RECOMMENDED PRACTICE
DNV-RP-F102

PIPELINE FIELD JOINT COATING AND FIELD REPAIR OF LINEPIPE COATING

OCTOBER 2003

DET NORSKE VERITAS

FOREWORD

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Amendments October 2003

This Code has been amended. The changes are incorporated in the Web, CD and printable (pdf) versions.

All changes affecting DNV Offshore Codes that have not been reprinted, are published separately in the current Amendments and Corrections, issued as a printable (pdf) file.

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Computer Typesetting (FM+SGML) by Det Norske Veritas.
Printed in Norway

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1.1 Introduction

1.1.1 The primary objective of external coatings on submarine pipelines is corrosion control. In addition, the coating system can be designed to provide mechanical protection during installation and operation, and/or thermal insulation. A corrosion protective coating may also be combined with a concrete weight coating for anti-buoyancy and/or mechanical protection during operation.

1.1.2 Coating applied in a factory to individual pipe lengths is often referred to as "linepipe coating" (or "factory coating"), see DNV-RP-F106. In this document, "parent coating" is sometimes used synonymous with linepipe coating. In order to facilitate girth welding, areas at each end of the individual pipe length are left uncoated. These areas are normally coated after welding, by applying a "field joint coating" (FJC) system. The same term applies for coating applied on the welded joint between a pipe and a pipeline component (e.g. bend or valve body) with pre-fabricated coating. In this document, the term "FJC" is used irrespectively of the coating being applied in a factory or in the "field".

1.1.3 Depending on the type of linepipe coating, the FJC may consist of one or more layers of coating materials, for the purpose of corrosion control, mechanical protection and/or thermal insulation. FJC systems may also be designed to provide a smooth transition to a concrete weight coating of the linepipe, or to a thick-layer thermally insulating coating. This is typically achieved by application of a moulding compound, referred to as "infill". In some cases, pre-fabricated half shells are installed by strapping to the field joint.

Guidance note:

For certain FJC systems developed for thermally insulated linepipe coating, the moulding compound serving as an "infill" is considered as an integrated part of the FJC.

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1.1.4 Linepipe coating may suffer damage during handling, transportation or pipeline fabrication/installation requiring repairs. This is referred to as "coating field repairs" (CFR). As for FJC, CFR systems may consist of one or more layers of coating and may be applied in a factory or in the field. Repair of linepipe coating may also apply in the case of deliberate modifications affecting the coating, e.g. for the purpose of installation of cables for electrical connection between galvanic anodes and pipe material. Certain FJC systems are applicable also for repair of large size damage to linepipe coating. (Repair of linepipe coating performed by the manufacturer at his premises is not referred to as CFR and is covered in DNV-RP-F106).

Guidance note:

In its widest sense, the term "pipeline coating" includes linepipe coating, field joint coating (FJC) and coating field repair (CFR). FJC and CFR are typically carried out by the same subcontractor to installation contractor, whilst linepipe coating is mostly carried out by some other subcontractor, contracted by either pipeline operator, installation contractor or linepipe manufacturer.

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1.1.5 Submarine pipelines are almost invariably designed with a cathodic protection (CP) system, mostly based on galvanic (or "sacrificial") anodes. The CP system serves as a back-up for any defficiencies of the pipeline coating, including defects during manufacturing and damage during transportation/installation, in addition to any assumed degradation of coating materials and mechanical damage during operation. Hence, CP design for submarine pipelines is closely related to the design and quality control of pipeline coatings, including FJC and CFR (see 1.5.3).

1.2 Scope

1.2.1 This "Recommended Practice" (RP) has been prepared to facilitate the work of pipeline operators, general contractors as well as sub-contractors carrying out coating work. While the requirements and recommendations are general, the document contains advice on how amendments can be made to include project specific requirements, and requirements and/or guidelines by a regulating authority, or to reflect the pipeline operator's general philosophy on pipeline corrosion control.

1.2.2 This RP covers the process of applying specific types of FJC / CFR and 'infill' systems. The conceptual and detailed design of such systems (i.e. for the purpose of corrosion and/or mechanical protection and thermal insulation), and the verification of such design by special testing, are not covered.

Guidance note:

Pipeline operators and main contractors should consider the needs to carry out qualification of generic coating systems for specially demanding applications; e.g. resistance to bending during installation by reeling and long term (>10,000 hrs) thermal degradation of critical coating properties associated with high operating temperatures. Purchasers of linepipe coating should further consider pre-qualification of coating manufacturers prior to the issue of purchase documents.

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1.2.3 The following 9 categories of FJC / CFR systems, applicable to corrosion control of submarine pipelines, and including associated risers, are covered in this document (see ANNEX 1):

— **1A** Adhesive tape (PVC or PE backing), with typical thickness of about 2 mm and mastic type adhesive, applied on substrate mechanically treated to Sa 2½ or St 3 (FJC only).
— **1B** Heat shrink sleeve (PE backing) with mastic type adhesive applied on substrate mechanically treated to Sa 2½ or St 3 (FJC only).
— **2A** PE heat shrink sleeve or repair patch (thickness 2-3 mm) with modified PE adhesive, applied on top of LE layer (min. 100 mm). Steel substrate treated by blast cleaning to Sa 2½ .
— **2B** As for 2A, but with heat shrink sleeve or repair patch in PP.
— **3A** FBE layer (min. 350 mm). Steel substrate treated to Sa 2½. LE (min. 100 mm) for repairs.
— **3B** As for 3A (lower FBE thickness may apply), with PE heat shrink sleeve (2-3 mm) applied on top and an intermediate layer of PE adhesive. (FJC only).
— **3C** As for 3A (lower FBE thickness may apply), with PP heat shrink sleeve (2-3 mm) applied on top. Fused bonding of PP to PP parent coating.
— **3D** As for 3A (lower FBE thickness may apply), with PP (3mm) applied by flame spraying, wrapping or extrusion (e.g. injection moulding). Fused bonding of PP to PP parent coating.
— **4A** Polychloroprene sleeve, wrapping or patch (on top of primer) with vulcanised bonding to parent coating. Steel substrate treated by blast cleaning to Sa 2½ (Used for linepipe coating in the same material type and typically applied by the same contractor).

