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External Field Joint Coating

Group Instruction for Supply

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

Work has been undertaken in Europe in producing a European Standard - EN 10329 - "Steel tubes and fittings for onshore and offshore pipelines – External field joint coatings."

The latest draft of EN 10329 has been taken as the basis for this GIS.

This is the first issue of Engineering Technical Practice (ETP) BP GIS 06-404. This Group Instruction for Supply (GIS) 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 application and related testing of the corrosion protection coatings applied to those steel surfaces which remain bare after the coated line pipe and/or coated fittings (components) have been joined by welding. It applies to both seamless and welded pipe.
- b. This GIS defines the responsibilities of the coating applicator.
- c. It defines the different types of field joint coatings for both buried and immersed pipelines.
- d. This GIS refers to field joint coatings for pipelines which are to be cathodically protected.

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.

BP

GIS 06-401	Cold Applied Tape Wrap.
GIS 06-402	Fusion Bonded Epoxy Powder External Pipeline Coatings.

European standards (EN)

EN 10289	Steel tubes and fittings for onshore and offshore pipelines - External liquid applied epoxy and epoxy-modified coatings.
EN 10290	Steel tubes and fittings for onshore and offshore pipelines - External liquid applied polyurethane and polyurethane-modified coatings.
EN 12068	Cathodic protection - External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection - Tapes and shrinkable materials.

International Organisation for Standardisation (ISO)

ISO 868	Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness).
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	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 11357-2

Plastics - Differential scanning calorimetry (DSC) -

Part 2: Determination of glass transition temperature.

NACE International (NACE)

NACE RP 0274

High Voltage Electrical Inspection of Pipeline Coatings.

Society for Protective Coatings (SSPC)

SSPC SP 1

Solvent Cleaning.

3. Terms and definitions

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

Purchaser

BP

Applicator

Person, company, or organisation who has agreed and entered into an order with the purchaser for the supply of materials and their application to *field joints* in accordance with this GIS.

Manufacturer

Producer of the coating(s) used in the coating application processes and approved by the purchaser for the contract.

4. Symbols and abbreviations

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

FBE Fusion bonded epoxy.

ITP Inspection and test plan.

5. Quality assurance

- a. The field joint coating operation shall be governed by a documented Quality System, which ensures that the requirements of the specification are met in every respect.
- b. The Quality System shall be based upon recognised quality standards of which ISO 9001/2 are suitable examples. Quality Assurance systems to other equivalent standards may be used if approved by the purchaser.
- c. A Quality Assurance Group shall be 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, and appropriate frequencies for the same 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. Field joint coating selection

6.1. Field joint coating-factory coating matrix

The permissible field joint coating-line pipe coating combinations are given in Table 1.

- a. In each case, the field joint coatings used shall be comparable in physical and mechanical properties to the line pipe coating, provide a satisfactory level of adhesion to the factory coating and the steel substrate, and be suitable for the full operating temperature range of the pipeline in the specific environment.
- b. The selection of the most appropriate field joint coating shall be made by reference to this table.



Table 1 - Types of field joint coating(s) depending on the factory applied coating

Factory Applied Line Pipe Coating	Field Joint Coating †						
	1	2	3	4	5	6	7
Cold applied laminate tapes	√	x	x	x	x	x	X
Coal tar and asphalt enamel	√	√	√	√	x	x	X
Epoxy powder	x	x	√	√	√	x	X
3-layer FBE powder/ polyethylene	x	√	√	√	x	x	x
3-layer FBE powder/ polypropylene	x	√*	x	x	x	√	√
Liquid epoxy and epoxy-modified coatings (bends and fittings)	x	x	√	x	x	x	x
Liquid polyurethane and polyurethane-modified coatings (bends and fittings)	x	x	x	√	x	x	x
† Field Joint Coating Key	Clause						
1. Cold applied laminate tape	9.1						
2. Heat shrinkable materials	9.2						
3. Liquid applied epoxy	9.3						
4. Liquid applied polyurethane	9.3						
5. FBE	9.5						
6. FBE/flame sprayed polypropylene	9.4						
7. FBE/tape applied polypropylene	9.4						
* Polypropylene heat shrink sleeves only (e.g. Canusa GTS-PP)							

