

DEP SPECIFICATION

**EXTERNAL FIELD JOINT AND REHABILITATION COATING
SYSTEMS FOR LINE PIPE
(AMENDMENTS/SUPPLEMENTS TO ISO 21809-3:2008)**

DEP 31.40.30.37-Gen.

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DESIGN AND ENGINEERING PRACTICE



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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for field-applied coating systems used for:

- external field joints during the construction of buried or submerged pipelines;
- repair (rehabilitation) to damaged and deteriorated coatings for buried or submerged pipelines.

It specifies the requirements for coating materials, coating application, inspection and testing and gives procedures for the qualification of coating materials and coating applicators.

The DEP is applicable to the following generic types of field joint coating systems:

- a. Liquid epoxy;
- b. Liquid polyurethane;
- c. Heat shrink sleeves;
- d. Polyethylene;
- e. Polypropylene;
- f. Fusion bonded epoxy;
- g. Visco-elastic self-healing wrapping;
- h. Thermally sprayed aluminium;
- i. Permanent high density mould sleeve for three layer polyethylene and polypropylene;
- j. Concrete weight coating;
- k. Polychloroprene rubber;
- l. Polypropylene/ polyethylene injection moulded field joint;
- m. Injection moulded polyurethane insulation;
- n. Half shell insulated field joints;
- o. Pipe in pipe flowlines;
- p. Electrically heated pipe in pipe flowlines;
- q. Pipe in pipe casing to bulk head joint casing.

Coal tar enamel and pre-preg fibre reinforced polymers (e.g., UV cured) field joint coating systems are not covered (see Part II, 2).

Field joint coatings for elastomeric riser coatings are covered by the riser coating DEP 31.40.30.36-Gen.

Field joint coatings of thermally sprayed aluminium (TSA) are covered by DEP 30.48.40.31-Gen.

This DEP is based on ISO 21809-3:2008. Part III of this DEP amends, supplements and deletes various clauses of ISO 21809-3:2008. Part III follows the clause numbering of ISO 21809-3:2008 for easy reference.

All clauses of ISO 21809-3:2008 not modified by this DEP remain valid as written.

This is a revision of the DEP of the same number dated February 2013; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturer/Supplier's nominated by them. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer

This DEP is intended for use in facilities related to oil and gas production, oil refining, chemical processing, gasification and distribution. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regard to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
Adhesive	Intermediate coating layer that improves adhesion between the primer and the coating (three layer system) or between the steel and the coating (two layer system).
Applicator	Party that applies the coating to the field joint in the field.
Batch	Amount of materials produced within one uninterrupted production run of maximum 8 h under constant production conditions.
Chemical Pre-Treatment	Treatment of the blast cleaned pipe surface with a chemical solution before application of the primer or adhesive to improve adhesion of the first coating layer (phosphate, chromate).
Field Joint	Part of the pipeline where pipes have been welded together and where, as a consequence, there is a discontinuity in the pipe coating.

Term	Definition
General Qualification	Qualification of a product as a generic field joint coating system.
Holiday	A defect penetrating through the coating to the steel pipe surface, of such dimensions that it is detectable by means of the specified procedures.
Inspector	Party appointed by the Principal to witness the Applicator's quality control of coating materials and the coating process.
Maximum Design Temperature	Temperature that is specified by the Principal as the maximum design temperature of the pipeline.
Primer	Coating layer applied directly onto the bare or pre-treated steel surface to improve the adhesion of the final coating to the pipe surface.
Shift	A production run of which the beginning and end coincide with a change in personnel. In the context of the quality control procedures of this DEP, the maximum duration of a shift is 10 h.
Specific Project Qualification	Qualification of a product for application for the specified project.
Three layer system	A pipe coating system consisting of three layers: primer, adhesive and outer layer.

1.3.3 Abbreviations

Term	Definition
CWC	Concrete weight coating
DN	Diameter Nominal (mm)
FBE	Fusion Bonded Epoxy
FJC	Field joint coating
FSPE	Flame spray polyethylene
HD	High density
HDPE	High Density Polyethylene
HSS	Heat shrink sleeves
IMPE	Injection moulded polyethylene
IMPU	Injection moulded polyurethane
ITP	Inspection Test Plan
LE	Liquid epoxy

Term	Definition
OIT	Oxygen Induced Time
PE	Polyethylene
PP	Polypropylene
PQT	Pre-Qualification Trial
PU	Polyurethane
PUF	Polyurethane foam
SCR	Steel Catenary Riser
TLPE	Three Layer Polyethylene
TLPP	Three layer polypropylene
TSA	Thermally Sprayed Aluminium
UV	Ultraviolet light
VIV	Vortex Induced Vibration

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced in this DEP are listed in (Part IV).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2013 which was a stand-alone document. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced use of shall / should / may for normative statements.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://swwww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

1.9 DOCUMENT HIERARCHY

In the event of conflicts between contract documents, AFC drawings, specifications and other referenced standards, the following document hierarchy shall apply:

- a. contract or agreement (including any approved exceptions);
- b. AFC drawings – latest revisions;
- c. principal's specifications (including project specific information);
- d. industry Standards (e.g., ISO, NACE).