1.2.4 For concrete coated pipes and thermally insulated pipes, the FJC systems above may be used in combination with a moulding infill. The following 4 types of infill are covered (see ANNEX 2):

i) asphalt mastic
ii) polyurethane
iii) rapid setting concrete
iv) polypropylene.

I and II may be applied directly on the field joint (FJ) with or without a primer coat (bonding agent). I, II and III are applicable for pipelines with concrete coating whilst II an IV are used for PP multilayer coatings for thermal insulation, typically with an inner 3-layer PP coating. II and IV may be applied as a homogenous solid product, sometimes with a filler material added, or as a foamed product. The manufacturing of half shells (typically on PU or PP basis) to be strapped around a FJ (with or without a FJC system) is not covered by this RP.

1.2.5 This RP may be fully or partly applicable to similar coating and infill systems, or to FJC / CFR associated with onshore pipelines. The user shall consider the needs for amendments and deviations for such applications.

1.2.6 The following activities associated with FJC / CFR are not covered:

— Requirements for the qualification of supplier specific coating materials for general (i.e. not project specific) purposes (see Guidance Note to 1.2.2).
— Detailed design of FJC for project specific purposes (e.g. heat insulation, see 1.2.2).
— Inspection of linepipe coating during installation and characterisation of damage for subsequent CFR. (In case of minor coating damage; i.e. where the inner corrosion protective coating is not affected, the requirements to CFR in this document may not be relevant).
— Repair of concrete weight coating.

1.2.7 Although considerations of safety and environmental hazards associated with coating work and properties of as-applied coating materials (i.e. as reflected by national and multi-national regulations) are of great importance, such are never-the-less beyond the scope of this RP.

1.3 Application and use

1.3.1 This (RP) has two major objectives; it may either be used as a guideline for the preparation of manufacturing specifications for FJC / CFR and infill systems as defined in 1.2.3 above, or it may be used as an attachment to an inquiry or purchase order specification for such systems. If Purchaser has chosen to refer to this RP in a 'purchase document' (see definition in Sec. 3), then Contractor shall consider all requirements in this document as mandatory (see Sec. 3), unless superseded by amendments and deviations in the specific contract (see 1.3.4 -1.3.5).

1.3.2 If reference is made to this RP in a purchase document, the following additional information and requirements shall always be specified (see Section 3), if applicable and relevant to the specific coating system as defined in the CFR / FJC and Infill Data Sheets of ANNEX 1 and 2, respectively:

Information:

— Pipe material (reference to selected standard or purchaser's specification), nominal inner diameter and wall thickness.
— Seam weld and girth weld dimensions, including tolerances, if relevant for the specified FJC / FCR system.
— Coating manufacturing specification(s) for linepipe (and pipeline components, if applicable).
— Linepipe coating factory cut back dimensions, including tolerances. Any temporary corrosion protective coating applied on cut backs or internal pipe coating.
— Pipeline maximum and minimum operating temperature, design life and any other project design premises and other information considered relevant to the detailed design of FJC / CFR and 'infills' (e.g. lay method including roller and stinger configuration).

Requirements:

— Project specific requirements associated with the detailed design of FJC / FCR and 'infill' systems; e.g. configuration of multi-layer systems, overlap to parent coating, minimum thickness of individual layers, thermal insulation capacity, composition and mechanical or physical properties of any 'infill', colour of coating. (see 5.4.2).
— Project specific requirements to 'pre-production qualification testing' (PQT), including schedule for notification and reporting, number of FJC / CFR (and 'infills' if applicable) for testing, and any requirement for qualification of coating applicators (see 5.2.2).
— Methods and acceptance criteria for any testing indicated as "to be agreed" in the applicable FJC / FCR and infill data sheet of ANNEX 1 and ANNEX 2, respectively (see 5.3.3).
— Permissible repairs for FJC, and infill if applicable (see 5.9).
— Requirements for marking and pipe tracking, if applicable (see 5.10.1).
— Requirements for documentation, e.g. schedule for supply of documentation and documentation format. (see 5.10.1).

1.3.3 If inspection and repair of linepipe coating damage on pipe joints as received by Contractor is included in the scope of work (see 5.5.1), the following requirements shall be enclosed:

— Requirements for inspection for linepipe coating damage; e.g. type or method and extent of inspection and acceptance criteria.
— Acceptance criteria for linepipe coating repair; e.g. maximum size and number of specific types of defects per pipe for damage considered repairable.

1.3.4 The following items, intended as a check-list, may be included in purchase documents, as applicable and relevant. (For specification of amendments and deviations in purchase documents, see 1.3.5 below.):

— Additional testing (i.e. requested by Purchaser) indicated "by agreement" in the FJC / CFR or infill data sheet (see 5.3.3), and any special conditions for testing (e.g. test temperature above or below normal ambient temperature, unless stated in the applicable data sheet).
— Specific coating materials to be used (e.g. supplier specific systems/grades, see 5.4.3.)
— Specific requirements for automatic control of application parameters, e.g. powder application (see 5.7.5).
— Specific requirements for the ITP (5.3.2).
— Qualification of personnel for FJC / CFR and 'infill' application (e.g. during PQT, see 5.2.1).
— Specification of management of concession requests (5.7.1) and non-conformities (5.8.7).
— Facilities needed for Purchaser's quality surveillance.
— Regulatory or Contractor's requirements for control of health and environment hazards associated with coating work.
— Special requirements to handling, storage and transportation of coated pipes, if relevant (see 5.11).
— Further deviations or amendments to this document.