6.2. Manufacturer's data

- a. The latest manufacturer's product data sheets and batch certificates for the materials to be used shall be obtained from the manufacturer and retained.
- b. The minimum amount of information that shall be obtained from the coating materials manufacturer, is given in the respective clause of this document covering each specific field joint coating material, see clauses 9.1 to 9.5. This information shall be provided either in the manufacturer's product data sheets or in supplementary documentation, before any work commences.
- c. Measures shall be taken to ensure that:
 1. Raw materials, including cleaners, abrasives, and coating materials comply fully with this GIS.
 2. The manufacturer's recommended storage instructions are followed.
 3. The manufacturer's recommended shelf life has not been exceeded.
 4. Raw materials are stored in accordance with the manufacturer's instructions and remain in an acceptable condition at all times.

7. General requirements for surface preparation and coating application**7.1. Preparation of the field joint area before coating****7.1.1. Surface cleaning**

- a. During inclement weather, such as wind and rain, cleaning operations may only be carried out if suitable protective awnings or shelters are provided which prevent contamination of the surface being prepared.



- b. The entire field joint area including, as a minimum, the first 100 mm (4 in) of adjacent line pipe coating shall be cleaned to remove any dirt, grease, or salt contamination in accordance with SSPC SP 1.
- c. Filing or grinding shall be used to remove any weld spatter, slag, rough weld capping, burrs, etc. that would otherwise be detrimental to the quality of the finished coating.

7.1.2. Steel surfaces

7.1.2.1. Surface preparation

- a. Surface preparation shall only take place when the relative humidity is less than 85% and the steel temperature is more than 3°C (5°F) above the dew point.
- b. Rust and scale shall be removed by blast cleaning with a suitable abrasive to produce a surface that corresponds to Grade Sa 2½ or better as defined in ISO 8501-1.
- c. The choice of abrasive shall be such that it produces an angular surface profile with amplitude of 50 to 100 microns (0,002 to 0,004 in). The surface profile shall be measured in accordance with one or more of the methods described in ISO 8503.
- d. Steel shot should not be used for abrasive blasting.

This produces a rounded profile resulting in less efficient coating adhesion.

7.1.2.2. Surface imperfections

- a. Slivers, laminations, or other imperfections exposed by the cleaning process shall be removed and the steel surface shall be re-blast cleaned.
- b. After removal of these imperfections the residual pipe wall thickness shall meet the minimum tolerance requirements of the pipe manufacturing specification.

7.1.2.3. Salt contamination

- a. A purchaser approved salt meter shall be used to carry out salt tests on the field joint to determine if further surface cleaning is required. Alternatively, a conductometric method may be used in accordance with ISO 8502 Part 9.
- b. In each case a minimum of one test shall be carried on each side of each field joint.
- c. The salt meter shall be calibrated in accordance with the equipment manufacturer's recommendations.
- d. Alternatively, a standard and/or proprietary volumetric procedure may be used to determine the level of salt contamination.
- e. The acceptance criteria shall be 3 µg/cm² (0,7 µoz/in²) maximum.
- f. Initially, the frequency of the salt tests shall be one for every hour of production. If, over a period of time, acceptable values are consistently achieved, the frequency of salt test measurements may be reduced at the purchaser's discretion.

7.1.3. Preparation of the adjoining factory applied coating

- a. A minimum of the first 50 mm (2 in) of factory coating adjacent to the field joint area shall also be prepared to provide a suitable surface to which the field joint coating can adhere.
- b. The methods for preparing this area are dependant upon the factory applied coating and are described more fully below. In all cases the first stage shall be the complete removal of dirt, grease, and other forms of contamination in accordance with clause 7.1.1.b.
 - 1. Coal tar and asphalt enamel surfaces – ragged edges shall be removed and the surface shall be roughened or abraded using abrasive paper or a file.