PART II GENERAL REQUIREMENTS

1 GENERAL

1. Part III of this DEP is written as amendments and supplements to ISO 21809-3:2008.
 - a. Wherever reference is made to ISO 21809-3, it shall be understood to mean ISO 21809-3:2008 as amended/supplemented by this DEP.
 - b. Clauses in ISO 21809-3, which are not mentioned in this DEP, shall remain valid as written.

For ease of reference, the clause numbering of ISO 21809-3 has been used throughout Part III of this DEP.

1.1 FIELD JOINT COATING QUALIFICATION

This DEP is used for general qualification of external field joint systems and products, and to define the requirements for qualification, application and testing of external field joint systems for specific projects including rehabilitation or repairs of existing pipelines/equipment coating systems.

General field joint coating qualification is performed for the purpose of overall qualification of field joint coating systems and Applicators, but is not necessarily related to a specific project. With this process, a list of qualified coating systems and Applicators is developed, from which the Principal may select a field joint coating system and Applicator for a specific project.

1. The general qualification may be given independent of line pipe diameter and wall thickness.
2. When qualification is required for a specific project, additional testing should be performed on the specific line pipe diameters and wall thicknesses during the Applicator qualification, see (7.3.1).
3. The approval of the field joint coating system shall be in accordance with the Principal.

The coating type is to be appropriate for the environment in which the pipeline will operate.

This DEP provides the flexibility to specify an appropriate field joint coating that will provide fit-for-purpose service in a wide range of environments.
4. The maximum temperature rating of the applied coating shall be greater than the maximum design operating temperature for the pipeline being coated.
 - a. The temperature rating of the coating designated in the Manufacturer/Supplier's product data sheet shall be provided to the Principal.
 - b. The suitability of a coating system for a particular temperature class shall be demonstrated by performing the qualification tests at the relevant test temperature given in this DEP.
 - i. Additional testing may be required at temperatures specified by the Principal.

This DEP does not identify maximum temperature limits for generic coating systems because there are a large variety of available grades of systems and components. The maximum allowable temperature for a coating system is determined by the system's components.

1.2 SAFETY

Application of coatings can include the use of hazardous materials, operations and equipment. This DEP does not purport to address all the potential safety concerns associated with their use. It is the responsibility of the Applicator to establish appropriate safety and health requirements and determine any regulatory requirements or limitations prior to use.

1. The safe practices recommended by Manufacturer/Supplier standards shall be followed including management of waste material, protective equipment.
 - a. Protective equipment requirements in the Manufacturer/Supplier's Material Safety Data Sheet(s) shall be followed.
2. Coating work pieces shall be electrically grounded (earthed) as required to eliminate static charges associated with surface preparation and coating operations.

1.5 MATERIALS

1. The Applicator shall obtain from the Manufacturer/Supplier copies of their most recent technical data sheets describing the product, its general performance, and application requirements.
2. The Applicator shall obtain from the Manufacturer/Supplier certification for each batch or lot of material to be used that includes basic physical properties of the coating materials.
3. All coating materials shall be furnished in unopened, clearly identified containers that include details of the material, batch number, and date of manufacture.
4. Coating materials handling, including storage, shall be as recommended by the Manufacturer/Supplier.
 - a. Material shall not be used after its expiration date.
 - b. Contaminated material and material showing any sign of degradation shall not be used.
5. All materials shall be approved by the Principal.

2 COATING SYSTEMS

Cold-applied tapes may be used if they fulfil the requirements specified for heat shrink sleeves (11).

1. Coal tar enamel and pre-preg fibre reinforced polymers (e.g., UV cured) field joint coating systems shall not be used.