1.3.5 As far as practical, tentative test methods and acceptance criteria for testing indicated in the 'FJC/CFR data sheet' as "to be agreed" (see 1.3.2) or "by agreement" (see 1.3.4), shall be specified by Purchaser in the inquiry. Purchaser may also specify any preference for a specic test methods in case more than one method is specified for mandatory testing ("to be included"). If alternative methods are given in the FJC / CFR or 'infill data sheet', and no specific method has been specified by Purchaser, the method to be used is then optional to Contractor.

1.3.6 ANNEX 3, Table 1 and 2 show how deviations and amendments to the common requirements in Sec 5, and to a specific FJC/CFR or 'infill data sheet', respectively, may be specified in a purchase document.

1.4 Structure of document

1.4.1 Requirements that apply to all categories of FJC / CFR and 'infill systems' are given in Sec. 5, whilst those applicable to a specific system are contained in individual FJC / CFR and infill 'data sheets' in ANNEX 1 and ANNEX 2, respectively.

1.5 Relation to DNV-OS-F101 and other DNV documents on pipeline corrosion control

1.5.1 DNV-OS-F101 "Submarine Pipeline Systems", Sec.8, gives some guidelines to the selection and design of pipeline external corrosion protective coatings (including field joint coatings and concrete coatings), and general requirements to their manufacturing.

1.5.2 DNV-RP-F106 "Factory Applied External Pipeline Coatings for External Corrosion Control" provides detailed requirements for the manufacturing of linepipe ("factory") coatings.

1.5.3 Cathodic protection (CP) of coated submarine pipelines is covered in DNV-RP-F103 "Cathodic Protection of Submarine Pipelines by Galvanic Anodes".

Guidance note:

This document offers CP design parameters that are based on the requirements to pipeline coatings in DNV-RP-F106 and in DNV-RP-F103, reducing the need for arbritary conservatism in CP design due to potential defficiencies associated with pipeline coating design and/or quality control of coating maufacturing .

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2. Normative References

The following standards are referred to in this document. The latest editions apply.

2.1 ASTM (American Society for Testing and Materials)

ASTM C518	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM D36	Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
ASTM D149	Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electric Insulating Materials at Commercial Power Frequencies
ASTM D256	Test Method for determining the Izod Pendulum Impact Resistance of Notched Specimens of Plastic
ASTM D257	Test Method for D-C Resistance or Conductance of Insulating Materials
ASTM D570	Test Method for Water Absorption of Plastics
ASTM D638	Test Method for Tensile Properties of Plastics
ASTM D746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D785	Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
ASTM D790	Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrically Insulating Materials
ASTM D792	Test Method for Density (Relative Density) and Specific Gravity of Plastics by Displacement
ASTM D870	Practice for Testing Water Resistance of Coatings Using Water Immersion
ASTM D1000	Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electronic and Electrical Applications
ASTM D1002	Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
ASTM D1084	Test Methods for Viscosity of Adhesives
ASTM D1149	Test Method for Rubber Deterioration – Surface Ozone Cracking in a Chamber
ASTM D1238	Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1525	Test Method for Vicat Softening Temperature of Plastics
ASTM D2084	Standard Test Method for Rubber Property – Vulcanization Using Oscillating Disc Cure Meter
ASTM D2240	Test Method for Rubber Property–Durometer Hardness
ASTM D3418	Test Method for Transition Temperatures of Polymers by Thermal Analysis
ASTM D3895	Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
ASTM D4060	Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrader
ASTM D4285	Test Method for Indicating Oil or Water in Compressed Air
ASTM E96	Test Methods for Water Vapour Transmission of Materials
ASTM G8	Test Method for Cathodic Disbonding of Pipeline Coating
ASTM G14	Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)
ASTM G17	Test Method for Penetration Resistance of Pipeline Coatings
ASTM G21	Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM G22	Practice for Determining Resistance of Plastics to Bacteria

2.2 BS (British Standards)

BS 903 Part A1	Physical Testing of Rubber. Determination of Density
BS 3900 Part F4	Resistance to Continuous Salt Spray
BS 4147	Specification for Bitumen-Based Hot-Applied Coating Materials for Protecting Iron and Steel, Including Suitable Primers Where Required
BS 6374 Part 5	Lining of Equipment with Polymeric Materials for the Process Industries Part 5. Specification for Lining with Rubbers

2.3 CSA (Canadian Standards Association)

CAN/CSA-Z245.20/21	External Fusion Bond Epoxy Coating for Steel Pipe–External Polyethylene Coating for Pipe

2.4 DIN (Deutsche Industrie Normen)

DIN 30670	Polyethylene Coatings of Steel Pipes and Fittings; Requirements and Testing
DIN 30672	Coatings of Corrosion Protective Tapes and Heat Shrink Sleeves; Materials for Pipelines for Operational Temperatures up to 50°C
DIN 30678	Polypropylene Coatings for Steel Pipes
DIN 53516	Testing of Rubber and Elastomers; Determination of Abrasion Resistance.

