be tested for the presence of oil by immersing a sample in water and

checking for oil flotation. Tests shall be made at the start of blasting, every four (4) hours thereafter, and at the end of blasting. If oil is evident, the contaminated abrasive shall be cleaned or replaced. All surfaces blasted since the last successful test shall be completely re-blasted using clean abrasive.

- 7.4.7 The blast cleaned surface shall not be contaminated with dirt, dust, metal particles, oil, water, or any other foreign material from any source, including, but not limited to, pipe transport systems, processing equipment components or tools, or airborne contaminants, nor shall the pipe surface or its profile be scarred or burnished.
- 7.4.8 After abrasive cleaning and before coating, the surface to be coated shall be carefully inspected under adequate lighting for metal defects, which may affect coating application, i.e., scabs, slivers, gouges or laminations. The SUBCONTRACTOR/SELLER shall be responsible for the repair of any defects, which can be repaired by filing or grinding, and or for restoring the profile at the locations of such repairs when the size of the repair exceeds four (4) square inches. The tools and manner employed to remove metal defects shall not burnish or destroy the profile or contaminate the surface. If the SUBCONTRACTOR/SELLER sees that metal repairs to uncoated pipe will require extensive metal work, welding or removal of parent metal in excess of that allowed by the pipe material specification, the affected pipe shall be set aside and the CONTRACTOR/BUYER shall be notified for disposition.
- 7.4.9 Pneumatic tools shall not be used on pipe unless they are fitted with effective oil and water traps on the exhaust air.
- 7.4.10 If the profile is destroyed over a single area greater than 25 square inches or over a total area greater than 0.5% of a pipe, the pipe shall be re-blasted at no expense to the CONTRACTOR/BUYER.
- 7.4.11 In instances where large amounts of body wall are removed, remaining body wall will be checked with a suitable ultrasonic thickness gauge or micrometer to ensure that the area remains within API specifications, specific pipe material specifications and/or any special wall thickness tolerances listed in the Material Requisition (MR).
- 7.4.12 Uncoated pipe requiring further attention or inspection shall be identified and segregated for further inspection at no additional cost to the CONTRACTOR/BUYER.

## 7.5 Phosphoric Acid Washing

- 7.5.1 If the pipe tested positive for halogen/chloride salts as described in Section 7.3.1, the following procedure shall be followed to remove salts by phosphoric acid washing after abrasive blast cleaning.
- 7.5.1.1 After blast cleaning, surface inspection and grinding, the pipe temperature shall be maintained between 80°F/ and 110°F for acid cleaning.
- 7.5.1.2 Prior to entry into the acid wash, the pipe temperature shall be measured in three (3) places to ensure it meets the above temperature requirements.

- 7.5.1.3 Acid cleaning is performed by uniformly spraying the external surface of the pipe with a 5° percent (by wt.) phosphoric acid solution.
- 7.5.1.4 The acid shall be rinsed with water at a minimum nozzle pressure of 2500 psi prior to heating the pipe for coating application. The water shall be demineralized with a maximum conductivity of five (5) micromhos/cm (0.5 milisiemens per meter). If the conductivity of the rinse water exceeds this level, the salt contamination test shall be repeated on each pipe that is acid washed and rinsed to verify that the rinse water has not re-contaminated the pipe.
- 7.5.1.5 The minimum time between acid application and water rinse shall be as follows:

Five (5) percent Phosphoric Acid Solution

Pipe Temperature		Dwell Time
(°F)	(°C)	(Seconds)
80	27	52
85	29	45
90	32	36
95	35	33
100	38	28
105	41	24
110	43	21
115	46	21
120	49	21
125	52	21

Note: In no case shall the applied acid solution dry anywhere on the pipe prior to entering the rinse cabinet.

- 7.5.1.6 When acid washing of the blasted pipe is required needed to pass the coating system pre-qualification tests, the acid washing shall be performed immediately prior to the application of the epoxy coating. The acid wash shall be performed in accordance with an approved procedure that follows the actual method used during Procedure Qualification Testing (PQT) that is required by this specification.

## 7.6 Coating Application

### 7.6.1 Heating Pipe

- 7.6.1.1 Total elapsed time between cleaning and coating of the cleaned surface shall be kept to a minimum and in no case shall be more than three (3) hours or the pipe shall be completely re-cleaned prior to coating. Oxidation of the steel prior to coating, in the form of “blooming” or other apparent oxide formation is not acceptable. The formation of visible oxides shall cause the pipe to be re-cleaned at the SUBCONTRACTOR’S/SELLER’S expense prior to coating.
- 7.6.1.2 Before coating, the pipe shall be heated so that the surface temperature is within the application temperature range recommended by the coating manufacturer when it reaches the coating application area. The surface temperature during coating application shall not be lower than that required for complete melt, flow-out, wetting of the pipe surface and fusion; nor shall it be higher than that at which optimum polymerization occurs without premature gelation before

completion of fusion, flow-out and wetting. Post-application cure temperature and time shall not be less than that required for full cure of the applied coating.

7.6.1.3 The furnace atmosphere shall be such that the clean pipe surfaces are not contaminated.

7.6.1.4 The temperature of the pipe shall be monitored continuously by means of contact pyrometers and/or optical pyrometers. For accurate control of surface temperature, the pipe shall be periodically checked with "Tempilstik" heat-indicating crayons or other suitable devices, provided that the amount of material deposited and the length of marks will be limited to that required for accurate temperature control.