PART III AMENDMENTS/SUPPLEMENTS TO ISO 21809-3:2008**3 TERMS AND DEFINITIONS**

Add at the beginning of this section:

1. Definitions in (I-1.3) of this DEP shall also apply.

4 SYMBOLS AND ABBREVIATED TERMS

Add at the beginning of this section:

1. Abbreviations in (I-1.3) of this DEP shall also apply

6 INFORMATION TO BE SUPPLIED BY THE PURCHASER**6.1 GENERAL INFORMATION**

Add the following bullets:

- project name;
- line pipe coating cut back length;
- end preparation and bevel angle of line pipe coating;
- type and thickness of the line pipe coating;
- minimum and maximum operating temperature of the pipeline;
- description of steel pipe;
- the geographical area (land/subsea);
- expected ambient temperature range during installation;
- installation method;
- soil and backfill conditions for land pipelines;
- seabed trenching, laying and burial conditions for subsea pipelines;
- subsequent coatings to be applied (e.g., weight coating, insulation);
- requirements for anti-slip treatment;
- type of cathodic protection system.

Add the following new section:

6.3 INFORMATION TO BE SUBMITTED BY THE CONTRACTOR

1. The Contractor shall submit the information referenced (6.3.1) thru (6.3.4) to the Principal on the field joint coating system to be used.

6.3.1 Coating system identification

1. The following data shall be submitted on coating system identification:
 - a. system designation or trade name;
 - b. name of coating Manufacturer/Supplier (s);
 - c. generic type of system;
 - d. coating application process;
 - e. system structure (e.g., 2-layer or 3-layer);
 - f. structure components (primer, adhesive, outer layer) ;
 - g. service temperature range;
 - h. total nominal coating thickness;
 - i. compatibility to line pipe coating system;
 - j. suitability for immersed services;
 - k. relevant international/national coating standard approvals.

6.3.2 Manufacturer/Supplier's data

6.3.2.1 Liquid epoxy and polyurethane

1. The following data shall be submitted on the liquid epoxy or polyurethane components:
 - a. trade name;
 - b. type of base (epoxy resin) and extender modification and type of curing agent (for liquid epoxy);
 - c. type of polyol and isocyanate (for polyurethane);
 - d. colour;
 - e. solids by weight and volume;
 - f. theoretical coverage per m² (ft²) for nominal thickness;
 - g. storage conditions and shelf life;
 - h. application procedures, pot life, overcoating time.

6.3.2.2 Heat shrink sleeve

1. The shrink sleeve Manufacturer/Supplier shall submit technical data on the system and system components for information of the Principal.

6.3.2.2.1 Primer

1. The following data shall be submitted on the primer:
 - a. the generic type of primer;
 - b. for liquid primers the solids content, the type of solvent and the density;
 - c. the method of application (e.g., brush, roller, spray);
 - d. required storage conditions, shelf life;
 - e. the nominal dry-film-thickness or spreading rate;
 - f. application procedures, temperature, pot life, overcoating times for various ambient temperatures (10 °C to 50 °C (50 °F to 122 °F));
 - g. health and safety data sheets.

6.3.2.2.2 Adhesive

1. The following data shall be submitted on the shrink sleeve adhesive:
 - a. generic type of adhesive;
 - b. nominal thickness of the adhesive;
 - c. softening point of the adhesive.

6.3.2.2.3 Shrink sleeve material

1. The following data shall be submitted on the outer sheath material:
 - a. generic type of sheath material;
 - b. nominal thickness of the sheath;
 - c. mechanical properties of the sheath film (tensile strength, elongation);
 - d. storage conditions, shelf life;
 - e. shape of delivered product (tubular, wrap or tape);
 - f. for wrappings, the type of closure;
 - g. colour.

6.3.2.3 Polyethylene and polypropylene

6.3.2.3.1 Primer

1. The following data shall be submitted on the primer:
 - a. the generic type of primer;
 - b. for liquid primers the solids content, the type of solvent and the density;
 - c. for powder epoxy primers the density, curing and gel time, particle size, moisture content, thermal analysis, recommended film thickness, colour;
 - d. typical film properties (flexibility, cathodic disbonding resistance);
 - e. the method of application (brush, roller, spray, electrostatic spray);
 - f. storage conditions and shelf life;
 - g. the nominal dry film thickness or spreading rate;
 - h. application procedures, temperature, pot life, overcoating times;
 - i. HSE datasheets.

6.3.2.3.2 Adhesive

1. The following data shall be submitted on the adhesive:
 - a. the generic type of adhesive;
 - b. the method of application (e.g., powder spray);
 - c. the nominal thickness;
 - d. storage conditions and shelf life.

6.3.2.3.3 Coating material

1. The following data shall be submitted on the polyethylene or polypropylene outer layer material:
 - a. generic type of material (e.g., high/medium/low density PE/PP);
 - b. delivered product (e.g., sheet, powder, granules, liquid);
 - c. storage conditions, shelf life;
 - d. colour;
 - e. nominal thickness of the outer layer;
 - f. mechanical properties of the outer layer film (tensile strength, elongation);
 - g. data on resistance to bio-degradation.