2.5 DNV (Det Norske Veritas)

DNV-OS-F101	Submarine Pipeline Systems
DNV-RP-F106	Factory Applied External Pipeline Coatings for Corrosion Control
DNV-RP-F103	Cathodic Protection of Submarine Pipelines by Galvanic Anodes

2.6 EN (European Standards)

EN 1426	Methods for Determination of Softening Point of Bitumen (Ring and Ball)
EN 10204	Metallic Products – Types of Inspection Documents
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

2.7 GBE (Gas Business Engineering)

GBE/CW6	Technical Specification for the External Protection of Steel Linepipe and Fittings Using Fusion Bonded Powder and Associated Coating Systems

2.8 ISO (International Organization for Standardisation)

ISO 34	Rubber, Vulcanised or Thermoplastic. Determination of Tear Strength
ISO 37	Rubber, Vulcanised or Thermoplastic – Determination of Tensile Stress- Strain Properties
ISO 178	Plastics, Determination of Flexural Properties
ISO 188	Rubber, Vulcanised or Thermoplastic – Accelerated Ageing and Heat-Resistance Tests
ISO 306	Plastics – Thermoplastic Materials – Determining of Vicat Softening Temperature
ISO 527	Plastics – Determination of Tensile Properties. Part 1 and 2.
ISO 813	Rubber, Vulcanised or Thermoplastic – Determination of Adhesion to Rigid Substrate- 90 Degree Peel Method
ISO 815	Physical Testing of Rubber. Method for Determination of Compression Set at Ambient, Elevated and Low Temperatures
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 1306	Rubber Compounding Ingredients – Carbon Black (Pelletized)-Determination of Pour Density
ISO 1431-3	Rubber, Vulcanised or Thermoplastic – Resistance to Ozone Cracking- Part 1: Static Strain Test
ISO 1515	Paints and Varnishes – Determination of Volatile and Non-Volatile Matter
ISO 1817	Vulcanised Rubber. Determination of the Effects of Liquids
ISO 2187	Non-Magnetic Coatings on Magnetic Substrates – Measurements of Coating Thickness – Magnetic Method
ISO 2409	Paints and Varnishes – Cross-Cut Test
ISO 2431	Paints and Varnishes – Determination of Flow Time by Use of Flow Cups
ISO 2655	Plastics – Resins in the Liquid State or as Emulsions or Dispersions – Determining of Apparent Viscosity by the Brookfield Test
ISO 2781	Rubber Vulcanised – Determination of Density
ISO 2808	Paints and Varnishes – Determination of Film Thickness
ISO 2811	Paints and Varnishes – Determination of Density
ISO 2815	Paint and Varnishes – Buchholz Indentation Test
ISO 3146	Plastics, Determination of Melting Behaviour (Melting Temperature) of Semi-Crystalline Polymers by Capillary Tube and Polarizing-Microscope Methods
ISO 4624	Paints and Varnishes – Pull-Off Test for Adhesion
ISO 4892-2	Plastics – Methods of Exposure to Laboratory; Light Sources
ISO 7253	Paints and Varnishes-Determination of Resistance to Neutral Salt Spray
ISO 7619	Rubber – Determination of Indentation Hardness by Means of Pocket Hardness Meter
ISO 8501-1	Preparation of Steel Substrate Before Application of Paint 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 8501-2	– Part 2: Laboratory Determination of Chloride on Cleaned Surfaces
ISO 8502-3	– Part 3: Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure Sensitive Tape Method)
ISO 8502-6	– Part 6: Sampling of Soluble Impurities on Surfaces to be Painted – the Bresle Method.
ISO 8503-2	Preparation of Steel Substrates Before Application of Paints and Related Products – Surface Roughness Characteristics of Blast-Cleaned Substrates. – Part 2: Method for the Grading of Surface Profile of Abrasive Blast-Cleaned Steel – Comparator Procedure
ISO 8503-4	– Part 4: Method for the Calibration of ISO Surface Profile Comparators and for the Determination of Surface Profile – Stylus Instrument Procedure
ISO 10005	Quality Management – Guidelines for Quality Plans
ISO 10474	Steel and Steel Products – Inspection Documents
ISO 13736	Methods for Determination of the Flash Point by the Abel's Apparatus

2.9 NACE (National Association of Corrosion Engineers)

NACE RP0274	High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

2.10 NF (Normes Francaise)

NF A 49-710	External 3- Layer Polyethylene Based Coating. Application by Extrusion
NF A 49-711	External 3- Layer Polypropylene Based Coating. Application by Extrusion

3. Terminology and Definitions

Purchaser	party (pipeline operator or main contractor) issuing inquiry or contract for coating work, or nominated representative.
coating	"coating", "coating application" and "coating material" may refer to an "infill" as well as to FJC / CFR.
Contractor	party to whom the coating work has been contracted.
manufacture manufacturing	"manufacture" and "manufacturing" relates to the processes associated with the qualification of FJC / CFR and 'infill', and the subsequent production of such coatings. The producer of coating materials is referred to as "coating material supplier", or "supplier" only.
shall	indicates a mandatory requirement.
should	indicates a preferred course of action.
may	indicates a permissible course of action.
agreed agreement	refers to a written arrangement between *Purchaser* and *Contractor* (e.g. as stated in a contract)
report and *notify*	refers to an action by *Contractor* in writing.
accepted acceptance	refers to a confirmation by *Purchaser* in writing.
certificate certified	refers to the confirmation of specified properties issued by *Contractor* or supplier of coating materials according to EN 10204:3.1.B, ISO 10474:5.1-B or equivalent.
purchase document(s)	refers to an inquiry/tender, or purchase/contract specification, as relevant

For definition of coating terms associated with submarine pipeline systems, reference is made to 1.1 above.

4. Abbreviations

CFR	Coating Field Repair
CP	Cathodic Protection
CR	Concession Request
FBE	Fusion Bonded Epoxy
FJ	Field Joint
FJC	Field Joint Coating
ITP	Inspection and Testing Plan (see 5.3.2)
LE	Liquid Epoxy ("two-pack" type)
MIP	Manufacturing and Inspection Plan (see 5.3.2)
MPS	(Coating) Manufacturing Procedure Specification (see 5.1)
NC	Non-Conformity
PE	Polyethylene (polyethene)
PP	Polypropylene (polypropene)
PQT	(Coating) Pre-Production Qualification Testing (see 5.2)
PU	Polyurethane
PVC	Polyvinylchloride
RP	Recommended Practice

5. Common Requirements

5.1 Coating manufacturing procedure

5.1.1 All work associated with the application of FJC / CFR and any 'infill' (including qualification of the application; "PQT", see 5.2) shall be described in a 'manufacturing procedure specification' (MPS). This MPS shall be submitted to Purchaser prior to the PQT and/or start of production.