7.6.1.5 All temperature readings shall be recorded. Pipe heated above 500°F shall be replaced at the SUBCONTRACTOR's/SELLER's expense.

## 7.6.2 FBE Coating

7.6.2.1 The fusion bonded epoxy coating shall be applied in accordance with approved procedures (Section 4.1), which include the coating manufacturer's latest published application instructions. The SUBCONTRACTOR/SELLER must have a copy of these procedures at the time where the coating is being applied. Any deviation from the SUBCONTRACTOR's/SELLER's approved application procedures shall be documented and submitted to the CONTRACTOR's/BUYER's representative for review and approval prior to use. The Coating Manufacturer's specification for the application and curing temperature and curing time of the specified Fused Epoxy Powder System shall become a part of this specification. It is the intention of this provision that the SUBCONTRACTOR/SELLER will be required to make applications of the coating materials in accordance with the Coating Manufacturer's published instructions, and to work with the Coating Manufacturer and/or the Coating Manufacturer's Representative to eliminate any difficulties that might arise in the application of the coating.

7.6.2.2 The pipe shall be coated while its surface temperature is within the manufacturer's recommended temperature limits.

7.6.2.3 Unless otherwise stated, the coating shall be applied by electrostatic spray or fog chamber to produce a uniform coating thickness.

7.6.2.3.1 The dry film thickness requirements of FBE coatings applied to pipe shall be no single spot reading less than 14 mils with 16 mils as the nominal dry film thickness. Pipe having a coating thickness between 20 mils and 24 mils must have "DO NOT BEND" written in permanent marker in large letters on the external FBE coated surface in three (3) locations along each pipe. Every effort must be made to keep the coating thickness within 14 mils to 18 mils. No more than five (5) percent of the pipe shall be accepted with a coating thickness in the range of 20-24 mils. Any pipe beyond the five (5) percent quantity shall be stripped and re-coated at the SUBCONTRACTOR's/SELLER's expense. Allowances will be made for initial startup. Coated items with thick nesses above 24 mils are rejected and shall be stripped and coated unless a written variance is issued by the CONTRACTOR/BUYER for each occurrence. Refer to Section 6.2 of this specification for the approved FBE coating materials.

- 7.6.2.4 The Dry Film Thickness (DFT) of girth weld coating on double-jointed pipe shall be 18-24 mils with a maximum of 30 mils. All double-jointed pipe where dry film thickness is  $\geq 20$  mils shall be labeled, "DO NOT BEND".
- 7.6.2.5 For Field Welds areas, the finished coating shall have a cutback of four to five (4-5) inches. The length of cutback for shop welds shall extend two (2) inches minimum and five (5) inches maximum, measured from the end of the pipe. If coating materials accumulate within one (1) inch of the pipe end, the cutback area shall be buffed free of coating material. Metal cutback rings used to keep coatings off those surfaces shall be kept clean. Masking tape may be used with the approval of the CONTRACTOR/BUYER. Tape and tape residue shall be removed after the FBE coating is cured.
- 7.6.2.6 Powder spray system air shall be clean and dry as verified in accordance with Section 8.1.8.
- 7.6.2.7 Powder batches shall not be mixed together except as necessary to keep the coating process continuous. The SUBCONTRACTOR/SELLER shall record all batch numbers used along with other information necessary for the CONTRACTOR/BUYER to relate the powder batch to the pipe on which it was applied.
- 7.6.2.8 Manufacturer's recommendations for full curing shall be followed. The curing reaction of the coating must be completed prior to entering the cool down tunnel. The temperature of the pipe exiting the cool down line onto the inspection platform shall not exceed 150°F/ for inspection and repair.
- 7.6.2.9 The cured coating shall be of uniform color and gloss and shall be free of bubbling, pinholes, holidays, skips, fish eyes, sags or runs, drips, barber poling and any other irregularities.
- 7.6.2.10 Where pipe were internally lined prior to external coating, the interior lining shall be inspected to make sure the lining was not damaged during the external cleaning and coating processes. Pipe with damaged internal lining shall be set-aside for the CONTRACTOR's/BUYER's review and evaluation. Any repairs required for the internal lining shall be carried out by the SUBCONTRACTOR/SELLER, at his expense, using CONTRACTOR/BUYER approved procedures.
- 7.6.2.11 During application, curing and handling, the coating shall not be physically damaged, nor shall it be contaminated with any foreign material including (without limitation) dirt, metal particles, oil, water, coating debris, excess powder or powder drips, whether airborne or from application equipment or enclosures, cutback rings or pipe handling mechanisms.

## 7.7 Coating Repairs

- 7.7.1 Each coated pipe leaving the Applicator's premises shall be free of holidays and visual coating defects.
- 7.7.1.1 Rejected Coatings
- 7.7.1.1.1 All rejected coatings (those coated pipe that fail to pass the criteria listed in Section 8.1 and 8.2), which cannot be repaired within the framework of this Specification, shall be completely removed from the entire pipe. The pipe surface shall be re-prepared and re-

coated by the SUBCONTRACTOR/SELLER in conformance with this Specification at no additional expense to the CONTRACTOR/BUYER.