6.3.2.4 Fusion bonded epoxy

1. The following basic properties of the epoxy powder resin are requested:
 - a. infrared scan;
 - i. an infrared spectrogram, carried out by means of a standard KBr disc, shall be submitted for comparison with all subsequent batches produced.
 - b. particle size analysis;
 - i. the particle size distribution analysis shall be carried out in accordance with ISO 8130-1;
 - ii. the coating Contractor shall confirm that the particle size is suitable for the electrostatic spraying equipment used by the proposed Applicator.
 - c. density;
 - i. the density of the powder shall be measured in accordance with ISO 8130-2 or ISO 8130-3.
 - d. curing schedule and gel time;
 - i. a curing schedule shall show the gel time and minimum curing time required for full curing of the coating at various recommended application temperatures.
 - ii. the gel time shall be determined in accordance with ISO 8130-6.
 - e. moisture content;
 - i. the moisture content of the powder shall be determined by means of ISO 8130-7 and shall not exceed 0.5 % by mass.
 - f. storage stability;
 - i. the storage stability of the epoxy powder shall be determined in accordance with ISO 8130-8.
 - g. thermal analysis;
 - i. a thermal analysis shall be made by means of differential scanning calorimetry to determine the glass transition temperatures and the enthalpy of curing of the powder.

6.3.2.5 Visco-elastic self-healing coating system

6.3.2.5.1 Visco-elastic self-healing wrapping

- a. colour;
- b. minimum coating thickness;
- c. generic type of polymeric film with typical properties;
- d. generic type of reinforcement material with typical properties;
- e. generic type of adhesive with typical properties;
- f. mechanical properties (e.g., elongation, tensile strength);
- g. storage conditions.

6.3.2.5.2 Mechanical outer wrap

- a. colour;
- b. minimum coating thickness;
- c. generic type of polymeric film with typical properties;
- d. generic type of reinforcement material with typical properties;
- e. generic type of adhesive with typical properties;
- f. mechanical properties (e.g., elongation, tensile strength);
- g. storage conditions.

6.3.3 Coating system qualification information

1. Qualification a field joint coating system shall be carried out according to the following procedures:
 - a. the Contractor or the coating Manufacturer/Supplier shall show that samples of the coating system applied on pipe joints of the specified pipe material have been successfully subjected to the tests and number of pipe joints as specified in Table B;
 - b. the tests shall be carried out by an independent test laboratory or, if approved by the Principal, by the coating Manufacturer/Supplier;
 - c. the Principal shall witness the application and the tests.

If agreed by the Principal,

- *previous qualification data developed in accordance with the requirements of this DEP can be used provided that the tests were performed using the same field joint coating system and the same specified coating application process.*
- *qualification tests carried out in accordance with other coating standards can be used insofar as the procedures are equal or more stringent than the procedures in this DEP.*

2. Qualification test information shall include full reports on test procedures and results that are signed by the laboratory representatives and certification body.

Add the following new section:

6.4 DOCUMENTATION**6.4.1 Qualification records**

1. The Contractor shall keep accurate records of the following information concerning the field joint coating qualification process:
 - a. copies of pre-qualification information;
 - b. records of all samples;
 - c. records of all qualification tests carried out including test equipment data, test conditions and identification of samples used;
 - d. records of all test results;
 - e. names of persons who carried out and/or witnessed the tests.
2. All information shall be compiled into a test report that shall be approved and signed by the responsible person of the test laboratory and by the Inspector.

6.4.2 Field records

1. During field application of the coating system, the Contractor shall keep accurate records of the following information related to the coating application:
 - a. copies of, or reference to, all procedures for the application of the coating;
 - b. copies of, or reference to, the field joint coating qualification report;
 - c. results of qualification tests for field joint coating Application workers including names and dates of qualification; number of application workers required for each applicable pipe diameter;
 - d. identification of the pipe joints where coatings have been applied, by reference to the joint numbers in the pipeline construction record book;
 - e. batch numbers of all coating components that have been applied, date/time of application and the name of the Application workers;
 - f. results of all quality control testing;
 - g. identification of field joint coatings that have been subjected to peel strength tests and destructive testing, with date/time of the test and all test results;
 - h. records of any process changes needed to comply with the specifications;
 - i. names and signatures of the responsible persons for the application process and quality control.
2. This information (6.4.2 Item 1) should be included in the Applicator's ITP.
3. All results shall be compiled into a report in a format agreed between the Contractor and the Principal.
4. Reports shall be made available on a daily basis for work performed the previous day.