5.1.2 The MPS shall as a minimum include the following data sheets, drawings, procedures and other information:

- detailed design of FJC (if included in scope of work), defining e.g. parent coating overlap, length and chamfer angle of parent coating cut-back, thickness of individual layers, calculations of heat insulation, design of permanent moulds or straps for infill, as applicable
- coating material properties, including supplier's product data sheets (PDS) and/or certificates (5.4.3-5.4.8)
- receipt, handling and storage of materials for surface preparation and coating (5.4.9-5.4.12)
- preparation of steel surface and parent coating cutback (5.6)
- coating application (including control of essential process parameters, see 5.7)
- inspection and testing (5.5, 5.6 and 5.8)
- repair of imperfect coating work (FJC / CFR and 'infill', if applicable, see 5.9)
- stripping of rejected FJC (and 'infill', if applicable), see 5.9
- handling, storage and transportation of coated pipes (if included in scope of work, see 5.11)
- documentation, and marking of FJC (if applicable).

The FJC design documentation and procedures for the last 4 items are subject to acceptance by Purchaser. Some detailed requirements to items for inclusion in the coating manufacturing specification are given in 5.4 – 5.11.

Guidance note:

For "accepted"/ "acceptance" and "agreed" /"agreement", see definitions in Sec.3.

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5.1.3 Purchaser may require that procedures for testing and inspection, handling of non-conformances and concession requests and/or other additional detailed information is included in the MPS (see 1.3.4).

5.2 Pre-production qualification testing (PQT)

5.2.1 The primary objective of the 'pre-production qualification testing' (PQT) is to verify that the MPS is adequate to achieve the specified as-applied coating properties. Purchaser may further specify that coating applicators are individually qualified during the PQT so that their capability to achieve specified coating properties can be verified (see 5.2.2).

Guidance note:

The verification of coating properties by destructive testing, as conducted during regular production of linepipe coating (e.g. by peel testing at pipe ends) is not feasible, or at least cumbrous for FJC. The qualification of a MPS for FJC / CFR and infill is consequently regarded as crucial. Moreover, the quality of the applied coating is more dependent on coating applicator skills. It is therefore recommended that the requirement to a PQT in this document is not waived, that coating applicators are qualified individually during the PQT and that the PQT is witnessed by a competent person representing Purchaser.

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5.2.2 Specific requirements for 'pre-production qualification testing', including e.g. schedule for notification and reporting, qualification of coating applicators, any preparations of FJC / CFR additional to the minimum requirements in 5.2.5, shall be specified in purchase documents (see 1.3.2).

5.2.3 A MPS and an 'inspection and test plan' (ITP, see 5.3) specific for the PQT, together with a detailed schedule for coating application, inspection and/or testing, and reporting shall be submitted to Purchaser in a timely manner (as per purchase document) prior to start-up of the qualification activities.

5.2.4 Coating application temperature, drying or curing conditions shall be according to coating material supplier's recommendations. Data sheets and calibration certificates for instruments essential to quality control (e.g. temperature sensors) shall be available for Purchaser's review during the PQT.

Guidance note:

For FJC application using induction heating for curing of an innermost epoxy layer, it is recommended that the capability of each coil to achieve uniform heat distribution for the period of curing is verified by actual temperature recordings during the PQT. The capability of equipment for automatic spraying of powder coating to obtain the specified thickness range should also be verified. Moreover, the maximum time between interruption of heating and completion of powder application to achieve specified properties of the coating, should be established.

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5.2.5 Coated pipes of the same supply as to be used for installation shall be utilised for the PQT. However, for FJC a simulated girth weld may be used for the PQT, except if a full scale bending test according to 5.2.12 is to be carried out. The number of personnel involved in coating application during the PQT, including any supervisor, shall be the same as that used for normal production. The duration of the individual main activities (e.g. blast cleaning, coating application) shall be roughly the same as to be used during production, and shall be reported.

5.2.6 As a minimum, 3 (simulated) FJs shall be coated with a full coating system. For 3- and multi-layer systems with an innermost layer of FBE, minimum one pipe shall be coated without adhesive to allow easy stripping of the outer PE / PP layer for verification of FBE thickness, curing of FBE and PE / PP 'as-applied' tensile properties. For qualification of CFRs, minimum 3 repairs shall be performed (for each repair procedure) using the maximum allowable repair size.

5.2.7 FJCs associated with joining of pipes or pipeline components with different coating systems shall be subject to a specific PQT.

5.2.8 For FJC or CFR to cover welded or brazed connections of galvanic anodes or other items, testing methods and acceptance criteria for verification of relevant properties shall be agreed based on e.g. Purchaser's tentative specification upon inquiry, or Contractor's proposal.

Guidance note:

Testing methods and acceptance criteria will be dependent on the detailed design that may not be completed at the issue of inquiry.

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5.2.9 As far as is practical, qualification of offshore FJC and 'infill' application shall utilise the same equipment and tools as on the actual vessel. Climatic effects for offshore applications shall be taken into account when defining the conditions for a factory PQT. Any significant differences in equipment and tools to be used for PQT and production shall be highlighted in the MPS for the PQT.

5.2.10 The PQT shall demonstrate that the materials and application procedure used for FJC / FCR and any 'infill' do not deteriorate the properties of the adjacent linepipe coating (e.g. mechanical properties and adhesion to steel substrate) or any internal pipe coating. It shall further be demonstrated that proper adhesion is obtained at the overlap to parent coating. Testing methods and acceptance criteria for verification of relevant properties shall be agreed based on e.g. Purchaser's tentative specification upon inquiry or Contractor's proposal.