## 7.8 Holiday Repair

- 7.8.1 All coating defects disclosed by visual or holiday detector inspection shall be repaired at no additional expense to the CONTRACTOR/BUYER. For all holiday repairs where repairs are allowed by the CONTRACTOR/BUYER, the following procedure shall be followed:
- 7.8.1.1 For small pinholes or pinhole sized metal sliver holidays where repairs by the patching stick method are approved by the CONTRACTOR/BUYER, the surface shall be thoroughly cleaned and abraded in accordance with SSPC SP11. The patch stick materials used shall be approved by the CONTRACTOR/BUYER and be compatible with the FBE coating being employed. Prior to repairs, the area surrounding the defect shall be abraded utilizing 80 grit carborundum cloth and/or a coarse file to promote patch adhesion. Using a small torch, the surface shall be heated until the patch stick melts when touched to the surface. Avoid charring the surface. The patch stick shall then be rubbed over the heated surface, building up a smooth puddle of patching compound over the abraded area while heat from the torch continues to be applied. A minimum thickness of 25 mils is required. The touch-up material shall overlap the undamaged coating by a minimum of one (1) inch. Heating time and temperature must be adequate to ensure that repairs are fully cured and pass the applicable inspections and tests required in Section 7.8.1.4.
- 7.8.1.2 Where larger areas of damaged coating are to be repaired, 1/8" in largest dimension, and where the use of a patch stick is not practical, a 100 percent solids liquid epoxy compound (supplied by the pipe coating material manufacturer) shall be applied to the area upon CONTRACTOR/BUYER approval. The pipe to be repaired shall be cleaned to remove all dirt and damaged or disbonded coating using CONTRACTOR/BUYER accepted procedures. The edges of the original coating shall be "feathered out" around the area to be coated and all dust wiped off before applying the patch coating. This type repair coating shall be applied by spatula. The patch coating shall be applied in accordance with the Manufacturer's recommendations to a minimum thickness of 25 mils. The touch-up material shall overlap the undamaged coating by a minimum of one (1) inch.
- 7.8.1.3 The freshly-patch-coated areas shall be allowed to cure fully according to the coating manufacturer's specifications prior to inspecting and handling.
- 7.8.1.4 After curing, all patches shall be visually inspected and holiday tested with a wand electrode of fine brass whiskers at a voltage of not less than 2100 DCV and tested for adhesion by knife lifting. The patch shall be holiday-free and shall not disbond when probed around the edge with a sharp knife.

## 8 Tests and Inspections

### 8.1 In Process Inspections

- 8.1.1 The SUBCONTRACTOR/SELLER shall have the full responsibility for the coating application quality in accordance with this Specification and shall be responsible for stopping operations when conditions develop which will adversely affect the quality of the completed work. All work shall be subject to the CONTRACTOR's/BUYER's inspection surveillance.
- 8.1.2 In addition to the ten (10) day written notice prior to the start of work the SUBCONTRACTOR/SELLER shall provide the CONTRACTOR's/BUYER's representative a written time schedule of all witness and hold points 24 hours in advance of the work activities.
- 8.1.3 The CONTRACTOR's/BUYER's representative shall be the final authority on the acceptability of surface preparation and coating application. Any coating which, in the CONTRACTOR's/BUYER's representative's judgment, has not been applied in conformance with this Specification shall be rejected.
- 8.1.4 The CONTRACTOR's/BUYER's representative shall have access to each part of the process (e.g., coating material storage/handling, surface preparation, coating application, testing and pipe handling and storage) and shall have the right and opportunity to witness any of the quality control tests and/or to perform such tests himself on a random sampling basis.
- 8.1.5 The SUBCONTRACTOR/SELLER shall furnish the necessary testing and inspection instruments, properly calibrated and maintained. Such equipment shall be available for use by the CONTRACTOR/BUYER in conducting surveillance of work.
- 8.1.6 The SUBCONTRACTOR/SELLER shall halt the coating of pipe and make alterations or corrections to the process/procedures, to correct repetitive faults found in the work that result in failure of the work to conform to this Specification.
- 8.1.7 Any defects disclosed during inspection shall be reinspected after correction.
- 8.1.8 Prior to using compressed air, the quality of the air downstream of the separator shall be tested in accordance with the requirements of ASTM D 4285 by blowing the air onto a clean white blotter or cloth for two (2) minutes to check for any contamination, oil, or moisture. This test shall be performed at the beginning and end of each shift and at least every four (4) hours thereafter. The test shall also be made after any interruption of the air compressor operation or as required by the CONTRACTOR/BUYER. The air shall be used only if the test indicates no visible contamination, oil, or moisture. If contaminants are evident, the equipment deficiencies shall be corrected and the air stream shall be retested. Separators shall be bled continuously. All lines shall be tested individually prior to use. Surfaces which are determined to have been blown down or blasted with contaminated air, shall be reblasted with clean air and abrasive. Coatings that have been determined to have been applied using contaminated air shall be removed and reapplied using clean air.
- 8.1.9 The inspection points shall be established as follows as a minimum:
- Prior to the start of work

- Immediately following the surface preparation
- Immediately prior to the coating application
- Following the application and curing
- Final inspection and sign-off, in accordance with the project requirements

8.1.10 The SUBCONTRACTOR/SELLER shall keep the records indicated below, and submit these records to the CONTRACTOR/BUYER daily for verification to the CONTRACTOR's/BUYER's satisfaction.