7 APPLICATION PROCEDURES AND QUALIFICATION

7.3 PROCEDURE QUALIFICATION TRIAL (PQT)

Replace this section with the following:

1. The Contractor or the coating Manufacturer/Supplier shall submit all data specified in (7.3.1.2) and (7.3.1.3).
 - a. The Contractor or the coating Manufacturer/Supplier shall show that samples of the coating system applied on pipe joints of the specified pipe material have been successfully subjected to the tests as specified in this DEP.
 - i. The tests shall be carried out by an independent test laboratory or, if approved by the Principal, by the coating Manufacturer/Supplier.
 - ii. Qualification test information shall include full reports on test procedures and results and is to be signed by the laboratory representatives and certification body.

If agreed by the Principal, previous qualification data developed in accordance with the requirements of this DEP can be used provided that the tests were performed using the same field joint coating system and the same coating application process as specified in the contract.

With the approval of the Principal, qualification tests carried out in accordance with other coating standards may be used in, so far as the procedures are equal or more stringent than the procedures in this DEP.

- b. The Principal shall witness the application and the tests.
 - c. The number of pipe joints to be tested and the test procedures are given in Table B.
2. The Contractor shall prepare a detailed procedure for all types of required field joint coatings for approval by the Principal
 - a. All inspections and measurements made during field joint application and any procedure qualifications shall be documented and provided to the Principal.
3. The application shall be carried out using the Contractors field joint coating procedure for the project.
 - a. The Contractor shall prepare a painting/coating procedure for approval to ensure compliance with the requirements in this DEP.

4. There shall be a PQT of all field joint coatings.
 - a. The PQT shall include details of equipment, materials, operator requirements, surface preparation, application techniques, repairs, and testing.
 - b. The PQT should include handling of waste materials and disposal methods.
 - c. The PQT shall use the same equipment and materials that will be used at the fabrication yard or on the offshore installation vessel.
 - i. Test pipe shall be coated with an approved mill applied coating, identical to that which will be used during actual field joint execution.
 - ii. If long field joints are used for J-Lay installation, multiple barriers to water ingress shall be used.
 - iii. The corrosion coating shall be holiday free,
 - iv. The application method shall ensure bonding between all components,
 - v. The mould for injection moulding shall be permanent and thermo-plastically welded to the parent coating (for PE/PP).
5. The coating procedure shall include details of actions to maximize the bonding when PU is used with a PE/PP parent coating.

7.3.1 Applicator qualification

7.3.1.1 General

1. Before application of a field joint coating system may commence, the Applicator shall be qualified to apply the coating system.

7.3.1.2 Field joint coating application procedure

1. The Contractor shall submit to the Principal information the required coating application process and recommended applicators.
2. Prior to start of production and any qualification testing, the Contractor shall prepare a detailed application procedure specification including the following:
 - a. quality plan;
 - b. Inspection and Test Plan (ITP);
 - c. description of the coating application process, tools and equipment;
 - d. pipe cleaning and surface preparation (cleanliness, profile, chemical pre-treatment);
 - e. required surface and material application temperatures;
 - f. recommended applicators;
 - g. repair and testing procedures;
 - h. marking, traceability and documentation.

7.3.1.3 Qualification

1. After approval of the coating application procedure and before field application starts, the Applicator shall submit evidence of previous successful application of the field joint coating system on pipes of the specified material, and that the product complied with the requirements of this DEP for the tests specified in Table B.
2. The Applicator shall make up application on at least 5 field joints in order to:
 - a. prove the quality plan;
 - b. prove the application procedures (both main and repair);
 - c. prove the ITP.

This is regardless of whether the Applicator has applied the particular type of field joint in the past.
3. If different procedures are required for different sizes of joints, this should be 5 test joints for each procedure.
4. All joints offered shall be tested in accordance with Table B.
 - a. After the Applicator has satisfactorily demonstrated application of the field joint coating, two joints shall be coated and the joints is to be tested in accordance with Table B.
5. At least two welded pipe pups with the factory line pipe coating shall be coated by the Applicator with the proposed field joint coating system and is to be subjected to the tests specified in Table B.
 - a. These tests may be carried out in the Applicator's own laboratory, or by an independent laboratory to be agreed by the Principal.
6. The Principal shall witness the application and testing.
7. The results of the tests shall be reported to the Principal, signed by the head of the laboratory and the witness.

7.4 PRE-PRODUCTION TRIAL (PPT)

Delete second to last paragraph beginning "Test methods and frequencies..."

7.5 QUALIFICATION OF COATING AND INSPECTION PERSONNEL

Delete last paragraph.

7.6 PRODUCTION TESTING AND INSPECTION

Delete last paragraph.