Guidance note:

Testing methods and acceptance criteria will be dependent on the detailed design that may not be completed at the time of inquiry issue. For the parent coating, the verification may include e.g. testing of resistance to peeling and cathodic disbonding. Verification of no detrimental effects on any internal coating should include e.g. visual examination for discolouration, cracking or blistering and adhesion test.

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5.2.11 It shall further be demonstrated during the PQT that the applied FJC (including any 'infill') can be efficiently cooled (or cured, if applicable) within the period of time required to avoid damage by downstream rollers or other equipment.

5.2.12 Any need to carry out a full scale bending test to verify FJC adhesion to parent coating and general flexibility of a FJC / 'infill' assembly should be considered for inclusion in the PQT. Testing may include e.g. visual examination of evidence for cracking, or disbonding of innermost layer or between individual layers, testing of residual adhesion strength. The need for a full scale impact test (simulating trawl board impact) should also be considered. (Any full scale testing shall be specified in purchase documents).

5.2.13 A procedure for stripping of rejected FJC and 'infill', and repair of imperfect coating work, shall be qualified during the PQT (see 5.9)

5.2.14 Results from all inspection, testing and calibrations during qualification, essential operational parameters for coating, duration of individual main activities and coating material certificates shall be compiled in a PQT report. Unless otherwise agreed, the report shall be accepted by Purchaser prior to start of production.

5.3 Quality control of production

5.3.1 Prior to start-up of regular production, Contractor shall submit the following documents to Purchaser for acceptance:

- a project specific MPS updated to reflect the process parameters used during the completed PQT
- a project specific 'inspection and testing plan' (ITP) for production (see 5.3.2)
- a 'daily log' format (see 5.7.4)
- a description of responsibilities of personnel involved in quality control.

5.3.2 The ITP shall meet the general requirements of ISO 10005, Sec.5.10. It shall be in tabular form, defining all quality control activities associated with receipt of coating materials, surface preparation, coating application and inspection/testing of the applied coating. The activities shall be listed in consequtive order, with each activity assigned a unique number and with reference to the applicable codes, standards and Contractor's procedures or work instructions that shall apply for the specific project. Furthermore, frequency and/or extent of inspection and testing, acceptance criteria and actions in the case of non-conformances (NCs) shall be defined in the plan. The ITP shall further contain a column for inspection codes, (e.g. inspection, witnessing and hold points) indicating the involvement of Contractor, Purchaser and any 3rd party. It is good practice to include a reference to the applicable reporting form or document, and to refer to the specific equipment or tools to be used for verification.

Guidance note:

It is recommended that the ITP also contains the relevant manufacturing steps, in addition to the inspection and testing activities, all in the consecutive order they occur during production. Such a document is sometimes referred to as a 'manufacturing and inspection plan' (MIP).

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5.3.3 Unless otherwise agreed (see 1.3.4), methods and frequency of inspection and testing, as well as acceptance criteria shall be in accordance with the applicable 'data sheet' in

ANNEX 1 or ANNEX 2 of this document. The following notes apply to all 'data sheets':

- "*according to MPS / ITP*" means that testing method and/or acceptance criteria are optional to Contractor but shall be defined in the MPS / ITP
- "*to be included*" under "*frequency / qualification*" means that testing shall be included during PQT
- "*to be agreed*" means that testing shall be carried out, and that test method and/or acceptance criteria (as applicable) are subject to agreement. (A tentative test method and acceptance criterion is preferably to be specified by Purchaser in inquiry and the agreed method / criterion shall be included in the contract)
- "*by agreement*" and "*agreed*" testing method or acceptance criterion means that Purchaser may require testing, and/or that methods and acceptance criteria are subject to agreement (to be specified by Purchaser in inquiry and confirmed in contract).

For specification of amendments and deviations to the 'data sheets', see 1.3.6.

5.3.4 The MPS, ITP, and 'daily log' shall be in English unless otherwise agreed.

5.3.5 Procedures and work instructions referenced in the ITP shall be available to all persons concerned with the associated coating work and in their normal language.

5.3.6 Purchaser shall have the right to inspect any activity associated with coating work. Purchaser shall identify any hold points for witnessing (see 5.8.2) in the ITP and inform Contractor accordingly.

5.4 Coating and blasting materials

5.4.1 In this subsection "coating materials" may refer to materials associoated with FJC, CFR and/or infill.

5.4.2 The selection of coating materials, and the specification of properties to be verified during qualification and production, shall take into account the maximum and minimum operating temperature of the pipeline, and any special conditions during installation.

Guidance note:

Unless included in Contractor's scope of work, the selection of generic types of coating materials (e.g. high density PE or PP) shall be specified by Purchaser. (This selection is typically carried out during conceptual design).

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5.4.3 Supplier specific coating materials shall be specified by Contractor in the MPS. Purchaser may specify upon inquiry any preferences for supplier specific coating materials.

Guidance note:

Prior to the issue of a specific purchase order, Purchaser or Contractor may choose to qualify specific coating material formulations according to their own requirements for FJC / CFR (which need not be project specific). Such coating qualification should be specific to a production facility, and a defined range of production process parameters. Purchaser or Contractor may require witnessing of the coating material qualification testing, either by himself or by a third party, or that the qualification testing shall be performed by a third party.

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5.4.4 Coating and 'infill' materials shall be described by supplier in specific 'product data sheets' (PDS), including relevant properties of raw materials and processed "as applied" materials, recommendations for surface preparation, application temperature range, conditions for curing or drying, as well as detailed instruction for storage and handling. The PDSs shall be included in the MPS.

5.4.5 Testing and certification of coating material properties may either relate to properties of raw materials (i.e. "as delivered"), or to properties of processed materials i.e. "as applied". In the latter case, test panels with applied coating, or specially prepared coating layers (i.e. without substrate) are used.