<u>Coating/Inspection Step</u>	<u>Required Frequency</u>
1. Salt Contamination	Until ten (10) consecutive pipes are found to be salt free and then every 20th pipe (See Section 7.3).
2. Surface Profile	Check three (3) locations on two (2) pipes (Refer to Section 8.1.11.2) <ul style="list-style-type: none"> <li>a. At the beginning of each shift and every four (4) hours throughout the shift.</li> <li>b. Whenever any change in abrasive type or mix or in blast pressure is made.</li> </ul>

<u>Coating/Inspection Step</u>	<u>Required Frequency</u>
3. Thickness	Twelve measurements per pipe (See Section 8.1.13.2).
4. Repaired Holidays	100% inspected. Record number of repaired holidays per pipe (See Section 7.8).

8.1.11 Surface Preparation

8.1.11.1 Surface cleanliness shall be judged against both written and visual (SSPC VIS1-89) standards. Surface cleanliness must be inspected on a continuous basis.

8.1.11.2 The surface profile shall be verified in accordance with the requirements of ASTM D 4417 with Testex Press-O-Film at the beginning of every eight (8) hour shift and every four (4) hours throughout the shift (Refer to Section 7.4.4). The profile shall be determined at three (3) different places on the pipe . The readings shall be recorded. Profiles shall also be checked if abrasive material, abrasive mix, or blast pressure is changed, and after grinding of slivers.

8.1.11.3 Verify pipe is free of salt contamination in accordance with Section 7.3.1.

8.1.11.4 Recirculated shot and grit shall be checked for the presence of oil in accordance with Section 7.4.6.

- 8.1.11.5 Grease-free chalk shall be used to mark areas which do not meet the specified requirements.
- 8.1.12 Preheat Temperatures for FBE coating
- 8.1.12.1 Optical pyrometers and/or contact thermometers/pyrometers shall be used to assure correct pipe temperature as recommended by the FBE coating manufacturer. Tempilstiks may be used to check accuracy of the pyrometers and/or thermometers, but their use must be minimized. (Refer to Section 7.6.1.4)
- 8.1.13 Dry Film Thickness
- 8.1.13.1 Dry coating thickness shall be measured with a magnetic film thickness gage such as an Elektro-Physik Mikrotest magnetic film thickness gauge or CONTRACTOR/BUYER-approved equal. The gage shall have a zero to 40 mil working range and shall check and record calibration accuracy at the start of each shift against the NIST (National Institute of Standards and Technology) Coating Thickness Calibration Standards for Non-magnetic Coating of Steel or CONTRACTOR/BUYER approved alternative standards. The calibration standards shall be in the 14 mil to 25 mil range, unless otherwise specified.
- 8.1.13.2 A minimum of eight random dry film thickness measurements shall be taken on each pipe joint up to forty feet long. Three (3) sets of readings shall be taken evenly spaced along the length of each pipe joint. All dry film thickness readings shall be performed in accordance with SSPC PA2 using the spot reading frequency specified herein.
- 8.1.13.3 Any pipe with a measured thickness below the minimum or above the maximum listed in Sections 7.6.2.3.1 & 7.6.2.4 shall be rejected. These items shall be re-cleaned and re-coated at the SUBCONTRACTOR'S/SELLER'S expense.
- 8.1.14 Visual Inspection of coated pipe
- 8.1.14.1 The pipe shall be visually inspected for bluing, lifted pipe scabs, and discoloration from burning or rusting of the substrate prior to coating. The coated pipe shall be visually inspected for defects under adequate lighting and shall be free of voids, loss of adhesion, bubbling, excess powder mounds, barber poling, peeling and lifted pipe scabs/slivers.
- 8.1.14.2 If the SUBCONTRACTOR/SELLER fails to promptly correct causes of regularly recurring holidays or other coating defects, the pipe coating may be rejected for any number of such regularly holidays or defects.
- 8.1.14.3 Coated pipe requiring additional inspection shall be set aside for such inspection at no additional expense to the CONTRACTOR/BUYER.
- 8.1.15 Holiday Detection
- 8.1.15.1 All coated pipe shall be 100% inspected for holidays using a non-pulsating spiral coil or brush operated according to the requirements of NACE Recommended Practice RP-02-74. Use 150 volts/mil or as recommended by the coating manufacturer. In no case shall the voltage be below 2100 DCV. The holiday detector shall have an audible alarm.

- 8.1.15.2 The holiday detector voltage shall be checked and recorded at least every hour with an accurate DC voltmeter. The holiday detector shall be adjusted as necessary after recording its voltage or during noticeable changes in handling.
- 8.1.15.3 The detector electrode shall be in direct contact with the entire surface of the coating being inspected. There shall be no gaps in the electrode or separations between the electrode and the surface of the coating, including the surfaces on either side of the seam of the pipe.
- 8.1.15.4 The travel rate of the detector's electrode shall not exceed one (1) foot/second and shall not be allowed to remain stationary while the power is on. Refer to NACE RP-02-74 to determine rate of travel.
- 8.1.15.5 All holidays and other coating defects, including without limitation those described in Section 8.1.14, shall be marked with a grease-free marker and the number and nature of holidays and coating defects in each pipe recorded.
- 8.1.15.6 Pipe with more than one (1) holiday per 20 square feet shall be rejected.
- 8.1.15.7 Rejected pipe shall be handled as described in Section 7.7.1.1. Non-rejected coated pipe that have defects shall be repaired per this Specification and approved procedures.

