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Guidance on Industry Standard for the Application of Three-layer Fusion Bonded Epoxy-Polyethylene Coating and Three-layer Fusion Bonded Epoxy-Polypropylene Coating Systems to Line Pipe

GIS 06-403

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GIS 06-403. This Guidance on Practice (GP) is newly created and is not based on heritage documents from the merged BP companies.

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1. Scope

- a. This GIS defines the minimum requirements for the factory application of three-layer fusion bonded epoxy (FBE)-polyethylene and three-layer fusion bonded epoxy (FBE) polypropylene coatings to pipes of various nominal outside diameters.

The pipe may have been previously internally coated. 'Internal coating' refers to thin film epoxy coatings applied at 50 to 100 micron (2 to 4 mil) thickness mainly to the internals of gas pipelines to assist internal flow characteristics and improve the efficiency of pipeline commissioning.

- b. This GIS also defines the tests for both pre-qualification and production that are to be carried out on the two types of three-layer coating systems.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

American Petroleum Institute (API)

API RP 5L1	Recommended Practice for Railroad Transportation of Line Pipe.
API RP 5LW	Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels.
API Spec 5L	Specification for Line Pipe.

American Society for Testing and Materials (ASTM)

ASTM G14	Test for Impact Resistance of Pipeline Coatings (falling weight test).
ASTM D42	Method for Indicating Oil or Water in Compressed Air.

Association Francaise de Normalisation (AFNOR)

AFNOR NF A49-710	Steel tubes. External coating with three polyethylene based coating. Application through extrusion.
AFNOR NF A49-711	Steel tubes. External coating with three polypropylene layers coating. Application by extrusion.

Canadian Standards Association (CSA)

CSA Z245.21	External Polyethylene Coating for Steel Line Pipe
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Deutsches Institut Fur Normung E.V. (DIN)

DIN 30670	Polyethylene Coatings for Steel Pipes and Fittings
DIN 30678	Polypropylene Coatings for Steel Pipes

International Organisation for Standardisation (ISO)

ISO 178	Plastics-determination of flural properties.
ISO 306/A	Plastics-theroplastic materials. Determination of vicat softening temperature.



ISO 527-2	Plastics - Determination of tensile properties Part 2: Test conditions for moulding and extrusion plastics.
ISO 868	Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness).
ISO 1133	Plastics - Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics.
ISO 1183/A	Plastics methods for determining the density of non-cellular plastics.
ISO 3146	Plastics - Determination of melting behaviour (Melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods.
ISO 6964	Determination of Carbon Black content by Calcination and Pyrolysis – Test Method and Basic Specification.
ISO 8501	Preparation of steel substrates before application of paints and related products.
ISO 8501-1	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 Supplement Representative photographic examples of the change of appearance imparted to steel when blast-cleaned with different.
ISO 8502	Preparation of steel substrates before application of paints and related products-Tests for the assessment of surface cleanliness Part 3: Assessment of dust on steel surfaces prepared for painting. (Pressure sensitive tape method). Part 9: Field method for the conductometric determination of water-soluble salts.
ISO 8503	Preparation of steel substrates before application of paints and related products-surface roughness characteristics of blast-cleaned steel substrates Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces Part 2: Method of Grading of Surface Profile of Abrasive Blast-Cleaned Steel-Comparator Procedure Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile – Stylus instrument procedure Part 5: Replica tape method for the determination of surface profile
ISO 9001	Quality management systems - Requirements.
ISO 11124	Preparation of steel substrates before application of paints and related products - Specifications for metallic blast cleaning abrasives Part 1: General introduction and classification Part 2: Chilled iron grit Part 3: High-carbon cast-steel shot and grit Part 4: Low-carbon cast-steel shot
ISO 11420	Method for the assessment of the degree of carbon black dispersion in polyolefin pipes, fittings and compounds

NACE International (NACE)

NACE RP0394	Application, Performance and Quality Control of Plant-Applied Fusion Bonded Epoxy External Pipe Coating.
NACE RP0490	Holiday Detection of Fusion Bonded Epoxy External Pipeline Coatings of 10 to 30 mls (0.25 to 0.70 mm).



The Society for Protective Coatings (SSPC)

SSPC SP1

Solvent Cleaning.

TRANSCO Standards

TRANSCO/CW6

Specification for the External Protection of Steel Line Pipe and Fittings
Using Resin and Associated Coating Systems
Part 1 Requirements for Coating Material and Methods of Test.

3. Definitions

For the purposes of this GIS, the following terms and definitions apply:

Purchaser

BP

Applicator

Shall mean the person, firm or organisation who has agreed and entered into an order with BP for the supply of materials and services, as specified in this Guidance for Specification

Supplier

The manufacturer(s) of the coating materials approved by the purchaser for the contract

4. Symbols and abbreviations

For the purpose of this (GIS, the following symbols and abbreviations apply:

DSC Differential scanning calorimetry

FBE Fusion bonded epoxy

ITP Inspection and testing plan

PE Polyethylene

PP Polypropylene

PQT Prequalification trial

5. Quality assurance

- a. The coating operation shall be governed by a documented Quality System, which ensures that the requirements of this GIS are met in every respect.
- b. The Quality System shall be based upon recognised quality standards of which ISO 9001 is a suitable examples. Quality Assurance systems to other equivalent standards may be used if approved by the purchaser.
- c. A Quality Assurance Group shall have been established, which shall be responsible for reviewing the Quality System and ensuring that it is implemented.
- d. Application and test procedures, which comprise the Quality System and the ITP shall be submitted to the purchaser for agreement.