5.4.6 Certain properties related to raw materials "as delivered" for coating shall be certified per batch or lot (i.e by an "inspection certificate" - type 3.1.B according to EN 10204, or type 5.1.B according to ISO 10474), in accordance with section 2, column "Production", of the 'data sheet' in ANNEX 1 and ANNEX 2. Contractor may specify further properties for batchwise certification as indicated "by agreement" in the data sheet (to be included in purchase document).

Guidance note:

In the case of continuous production, "batches" will not apply and a "lot" is defined, based e.g. on hours or on weight and/or volume of production.

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5.4.7 For properties of processed "as applied" coating materials, and in particular those related to long-term environmental degradation resistance, data for a representative product specification (i.e. not batch or lot specific) will normally apply and a "test report" based on non-specific testing is issued (e.g. EN 10204, Type 2.2 or ISO 10474, type 4.2). For certain coating systems, mandatory requirements for certification of such properties (not batch or lot specific) apply as indicated by "to be included" or "to be agreed" in section 2 of the 'data sheet', column "coating material qualification", see 1.3.2. Contractor may specify further properties for certification as indicated "by agreement" in the 'data sheet' (to be included in purchase document, see 1.3.4). The specified physical properties in the data sheets should be regarded as indicative. Other values may be agreed based on project specific requirements.

5.4.8 Properties of blasting materials shall be documented (e.g. in a product data sheet for inclusion in the MPS). Abrasives for stainless steel linepipe shall be based on fused aluminium oxide, stainless steel shot or non-ferrous garnet according to an appropriate standard.

5.4.9 Contractor shall verify that all coating materials and abrasives received are in accordance with the specified requirements in the MPS. The verification may include actual testing by Contractor (or by a third party), and/or a review of manufacturer's certificates. Review of certificates and any verification testing to be performed by Contractor shall be included in the ITP.

5.4.10 Until compliance with specified requirements has been confirmed, the coating and blasting materials received by Contractor shall be kept physically separated from checked materials. Any materials checked and found non-conforming shall be clearly marked and quarantined.

5.4.11 All materials to be used for surface preparation and coating shall be contained in their original packing until use and shall be adequately marked, including:

- manufacturer's name and location of manufacture
- material type/designation
- batch/lot number
- weight (for materials in drums, bags or similar)
- size (for materials in rolls or similar)
- date of manufacturing (and shelf life, if applicable)
- manufacturing standard (if applicable)
- short instruction for storage and handling (including health and safety notes).

5.4.12 Contractor shall ensure that all materials for coating and surface preparation are stored and handled so as to avoid damage by the environment or other effects. Supplier's recommendations for storage and use shall be readily available for Purchaser's review.

5.4.13 All completed FJCs / CFRs and 'infills' shall be traceable to individual batches or lots of coating materials.

5.5 Initial inspection of linepipe coating and of field joints to be coated

5.5.1 Inspection of linepipe coating (if included in the scope of work) and assessment of coating damage for CFR shall be carried out as specified by Purchaser (see 1.3.3). Such inspection may include visual examination and/or "holiday" detection (manual or automatic). A detailed procedure shall then be included in the MPS.

Guidance note:

Characterisation of damage to the linepipe coating should distinguish between e.g.

a) superficial defects that can be repaired by light surface dressing

b) defects with major reduction in coating thickness but without exposure of bare metal (or no indication by "holiday" detector)

c) damage that extends down to the pipe material or an inner coating layer (indication by holiday detector).

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5.5.2 Dimensions of parent coating cutback, chamfer geometry and general conditions of the parent coating in the overlap area shall be inspected as required to confirm suitability for the specific FJC system.

5.5.3 The girth weld and adjacent steel surface to be coated shall be subject to an initial visual examination. Any organic contaminants like oil and grease shall be removed by using suitable solvents or detergents (type to be specified in MPS). Dirt or salts shall be removed by high pressure washing with fresh water. Any dents, laps, weld sputter or other surface defects that could deteriorate the properties of the coating shall be eliminated by light grinding ("cosmetic") only. Purchaser shall be informed if any defects cannot be removed by such measures.

Guidance note:

Cleaning of pipe ends from dirt and salts should be carried out by the welding contactor prior to welding. Removal of weld sputter and any other surface contaminants associated with the welding process should also be included in welding contractor's scope of work. However, Contactor shall confirm that the surface is suitable for FJC and carry out corrective measures if required.

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5.6 Preparation of steel surface and linepipe coating overlap for application of coating

5.6.1 All surface preparation and associated inspection and monitoring activities shall be carried out according to the qualified MPS (5.1) and the ITP (5.3.2). Methods, acceptance criteria and frequency and/or extent of inspection and testing shall comply with requirements given in the FJC / CFR and infill 'data sheets' in ANNEX 1 and 2, respectively, and/or amendments in purchase documents (see 1.3.4), if applicable.

5.6.2 Prior to surface preparation, parent coating shall be shielded as required to avoid any detrimental effects of this work.

5.6.3 Pipe surfaces shall be prepared for coating using blast cleaning or brushing to provide a surface cleanliness and surface roughness ('anchor pattern') to meet the requirements in the applicable FJC / CFR 'data sheet' of ANNEX 1. Any relaxation of these requirements based on coating material supplier's recommendations shall be accepted by Purchaser. Materials and equipment to be used shall be described in the MPS.

5.6.4 The blasting material and pressurised air system shall be kept dry and free from injurious contaminants, including salts, oil and grease. Recycled blasting material shall be checked for cleanliness at regular intervals (to be specified in the ITP and recorded in the 'daily log'). Checking of oil contamination shall be carried out according to ASTM D4285. Conditioning of grit during production shall be described in the MPS. Special precautions shall be taken to avoid contamination of blasting materials for stainless steel linepipe (to be specified in MPS).