## 8.2 Applied Material Testing

- 8.2.1 The SUBCONTRACTOR/SELLER shall perform all the tests listed in this Section. The CONTRACTOR's/BUYER's representative may be present during the tests. Test results must be made available within 72 hours of taking the sample. The SUBCONTRACTOR/SELLER shall make such processing adjustments as indicated to be required by results of these tests, including coating material application and curing temperatures and times. No pipe lot shall be accepted before the test results from the representative samples are known. If any test results do not meet the requirements of this Specification, the CONTRACTOR/BUYER will specify additional samples to be tested at the SUBCONTRACTOR's/SELLER's expense. Also, the CONTRACTOR/BUYER reserves the right to test additional samples at the SUBCONTRACTOR's/SELLER's expense.

### 8.2.1.1 Sample Frequency

- 8.2.1.1.1 From the first pipe for each pipe diameter and wall thickness and from one (1) corresponding pipe on per shift basis (max. 12 hrs.) thereafter, the SUBCONTRACTOR/SELLER shall cut an 18 inch wide ring sample from the end of the pipe for coating tests. The cut pipe ends shall be re-beveled and all burnt coating removed. The sample shall be labeled with the coating date, pipe number, powder batch number, and powder used. In the event any or all of the required tests fail, additional ring samples may be required to reduce the size of rejectable lot. The size of the rejectable lot may be determined by identifying the characteristic causing the coating to fail the test or tests and identifying other pipe with that characteristic in common. The characteristics causing test failure may include powder batch, production line problems, pipe surface condition and other identifiable deviations.

8.2.1.2 Bend Tests

8.2.1.2.1 The ability of the coating applied on pipe to resist cracking, tearing, disbondment, or other mechanical damage as a result of bending shall be determined by bending a coated bend strap (8"x1"x wall thickness) in a four (4) point modular bending jig or mandrel bending jig. The coating shall not disbond from the pipe, delaminate, crack or break when bent at five (5) degrees per pipe diameter length (4.35 percent elongation) at 32°F and 1.75 degrees per pipe diameter length (1.52 percent elongation) at 0°F.

8.2.1.3 Differential Scanning Calorimeter (DSC) Analysis

8.2.1.3.1 The SUBCONTRACTOR/SELLER shall perform a DSC analysis on each ring sample. Delta Tg shall be less than 5°F for the coating to be considered fully cured.

8.2.1.3.2 If analysis shows any sample to be partially cured, it must be determined which pipes of the lot were not properly cured. Those pipes not properly cured will be rejected and reworked.

8.2.1.4 Adhesion Test

8.2.1.4.1 At production start up, after production interruptions, at the start of using a new batch of powder, and once every hour or 20 pipes (whichever is more frequent), the adhesion of the coating will be determined at one (1) location on the pipe. After three (3) consecutive production tests have been acceptable, the frequency may be reduced to once every two (2) hours or 50 pipes, whichever is sooner.

8.2.1.4.2 Using an Exacto Knife make two (2) one (1) inch long incisions through to the metal substrate to form an X.

8.2.1.4.3 At the intersection of the X, attempts shall be made to force the coating from the steel substrate with the knife point. Refusal of the coating to peel constitutes a pass. Partial or complete adhesion failure between the coating and the metal substrate constitutes a failure.

8.2.1.5 Foam Structure and Pipe/Coating Interface Contamination Tests

8.2.1.5.1 Using a bend strap, use a sharp knife or Exacto Knife and make a cut to the metal in the middle of the sample from side to side. Cool the bend sample using dry ice until the sample temperature is 0°F or lower. Bend the sample until the FBE coating disbonds from the steel strap on both sides of the cut. Break off the two disbonded FBE coating samples in as large a sample as possible. Use these two samples to perform the Foam Structure and the coating interface contamination test.

8.2.1.5.2 Foam Structure Test- Cool one of the two disbonded FBE coating samples with dry ice. While the FBE coating sample is very cold "snap" it into two or three pieces. The breaks shall be a brittle fracture and not a tear or semi-tear. Using a high powered light and a 30x-40x microscope compare the degree of foaming or porosity in the cross section of the cured FBE sample with Figure 1. The extent of foaming at the coating to pipe interface and throughout the film will be determined. The degree of foaming, through film and interface, shall be evaluated in terms of the ratings shown below. Report the rating most closely

representing the degree of foaming or porosity in the cured FBE chip. A rating of one (1) is best and a rating of five (5) is worst. Foaming shall not exceed #3. A #4 or #5 rating is a reject.