2. Cold applied tapes – disbonded and ragged tape shall be cut back to a firmly adherent edge and a square end. The outer surface shall be lightly roughened with abrasive paper.
3. FBE – lightly sweep abrasive blast clean or hand abrade to provide a roughened finish with no loosely bonded coating remaining.
4. Three layer FBE polyethylene
 - a) FBE toe – if a toe of FBE is provided beyond the polypropylene layer termination, this shall be treated as in 3 above.
 - b) Polyethylene outer coating – either abrasive blast clean, scrape with a surform or similar tool, or abrade with a coarse flexible sanding disc (P60) to provide a firm key. If it can be demonstrated that this is beneficial, controlled flame treat with an appropriate oxidizing flame. Measurements of surface energy may be carried out before and after flame treatment using surface tension pens to determine the effectiveness of the treatment.
5. Three layer FBE – polypropylene
 - a) FBE toe-As for 4.a) above.
 - b) Polypropylene outer coating – scrape clean using a surform or equivalent tool. If a polypropylene field joint coating is to be applied, apply external heat until the outer surface of the polypropylene is soft when prodded with a blunt instrument. Heating of the polypropylene at the overlap areas shall be carried out just before the application of the polypropylene field joint coating component.
6. Liquid applied epoxy and urethane coatings – the area to be overlapped shall be lightly abrasive blast cleaned or hand abraded in order to provide a roughened surface to overlap subsequent coatings on to.

7.1.4. Contamination of prepared surfaces

- a. Before the field joint coating is applied, residual abrasive dust and debris shall be removed from the surface of the joint by blowing with clean compressed air or another method agreed with the purchaser.
- b. If the prepared field joint becomes contaminated in any way before coating application can be carried out, it shall be subjected to further cleaning in accordance with the requirements stated above.

7.1.5. Quality control of surface preparation

- a. The relative humidity, dew point, and steel temperature shall be measured at the start of every shift and at a minimum of every 4 hours thereafter.
- b. Visual inspection of every field joint shall be carried out over 100% of the surface to determine conformance to clauses 7.1.2.1 and 7.1.2.2.
- c. Surface profile measurements shall be carried out at a minimum frequency of 2 measurements per field joint and one field joint at the start of every shift, and one every 4 hours thereafter.
- d. The level of dust contamination shall be determined in accordance with ISO 8502-3 at the start of every shift and every 4 hours thereafter. The degree of cleanliness shall be rating 2 or better.
- e. The quality control requirements during surface preparation shall be in accordance with Table 2 unless otherwise agree with the purchaser.



Table 2 - Quality control of surface preparation

Item	Requirement	Clause Reference	Frequency	
			Prequalification	Production
Abrasive	Present Batch Certificate	6.2.a	Every batch	Every batch
	Check Storage Conditions	6.2.c	Every batch	Every batch
Environmental Conditions		7.1.2.1.a / 7.2.a	Beginning of every shift and every 4 hours thereafter	Beginning of every shift and every 4 hours thereafter
Pipe Surface Condition		7.1.5.b	100% every field joint	100% every field joint
Surface Cleanliness		7.1.2.1.b	100% every field joint	100% every field joint
Surface Contamination		7.1.5.d	2 locations minimum per field joint	2 locations on 1 field joint. Start of every shift and every 4 hours thereafter
Surface Profile		7.1.5.c	2 locations minimum per field joint	2 locations on 1 field joint. Start of every shift and every 4 hours thereafter
Salt Contamination		7.1.2.3	1 location minimum per field joint	Once per field joint per hour
Preparation of Line Pipe Coating		7.1.3	100% every field joint	100% every field joint

7.2. Coating application

- a. No coatings shall be applied when the relative humidity is greater than 85% or the steel temperature is less than 3°C (5°F) above the dew point.
- b. The field joint shall be coated within 4 hours of surface preparation, or before any visual deterioration of the surface, whichever is the sooner.
- c. Immediately before application, the surface temperature of the joint shall be within the temperature range specified by the coating manufacturer.
 1. The temperature of the joint shall be monitored, using a reliable temperature measurement technique, to ensure that the application conditions on the steel substrate and factory applied coating are being met fully.
 2. Instruments used for this purpose shall be fully calibrated.
- d. The coating shall be applied fully in accordance with the manufacturer's recommendations by trained and qualified personnel, except that if pre-heat is required to raise the temperature of the steel substrate this shall be by induction heating.

Heating with an open flame cannot provide uniform heat input to the field joint area and often results in damage to the existing line pipe coating.

- e. Induction heating coils used to heat the pipe at any stage in the surface preparation and coating process shall undergo a heat profile test during the field joint coating prequalification.
 1. This shall involve fixing a minimum of 6 thermocouples to the steel substrate and recording the temperature profile across and around the circumference of the field joint during the rise and decay in the temperature.
 2. A permanent record of the heat rise and decay for each induction coil used shall be retained for the duration of the production workscope.
 3. The temperature variation across the field joint shall not exceed 15°C (27°F).
- f. If the coating is applied using automated equipment, a documented maintenance routine shall be developed to ensure the reliability of the equipment.