8 CLASSIFICATION OF FIELD JOINT COATINGS

Replace this section with the following:

1. The field joint coating system shall be suitable to provide corrosion protection to the field joints of a pipeline to the same standard or better than the pipe coating system used on the main body of the pipeline.
2. The field joint coating system specified in this DEP shall be manufactured to obtain the required coating properties under the prevailing design, installation and operating conditions.

8.1 COATING TYPES

8.1.1 Liquid epoxy

1. Liquid epoxy and epoxy-modified coatings shall be solvent free.

These are two-pack coating systems composed of a base (epoxy resin) and a curing agent. The coating system can be modified with other components.

Reinforcement of the coating systems can be achieved by using glass fibres of glass flakes.

8.1.2 Liquid polyurethane

1. Liquid polyurethane and polyurethane-modified coatings shall be solvent free.

These are two-pack coating systems composed of polyol (pack A) and isocyanate (pack B). The coating system can be modified with other components.

8.1.3 Heat shrink sleeve

A heat shrink sleeve is a type of field joint coating, applied to a pre-heated pipeline in the form of a sleeve or wrap, which shrinks in the circumferential direction under the influence of heat or by other means, forming an adherent field joint coating.

The shrink sleeve consists of a polyolefin (PE or PP) based backing with an adhesive layer (mastic or hot melt) on one side.

1. The shrink sleeve may be applied with or without a primer.

8.1.4 Polyethylene

8.1.4.1 Polyethylene heat shrink sleeve

Polyethylene heat shrink sleeve is described in (8.1.3).

8.1.4.2 Flame sprayed polyethylene

1. Flame sprayed polyethylene shall be applied over an epoxy primer coating (either a powder applied by dusting or electrostatic spray or a spray-applied liquid coating).
 - a. The primer shall be overcoated with modified polyethylene powder applied by spray or by flame spray
 - b. The required thickness shall be achieved by further flame spray application of the modified polyethylene powder.

8.1.4.3 Polyethylene tape/sheet

1. Polyethylene tape/sheet shall be applied over an epoxy primer coating (either a powder applied by dusting or electrostatic spray or a spray applied liquid coating).
 - a. The primer shall be overcoated with modified polyethylene powder applied by spray
 - b. The required thickness shall be achieved by wrapping the joint with polyethylene tape/sheet; either in a spiral or a single piece large enough to cover the required area.

8.1.5 Polypropylene**8.1.5.1 Polypropylene heat shrink sleeve**

Polypropylene heat shrink sleeve is described in (8.1.3).

1. For this coating type a polypropylene copolymer adhesive layer and epoxy primer layer shall be used.

8.1.5.2 Flame sprayed polypropylene

1. Flame sprayed polypropylene shall be applied over an epoxy primer coating (either a powder applied by dusting or electrostatic spray or a spray applied liquid coating).
 - a. The primer shall be overcoated with modified polypropylene powder applied by spray or by flame spray
 - b. The required thickness shall be achieved by further flame spray application of the modified polypropylene powder.

8.1.5.3 Polypropylene tape/sheet

1. Polypropylene tape/sheet shall be applied over an epoxy primer coating (either a powder applied by dusting or electrostatic spray or a spray applied liquid coating).
 - a. The primer shall be overcoated with modified polypropylene powder applied by spray.
 - b. The required thickness shall be achieved by wrapping the joint with polypropylene tape/sheet; either in a spiral or a single piece large enough to cover the required area.

8.1.5.4 Injected moulded polypropylene

1. Injected moulded polypropylene shall be applied over an epoxy primer coating (either a powder applied by dusting or electrostatic spray or a spray applied liquid coating).
 - a. The primer shall be overcoated with modified polypropylene powder applied by spray
 - b. The required thickness shall be achieved by injecting polypropylene into a mould around the joint.

8.1.6 Fusion bonded epoxy

1. Fusion bonded epoxy shall consist of a fusion bonded epoxy layer applied by spraying epoxy powder on an electrostatically heated pipe surface.

8.1.7 Visco-elastic self-healing wrapping system

1. Visco-elastic self-healing wrapping system shall consist of two layers.

The first layer is a visco-elastic polymeric tape with self-healing properties to provide corrosion protection to the underlying substrate. The second layer is an outerwrap applied to provide mechanical protection.

8.2 TEMPERATURE

1. The suitability of a field joint coating for a particular temperature shall be demonstrated by performing the qualification tests at the relevant test temperature specified in this DEP.

8.3 PIPE COATING COMPATIBILITY

1. The field joint coating shall possess the required adhesive properties when applied on the base pipe and the various line pipe coating materials.
 - a. The preheat and application temperatures required for the application of the field joint coating shall not cause loss of functional properties of the line pipe coating.