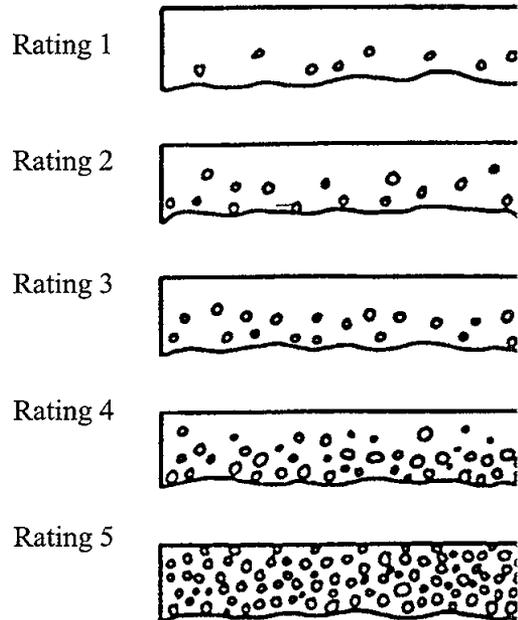


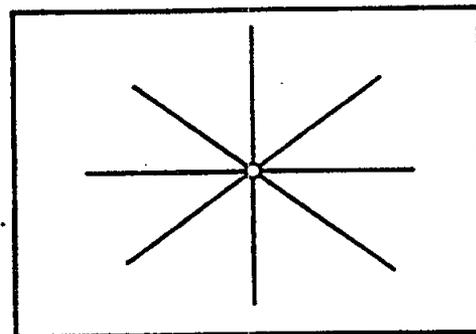
Figure 1

- 8.2.1.5.3 Interface Contamination Test- The percentage of contamination at the coating to pipe interface shall be determined on any of the disbonded FBE coating samples from 8.2.1.5. The sample shall be evaluated at 40X magnification using a microscope. Apply a copper sulfate solution to the backside of the FBE coating sample (the side that was in contact with the steel surface) to highlight the steel dust contamination at the interface. The percentage of contamination shall be determined visually using photographic examples with a 100 point reticule as a reference. The percentage of surface contamination shall under no circumstance exceed 25 percent.
- 8.2.1.5.4 If either the foam structure or the interfacial contamination test fails to meet the specification requirements then two additional bend strap samples from the same ring sample shall be tested and both must pass. If one or both fail to meet the specification requirements then another ring sample from a different pipe from the same production shift shall be prepared and tested. If these samples exceed the specification requirements then a systematic investigation shall be performed to identify the scope of the problem and the quantity or reject coated pipe. Also, the blasting and coating line shall be evaluated to determine how the deficiency can be corrected.
- 8.2.1.6 Cathodic Disbondment Test
- 8.2.1.6.1 A cathodic disbondment test shall be conducted on the samples as follows:
- 8.2.1.6.1.1 A four (4) inch x four (4) inch plate is cut from the production-coated ring sample. The coated test plate shall be verified holiday free using 2100 DCV per Section 8.1.15. A 3.2

mm holiday is drilled through the coating to the steel. A three (3) inch diameter PVC cell is centered over the intentional holiday and fixed to the coated surface using a silicone sealant.

8.2.1.6.1.2 The cell is filled with three (3) % NaCl electrolyte and platinum wire anode is inserted below the electrolyte level. A 3.5 DC voltage (reference saturated calomel) is impressed and the entire test plate and apparatus are maintained at 150°F for 24 hours. To maintain a uniform heat distribution on the curved test panel, a sand bed shall be used in conjunction with a hot plate. Add a minimum of 300 ml of the NaCl solution and mark the solution level on the cylinder. The solution level shall be checked periodically and the level maintained by adding distilled water.

8.2.1.6.1.3 At test completion, make four (4) evenly spaced radial cuts through the coating that extend 20 mm from the center of the holiday as shown in Figure 2. The amount of coating removed in the “V” areas are evaluated and expressed in millimeters radius (mmr), as measured from the holiday edge to the area where well-bonded coating exists. The coating shall cathodically disbond 13 mmr or less from the edge of the intentional holiday. The test sample shall be air cooled to 68°F ± 5°F and shall be evaluated within one (1) hour after removal from the heat.



**Figure 2**  
**Example of Radial Cuts Through the Coating**

#### 8.2.1.7 Moisture Permeation Test

8.2.1.7.1 Samples of coated pipe shall be tested to determine the coating's resistance to moisture permeation by immersing them in 150°F tap water for 24 hours. The coating shall then be visually examined for the presence and size of blisters, cracking, or wrinkling. These visual defects shall be reported..

8.2.1.7.2 While the sample is still warm, use a sharp knife to scribe a rectangle (approximately 1" x 1/2") through the coating to the substrate. Air cool the sample to 70 ± 5°F.

8.2.1.7.3 Evaluation of adhesion shall be made using a knife blade aligned almost parallel to the substrate. Within one (1) hour after removal from the hot water, use the knife to try and pry up the coating inside the corner of the scribed rectangle using a levering action. Continue

inserting the knife and levering under the edge of the coating within the rectangle until the coating demonstrates a definite resistance to the levering action. Rate the coating adhesion as follows:

- #1 Coating cannot be removed cleanly
- #2 Less than 50% of coating in a rectangle can be removed
- #3 More than 50% of the coating in the rectangle can be removed but the coating chips and demonstrates a definite resistance to the levering action
- #4 The coating can be easily removed from the rectangle in strips or large chips
- #5 The coating can be completely removed from the rectangle as a single piece.