1. Sufficient spare parts shall be available at site to fully support the maintenance activities and prevent prolonged equipment outages.
2. The documented maintenance routine shall form part of the inspection and test plan.

Hot twin airless spray equipment used to apply solvent free two pack epoxy and polyurethane coatings is particularly prone to off specification mixing due to equipment malfunction when used continuously over extended periods of time.

7.3. Appearance of the applied coating

The applied coating shall be of uniform appearance over the entire surface, with no foreign matter inclusions (grit, dust, etc.), and no wrinkles, blisters, runs, or sags.

7.4. Testing

Throughout production, regular inspection of the surface cleaning, surface preparation, and coating application shall be carried out at every stage.

- a. Table 2 in clause 7.1.5.e covers the inspection requirements during surface preparation.
- b. The inspection requirements during and after coating application are given under each generic coating type in clause 9.
- c. The relevant inspection and test procedures are given in Annexes A to I.
- d. The activities listed in the inspection and test procedures shall be the minimum acceptable to the purchaser.

7.5. Coating repairs

For each line pipe coating – field joint coating combination to be used, a coating defect acceptance criteria and repair procedure shall be proposed for review and approval by the purchaser before the procedure pre-qualification.

8. Coating application - Procedure pre-qualification

8.1. General

- a. Proposed procedures to be used for the field application of the specified field joint coating system, which fully comply with the GIS, shall be submitted to the purchaser for approval.
- b. Before the start of production coating, proposed procedures for field joint coating shall be qualified.

8.2. Coating procedures

The coating procedures shall incorporate full details of the following:

- a. Full descriptions of raw materials, their manufacturer(s), and the grades to be used including current data sheets providing values for the basic properties of each material.
- b. Raw material verification test methods and results.
- 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. Measurement of residual dust contamination.
- j. Pipe preheat method and pipe temperature at the point of coating.
- k. Coating application procedures.
- l. Coating inspection procedures, testing methods, and acceptance criteria.
- m. Coating repair procedures.
- n. Inspection and test plan (ITP).

8.3. Coating procedure approval tests/pre-qualification

- a. Before commencement of coating procedure approval tests, approval of the documented coating procedures shall be obtained from the purchaser (see clause 8.2). These shall include the test methods and acceptance criteria, which shall be as detailed in the Annexes.
- b. Coating procedure approval tests will be witnessed by the purchaser. The purchaser shall be given a minimum of seven (7) working days notice to witness procedures and tests.
- c. A minimum of 3 field joints shall be prepared and coated during the coating procedure approval tests in accordance with the approved coating procedure.
- d. As a minimum, tests shall be carried out on the raw materials used and on the final coating on all three test field joints in accordance with the relevant inspection and test requirements within clause 9, for formal approval of the overall coating application procedure. Proposed coating repair procedures shall also be qualified during the coating procedure approval tests.
- e. Within four (4) days of completion of the coating procedure approval tests, a written test report complete with a full set of records covering the properties of the raw materials and the applied field joint coating shall be submitted to the purchaser for consideration and approval.

9. Field joint coatings, coating application, and quality

9.1. Cold applied laminate tapes

9.1.1. Coating description

Cold applied laminate tape systems shall consist of:

- a. A quick drying primer, suitable for either brush or spray application.
- b. An anticorrosion tape consisting of a PVC or polyethylene carrier with a minimum thickness of 0,75 mm (0,030 in) firmly adhered to an inner layer of a self adhesive bituminous rubber compound with a minimum thickness of 0,8 mm (0,031 in).
- c. Optional (if specified); a Mechanical Protection Outer Wrap with a minimum thickness of 0,75 mm (0,030 in) and complying fully with GIS 06-402. Tape shall be suitable for application by hand or by machine.
- d. The coating shall conform to GIS 06-401 except as otherwise specified below.

9.1.2. Technical information

General technical data on the cold applied laminate tape system as described in clause 8.2.a and 8.2.b shall be obtained from the tape manufacturer. Specific technical data as listed in Table 3 shall also be obtained.