The generic types of line pipe coatings are:

- Polyethylene;
 - Polypropylene;
 - Polyurethane;
 - Fusion bonded epoxy;
 - Hot applied bitumen, asphalt or coal tar enamels.
2. The suitability of the field joint coating for use with a particular line pipe coating system shall be demonstrated by carrying out a full application procedure followed by adhesion testing using the generic types of pipe coating as a substrate.
 3. Any deterioration or loss of functional properties of the line pipe coating due to the application of the field joint coating using recommended procedures shall render the field joint coating unsuitable for use in conjunction with that type of line pipe coating.

8.4 PIPELINE DIAMETER

1. The field joint coating shall be suitable for application in the field on the pipeline diameters used in a specific project, in accordance with the Manufacturer/Supplier's application instructions.

Variation in pipeline diameter is not part of the common qualification procedure, except when different diameters require different application procedures (e.g., flame heating rather than induction heating, or one-person rather than two-person application).

2. The Contractor shall demonstrate that a field joint coating, applied on the pipeline of specified diameter in the field, complies with this DEP.

Procedures for the testing of applied field joint coating in the field are specified in (9). Qualification of the Applicator is specified in (7.3).

9 GENERAL REQUIREMENTS FOR SURFACE PREPARATION, COATING APPLICATION, TESTING AND REPAIR

Replace this section with the following:

1. The coating Manufacturer/Supplier shall submit full application procedures, which is to consist of the following as a minimum:
 - a. surface preparation of the steel surface (method, cleanliness, profile);
 - b. preparation of the line pipe coating at the overlap (method, roughness, chamfer);
 - c. application of primer (method, thickness);
 - d. pre-heating requirements (method, temperature, testing);
 - e. method of application;
 - f. quality control procedures.
2. The application procedures shall be qualified by the Contractor or Applicator, for both the product and the individual application personnel, under the supervision of the coating Manufacturer/Supplier.
 - a. If required, multiple application procedure qualifications shall be undertaken to cover the full range of pipeline diameters, wall thicknesses and corrosion coating types, as applicable.

9.1 FIELD JOINT COATING INSTALLATION

1. The maximum time between surface preparation and start of the field joint coating application shall be no longer than 4 h.
 - a. Pipe joints whose coating is delayed beyond this period, or pipes showing any visible rust stains or discoloration, regardless of the time period since blasting, shall be blast cleaned again.
2. The application of the coating shall be strictly in accordance with the coating Manufacturer/Supplier's application procedures and applied by qualified personnel, see (7.3).
3. For all field coating applications, the surface temperature of the joint shall comply with the requirements specified in the application procedures.
 - a. Heating equipment shall be controlled to maintain uniform temperatures throughout the coating process.
 - b. The temperature of the joint shall be monitored using suitable means in order to fulfil the application requirements (9.2.9).
 - c. Induction heating shall be used for all FBE applications for offshore pipelines and specifically for pipeline nominal diameters above 600 mm (24 in).
 - d. The method of heating used during qualification shall also be used on site during application.
4. For multi-layer systems, the temperature and time between subsequent layers shall be controlled to obtain sufficient interlayer adhesion.
 - a. The required layer thickness of the primer (if required) and the total coating layer shall be specified in the application procedures.
5. Batches of coating components shall be used in the same sequential order in which they were manufactured.

9.2 QUALITY CONTROL DURING FIELD APPLICATION

9.2.1 General

1. All personnel and techniques and equipment shall be qualified.
 - a. Certification and records of qualification that are traceable to individual applicators and equipment shall be maintained on site.
2. During field application of the coating, the Applicator (or Contractor as directed by the Principal) shall carry out all quality control activities needed to ensure that the coating is being applied in accordance with the approved coating application procedures and that the final product complies with the requirements of this DEP.
3. The inspection and testing procedures shall be carried out as agreed between the Principal and the Contractor in the Quality Plan (or Inspection and Test Plan).
4. The minimum quality control tests to be performed shall be as specified in Table A.
5. The Principal retains the right to witness all coating system application work.
 - a. No coating work shall be performed without inspection staff designated by the Principal.
 - b. The results and documentation of the quality assurance program shall be available to the Principal at all times.
 - c. Joints that do not comply with the requirements shall be rejected, and therefore cleaned and recoated as required.