8.2.1.7.4 Coating adhesion shall meet a rating of #1 or #2.

## 9 Storage, Handling and Shipping

### 9.1 Storage and Handling

- 9.1.1 The SUBCONTRACTOR/SELLER shall be solely responsible for the condition of the pipe from the time it is received until after it has been delivered to the CONTRACTOR/BUYER.
- 9.1.2 All booms, hooks, clamps, forks, supports, and skids used in handling or storing coated pipe shall be designed and maintained in such a manner as to prevent any damage to the pipe or to the coating and shall be approved by the CONTRACTOR's/BUYER's representative. Each hook shall be aluminum, brass or other material that will not cause damage to the beveled pipe ends.
- 9.1.3 The SUBCONTRACTOR/SELLER shall inspect pipe upon receipt for damage such as dents, flat ends, end caps, and bevel damage. Any visible damage observed at this point shall be noted on the inbound pipe tally.
- 9.1.4 Uncoated pipe shall be racked in snug rows and tiers with a minimum space between pipes in such a manner that will prevent damage to the pipes.
- 9.1.5 Pipes shall be provided with end caps by the pipe manufacturer. End caps that are found to be damaged or missing during inspection on the inbound pipe tally shall be replaced. End caps that are damaged after entering the coating yard and before delivery to the point of destination shall be replaced at the SUBCONTRACTOR's/SELLER's cost.
- 9.1.6 Identification markings (from the inside of the pipe or those removed from the exterior pipe surface by blast cleaning) shall be legibly stenciled with paint on the exterior surface of the pipe on the cured epoxy powder coating approximately twelve inches from one end of each pipe. The identification markings shall include the following as a minimum:
  - Pipe Manufacturer's Name or Mark
  - Outside Diameter in English Units
  - Wall Thickness in English Units
  - Pipe Number
  - Date Coated

- Company Name of Applicator
- Symbol Indicating Grade
- Pipe Material Requisition (MR)Number
- Powder Used (Including batch)
- Country of Origin (if other than U.S.)
- Weight (in pounds and kilos)

9.1.7 The coated pipe shall not be racked until the coating has cooled to 120°F.

9.1.8 All coated pipes shall be stored on padded racks or polyethylene-sheathed sand berms not less than six (6) inches off the ground until time for shipment. The supports shall be properly spaced and leveled to support the pipe without damage. The bottom row of pipe shall be restrained to prevent the pipe from rolling. Non-compressible rubber pads 1/2 inch thick, or hoops 5/8 inch nylon rope shall be used to separate the pipe for yard transportation and storage. A minimum of three (3) rubber pads or four (4) nylon rope hoops shall be used for single lengths of pipe and a minimum of six (6) rubber pads or six (6) nylon rope hoops shall be used for double lengths of pipe. One (1) separator shall be placed near each end of the pipe and the remainder proportionally spaced along the pipe.

9.1.9 The CONTRACTOR's/BUYER's representative will have authority to stop any storage procedure or means of transport from the yard, if in his opinion there is a possibility of damage to the coating because of improper procedures.

9.1.10 Any pipe damaged by the SUBCONTRACTOR/SELLER shall be repaired in accordance with the CONTRACTOR's/BUYER's pipe specifications and applicable API Standards at the SUBCONTRACTOR's/SELLER's expense. Only repair procedures acceptable to the CONTRACTOR/BUYER shall be used. Pipe damaged beyond permissible repair shall be replaced by and become the property of the SUBCONTRACTOR/SELLER.

## 9.2 Shipping (General)

9.2.1 Pipe shall be transported from the coating yard by truck, rail, barge, or ship as specified in the contract order. Pipe shall be shipped using sufficient dunnage to adequately protect the pipe and its external coating.

9.2.2 Dunnage shall be made from hardwood and conform to the following dimensions. Any deviations from this Specification require the CONTRACTOR's/BUYER's approval prior to use.

9.2.3 Chocks shall be four (4) inches wide by six (6) inches high. Chocks shall be cut at an angle to cause maximum contact of the entire angled surface to the pipe. In no cases shall plastic chocks be permitted. Nails used to secure the chocks shall be driven perpendicular to the plane of the angle side of the chock securing the chock to the bolster. Nails will be driven outside the pipe contact area and must be countersunk a minimum of 1/8".

9.2.4 Bolsters shall be a minimum of two (2) inches by six (6) inches by eight (8) feet in length. The maximum length of any bolster shall be eight (8) feet six (6) inches. Four (4) bolsters per layer of single length pipe and eight (8) bolster per layer of double jointed pipe per load shall be used and shall be padded with 1/4" thick rubber with securing nails placed outside the pipe contact.

### 9.3 Truck Shipments

- 9.3.1 Truck shipments shall be made on trailers adequate for pipe hauling. The trailer shall be of sufficient length to eliminate excessive overhang. Pole trailers shall not be used. All trucks and trailers used for hauling coated pipe shall be equipped with fenders and gravel guards to prevent road gravel or slag impact damage to the coating.
- 9.3.2 Pipe shipped by truck shall be loaded in compliance with existing highway shipping standards and regulations.
- 9.3.3 All sills, skids, bolsters, standards and separators shall be padded with minimum 1/4 inch thick rubber pads or equivalent, with the securing nails placed outside the pipe contact area.
- 9.3.4 Each single length pipe shall be separated from each adjacent pipe by a minimum of three (3) 1/2 inch thick non-compressible rubber pads or four (4) 5/8 to 3/4 inch thick rings of nylon rope placed on each end and proportionally spaced along the length of the pipe. A minimum of six (6) separators shall be used for each double jointed pipe.
- 9.3.5 Nylon straps shall be used on all shipments of pipe and/or coated pipe to prevent movement. Chains may not be used at anytime.
- 9.3.6 The nylon straps are to be brought up over the pipe and fastened down.
- 9.3.7 Rubber padding or other suitable padding shall be used to protect the pipe and/or coating from the tie down buckles.