- e. The Quality System shall include control of material and equipment suppliers and sub-contractors and shall ensure that the requirements of this GIS are satisfied by the suppliers and sub-contractors operating quality systems in their own organisations.
- f. A Quality Plan and ITP for the activities necessary to satisfy the requirements of the specification shall be prepared and issued to the purchaser for agreement before commencement of work.
 - 1. The Quality Plan and ITP shall include any sub-contracted work and the sub-contractor's Quality Plans shall be submitted.
 - 2. The Quality Plan shall be sufficiently detailed to indicate sequentially, and for each discipline, the requisite quality control, inspection, testing, and certification activities with reference to the relevant procedures and the acceptance standards.
- g. The Quality System and associated procedures may, with due notice, be subject to formal audits by the purchaser. The application of quality control will be monitored by the purchaser's inspectors, who will witness and accept on behalf of the purchaser the inspection, testing, and associated work required by the specification.
- h. The provision of inspection services reporting directly to the purchaser shall in no way relieve the responsibility to ensure that the full scope of work is carried out entirely in accordance with the specification and the agreed Quality Plan and ITP.

6. Coating selection

This GIS details both FBE-PP and FBE-PE three-layer coatings. The choice of which type of coating to use shall depend on the nature of the pipelining project.

- a. For pipeline product temperatures at or below 70°C (158°F), a three-layer FBE-PE system using medium-density or high-density PE may be utilised.

It should be noted that a number of proven FBE-PP field joint coating systems exist which are comparable to and fully compatible with FBE-PP line pipe coating, see GP 06-40. These FBE-PP field joint coatings eliminate field joint-line pipe coating interface issues between different generic coating types that need to be addressed when specifying three-layer FBE-PE coatings. No similar proven field joint coating systems exist for three layer FBE-PE. Therefore, it is often advantageous to specify a three-layer FBE-PP line pipe coating even though the maximum operating temperature does not exceed 70°C (158°F).

An FBE-PP pipeline coating system may also be preferred because of the superior mechanical properties compared to three-layer FBE-PE at the same operating temperatures.

- b. For three layer FBE-PP coated pipe, the maximum operating temperature shall be 110-125°C (230-257°F).

The maximum operating temperature will be determined by the specific FBE coating used and the Purchaser will verify that the FBE selected is appropriate for the specific maximum temperature to be encountered in service.

7. Procedure qualification

7.1. General

- a. Procedures proposed for factory application and repair of three-layer fusion bonded epoxy-polyethylene or fusion bonded epoxy-polypropylene coating shall be submitted to the purchaser for approval.



1. Procedures shall include a range of nominal outside pipe diameters.
 2. Procedures shall comply with clause 7.2.
- b. Before the start of production coating, proposed procedures for coating of the linepipe, as specified in clause 7.3, shall be qualified.

7.2. Coating procedures

The coating procedures shall incorporate full details of the following:

- a. Raw materials to be used including current data sheets providing values for the basic properties of each (see clause 8).
- b. Raw material test methods.
- c. Preliminary pipe inspection.
- d. Pipe cleaning/dirt and grease removal.
- e. Blast cleaning abrasives and technique.
- f. Testing for soluble salts.
- g. Abrasive blast cleaning quality, standard, and surface profile.
- h. Method of dust removal.
- i. Chemical pre-treatment methods.
- j. Pipe preheat method and pipe temperature at the point of coating; method of measurement of pipe/substrate temperature.
- k. Manufacturer and grade of FBE powder, its gel time, cure time, T_g, and application method.
- l. Adhesive material and application method.
- m. Polyethylene or polypropylene material and application method.
- n. Coating inspection procedures, testing methods, and acceptance criteria.
- o. Coating repair procedures.
- p. Pipe handling and identification.
- q. Quality control procedures, quality plan, and ITP.

7.3. Coating procedure approval tests/pre-qualification trial (PQT)

- a. Before commencement of coating procedure approval tests, the applicator shall have obtained approval of the coating procedures (see clause 7.2) including the test methods and acceptance criteria which shall be as described in Annexs A and B.
- b. The purchaser shall be given a minimum of seven (7) working days notice to witness procedures and tests.

Coating procedure approval tests/prequalification will be witnessed by the purchaser.

- c. Ten pipes shall be prepared and coated in accordance with the approved coating procedure.
 1. Five pipes shall be coated with chemical pretreatment(s) (see clause 11) and five pipes shall be coated without chemical pre-treatment.

Coating line pipe with and without chemical pretreatment enables the effectiveness of the chemical treatment to be confirmed.