9.2.2 Ambient conditions

1. The Applicator shall measure the ambient conditions at regular intervals during blasting and coating using certified and calibrated instrumentation and keep records of prevailing temperature, humidity and dew point.
2. During the entire surface preparation and coating process, the pipe joint surface temperature shall be more than 3 °C (5.4 °F) above the ambient dew point.
 - a. The ambient relative humidity (RH) shall be monitored and recorded.
 - i. Below 85% RH, up to four hours may be allowed after blasting and prior to coating.
 - ii. Above 85% RH, one hour is allowed.
 - iii. Pipe that exceeds these limits shall be re-blasted.
 - b. The temperature of the pipe surface shall be in accordance with the application guidelines and checked by means of instruments like infrared sensors, contact thermometers or thermocouples.
3. If the environmental conditions lead to parameters that are outside the limits specified in the qualified procedures or this DEP, the application shall be suspended until the requirements are met.

9.2.3 Inspection of uncoated joints before blasting

1. Before surface preparation starts, each joint shall be visually examined for dents, laps, weld spatter or any other defects to avoid coating unusable joints.
 - a. No repairs to a damaged pipe joint may be made without a written procedure agreed by the Principal.
2. The factory coating shall be checked for visible defects.
 - a. Pipes with non-adherent and/degraded pipe coating shall be rejected.
3. All surfaces to be coated shall be dry and free of all surface contamination.
 - a. Oil, grease, and other contaminants should be removed, before blast cleaning by a suitable solvent.
 - b. Detergent washing shall not be used.
 - c. Excessive dirt may require removal by a high pressure, fresh water rinse.

9.2.4 Preparation of factory applied coating transition area

1. The factory applied coating adjacent to the joint area shall be prepared to provide a suitable surface to which the field joint coating will adhere.
 - a. The preparation methods shall be submitted by the Applicator and agreed to by the Principal as part of the Inspection and Test Plan.
 - b. Field inspection will follow the agreed protocol.
2. Any damage sustained to the factory applied coating adjacent to the joint area shall be repaired before acceptance of the field joint coating.

9.2.5 Blast Cleaning

1. Compressed air used for blast cleaning are to be free from oil, condensed moisture and any other contaminants and shall conform to the requirements of ASTM D4285.
2. Blasting equipment that includes devices to recycle abrasives shall have equipment that ensures removal of dust, fines, corrosion material and any other contaminants.
3. For stainless steel pipes, stainless steel abrasives or non-ferrous abrasives shall be used for blast cleaning.
4. Approved abrasives for carbon steel surfaces are steel grit, aluminium oxide, or coal slag.
 - a. Any blasting material with a conductivity greater than 50 $\mu\text{S}/\text{cm}$ (127 $\mu\text{mho}/\text{in}$) shall not be used.
5. Immediately after blast cleaning, all remaining weld spatter and irregularities shall be removed from the pipe surface by chiselling and/or grinding.
 - a. Any treated surface with an area larger than 25 cm^2 (3.9 in^2) shall be re-blasted to the cleanliness and roughness as specified above.
6. Any grit blast media or debris remaining in the ID of the pipe after grit blast shall be removed using high pressure air.

9.2.6 Inspection after blasting

1. The pipe surface shall be cleaned of mill scale, rust and other foreign matter to achieve a minimum surface cleanliness of Sa 2½.
2. The dust level on the blast-cleaned surface at the time of coating shall not exceed quantity rating 2 in accordance with ISO 8502-3.
 - a. An increased conductivity level may indicate that an ionic contaminant has been introduced into the blasting material from the pipe surface.
 - i. If contamination of the surface occurs, the quality of the blast cleaning material and process shall be examined according to ISO 11127-6.
3. The surface profile shall be sharp and angular, is to be in accordance with the field joint coating Manufacturer/Supplier's specification.
 - a. Method for measurement of surface profile shall be documented in the written Inspection and Test Plan and measured in accordance with ISO 8503-2 or measured directly using a digital profile gauge approved by the Principal.
 - b. Surface profiles outside of specified limits shall be re-blasted.

9.2.7 Residual chloride assessment

1. The maximum residual chloride level on the blast-cleaned surface shall be 2 µg/cm², (1.9 mg/ft²) in accordance with ISO 8502-6 or using a conductrometric salt contamination meter in accordance with ISO 8502-9, or any other method approved by the Principal.
 - a. Chloride levels exceeding these value shall be treated with salt washing and removal methods approved by the Principal until acceptable levels are achieved..

9.2.8 Coating application temperature

1. The temperature of the pipe surface during application shall be checked by means of infrared sensors, contact thermometers or thermocouples or Principal approved instruments.
2. The temperature of the pipe surface during application shall be in accordance with the application guidelines.
 - a. Temperature indicating sticks shall not be used
3. The monitoring instruments shall be independent of the temperature control equipment.
 - a. The instruments shall be calibrated once per 24 h.
4. Field joint coatings applied outside the qualified temperature range shall be identified by marking and subjected to additional quality control tests (9.2.9) at the discretion of the Inspector.