### 9.4 Rail Shipments

- 9.4.1 Rail shipments shall be loaded in accordance with the latest edition of API-RP5L1 and the following:
  - 9.4.1.1 All foreign material shall be removed from cars; no part of the car shall be nearer to the pipe than two (2) inches/55 mm.
  - 9.4.1.2 Each pipe shall be separated and tied down as stated in Sections 9.1 and 9.2 above.

### 9.5 Marine Shipments

- 9.5.1 Marine shipments shall be loaded in accordance with the latest edition of API-R5L5, and the following:
  - 9.5.1.1 The pipe is to be stored in a manner and in a location to prevent damage to it and/or its coating. The pipe's location should be such that the pipe shall be undisturbed until it is unloaded.
  - 9.5.1.2 The bottom row of pipe shall be cushioned against the deck with strip wood placed perpendicular to the pipe. The wood shall be evenly distributed to make a uniform support. The top tier of pipe shall be held down to stop rotation in transit.
  - 9.5.1.3 No cargo of any nature shall be stored on top of the pipe. Pipe shall not be stored against the sloping sides of the ship's hold.

9.5.1.4 Each pipe shall be separated as stated in Sections 9.1 and 9.2.

## 10 Quality Records

- 10.1 A record of all material test reports (individual batches of FBE powder, phosphoric acid, abrasive, rinse water quality, silver nitrate, etc.) for materials used for a given Lot of FBE coated pipe, shall be included as part of the shipping documentation package.
- 10.2 A record of all required daily production test results for pre-surface preparation, chloride contamination testing, environmental conditions, compressed air cleanness, surface preparation and profile, acid wash, steel defects, FBE coating, water quench, etc. shall be included as part of the shipping documentation package.
- 10.3 A record of all required daily production test results on each FBE coated pipe, such as dry film thickness, holiday testing, visual defects including X cut knife adhesion tests shall be included as part of the shipping documentation package.
- 10.4 A record of all required daily laboratory test results for each Lot of FBE coated pipe shall be included as part of the shipping documentation.
- 10.5 All quality documentation shall be available for review by the CONTRACTOR's/BUYER's representative within 24 hours from the time it is generated.
- 10.6 SUBCONTRACTOR/SELLER documentation forms. proposed for use, shall be provided as part of the procedures submitted to the CONTRACTOR/BUYER for review. (Refer to Section 4.1)
- 10.7 All original documentation generated during the coating work shall be submitted within 30 days after the last item in the order is completed. The documentation package shall have a cover page that identifies the project, contract number and the report issue date. There shall be a letter of certification signed by management certifies the work performed complied with all the contract performance and quality requirements. The submittal package shall contain a table of contents and organized sections that contain the original documents generated during the work.

## 11 Design Changes Incorporated by Reference

- 11.1 The following is a listing of design changes that are identified by reference and do not require modification to the specification.

### Design Change Document

\*24590-WTP-SDDR-PROC-01-0001

\*24590-WTP-SDDR-PROC-01-0002

\*24590-WTP-SDDR-PROC-01-0003

\*24590-WTP-SDDR-PROC-01-0004

\* 24590-WTP-SDDR-PROC-03-0307

\* 24590-WTP-SDDR-PROC-03-0268

\* 24590-WTP-SDDR-PROC-03-0269

\*24590-WTP-SDDR-PROC-03-0270

\* 24590-WTP-SDDR-PROC-03-0271

\* Denotes a new entry for this revision of the specification

# APPENDIX 1

## Supplier Quality Assurance Program Requirements Data Sheet

### DOE ORDER 414.1A REQUIREMENTS

The following marked QA Program Elements of DOE ORDER 414.1A apply and are subject to BUYER evaluation and verification

DOE O 414.1A	PROGRAM ELEMENTS	SUPPLIER DOCUMENT AND PARAGRAPH REFERENCES TO BE COMPLETED BY THE SUPPLIER
N/A	<input checked="" type="checkbox"/> <input type="checkbox"/> PROGRAM	
	<input checked="" type="checkbox"/> <input type="checkbox"/> PERSONNEL TRAINING & QUALIFICATION	_____
	<input checked="" type="checkbox"/> <input type="checkbox"/> QUALITY IMPROVEMENT	_____
	<input checked="" type="checkbox"/> <input type="checkbox"/> DOCUMENTS & RECORDS	_____
	<input checked="" type="checkbox"/> <input type="checkbox"/> WORK PROCESSES	_____
	<input type="checkbox"/> <input checked="" type="checkbox"/> DESIGN	Coating manufacturers and coating applicators- "Design" Special Protective Coatings provided by 24590-WTP-3PS-PX04-T0001
	<input checked="" type="checkbox"/> <input type="checkbox"/> PROCUREMENT	_____
	<input checked="" type="checkbox"/> <input type="checkbox"/> INSPECTION & ACCEPTANCE TESTING	_____
	<input type="checkbox"/> <input checked="" type="checkbox"/> MANAGEMENT ASSESSMENT	_____
	<input type="checkbox"/> <input checked="" type="checkbox"/> INDEPENDENT ASSESSMENT	_____
	SIGNATURE OF SUPPLIER REPRESENTATIVE	_____