5.6.5 For stainless steel pipes, abrasives shall be based on fused aluminium oxide, stainless steel shot or non-ferrous garnet according to an appropriate standard. Any brushing or grinding shall be carried out using stainless steel tools only. Precautions shall be taken to avoid contamination by e.g. residual C-steel particles, C-steel tools and handling equipment.

5.6.6 The pipe surface shall be at least 3°C above the dew point temperature and the ambient relative humidity not exceed 85% during the blast cleaning. Pre-heating is required if the humidity is higher.

5.6.7 Dust or abrasive remains shall be removed from the pipe surface using dry clean air, vacuum cleaning, brushing or an equivalent technique. Compressed air quality shall be controlled (to be specified in MPS / ITP). Surface cleanliness and roughness shall be verified as detailed in the applicable FJC / CFR 'data sheet' in ANNEX 1. Measurements of residual salt contamination may be performed using special proprietary equipment if specified in the ITP, and provided that compliance with the referenced standard can be demonstrated. Prepared field joints not meeting specified requirements shall be subject to new surface treatment. In case of failure during fractional testing of surface treatment, the testing frequency shall be increased until the efficiency of corrective actions has been confirmed.

Guidance note:

If salt contamination is established during production testing, measures should be taken to remove such contamination prior to welding using washing by high-pressure fresh water.

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5.6.8 Precautions shall be taken to avoid rusting and/or contamination after completed surface preparation. The affected areas shall be efficiently shielded from atmospheric precipitation, sea spray, etc. Requirements to maximum duration between blasting and coating, and/or maximum relative humidity shall be specified in the MPS / ITP.

5.6.9 Cleaning of the parent coating overlap area is normally required to remove any contamination or thermal degradation of the coating surface by steel surface preparation or previous handling. Such cleaning and any further mechanical preparation of parent coating cutback for FJC / CFR shall be specified in MPS / ITP.

5.7 Coating application

5.7.1 All work associated with coating application shall be carried out according to the qualified MPS (see 5.1 and 5.2). Purchaser may specify that coating applicators shall be qualified individually during the PQT (5.1.2). The manning of the application crew, including any supervisor, shall not be less than during the PQT, except for any activities that will not apply during production. Once the MPS has been qualified,

any changes shall be formally accepted by Purchaser through a 'concession request' (CR).

5.7.2 Coating application temperature, any pre-heating of coating materials, and drying or curing conditions shall comply with coating material suppliers's recommendations (see 5.4.3) and/or the qualified MPS.

5.7.3 Parent coating shall be shielded from any detrimental effects of preheating of steel surface and coating application. Direct heating of steel surface after completed surface preparation, if applicable, shall be by induction heating. The applied frequency shall be such that adequate through-thickness-heating is achieved. The control of heating shall ensure that any accidental heating of the pipe wall to a temperature higher than 270°C is prevented. Flux shields may be required to prevent excessive heating of parent coating by induction heating. Any direct heating of PE / PP parent coating overlap shall be by hot air or infrared heat. Pre-heating by gas torches is not allowed, except for FJC/CFR systems 1A and 1B.

5.7.4 Adequate shelter from rain and wind shall be provided. Throughout coating application, essential parameters affecting the quality of the coating (e.g. steel temperature and relative humidity, pre-mixing of 'infill' components) shall be monitored and recordings noted in the 'daily log' (5.8.8). Equipment for monitoring (e.g. temperature and pressure sensors, injection flow meters.) shall be calibrated at scheduled intervals as specified in the ITP (5.3.3).

5.7.5 Control of coating application parameters shall be sufficient to verify that individual layers of coating are applied within the qualified temperature range and time frame for the application of individual layers, in order to achieve the specified coating thickness, inter-layer adhesion and other properties of each layer.

Guidance note:

For more complex FJC systems, this will normally require use of automatic control of heating and coating application.

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5.7.6 The design of any permanent moulds or straps for 'infill' shall be accepted by Purchaser.

5.8 Inspection and testing of coating

5.8.1 Completed FJC / CFR and 'infills' shall be inspected and tested according to the ITP (5.3.2). Any changes shall be formally accepted by Purchaser through a 'concession request' (CR).

Guidance note:

Inspection of FJC / CFR (including any 'infill') is to a large extent based on visual inspection. It is essential that acceptance criteria are defined in quantitative and objective terms as far as practical, based on results from the PQT and/or previous experience. Photographic documentation of acceptable contra non-acceptable defects may be helpful.

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5.8.2 Purchaser shall be allowed to witness all inspection and/or testing. For any special hold points identified by Purchaser (see 5.3.6), Contractor shall give adequate notice for Purchaser to arrange for witnessing. Purchaser may further specify that each FJC / CFR shall be formally accepted by an inspector of his choice.

Guidance note:

Purchaser should consider the needs and benefits of carrying out quality surveillance during production, either as single audits or continuous presence by trained and qualified inspectors.

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5.8.3 Inspection and testing of coated pipes during qualification and production shall be carried out according to the applicable methods, acceptance criteria and frequencies specified in the applicable FJC / CFR and/or infill data sheet, and any amendments made in purchase documents (see 1.3.4). If alternative test methods are given in the data sheet and Purchaser has not specified any preference in purchase document (see 1.3.5), then the selection of method is optional to Contractor.

5.8.4 Purchaser may specify testing of specific coating properties by destructive testing during production. Such testing may then be carried out on a dummy pipe piece or on an actual field joint to be stripped and recoated (or possibly repaired if accepted by Purchaser) after testing.

5.8.5 Failures during testing which are obviously due to defective sampling or operational errors of testing equipment may be disregarded and testing repeated on the same FJC / CFR.

5.8.6 Individual FJCs / CFRs and 'infills' not meeting specified criteria shall be recoated, or if possible, repaired according to an accepted procedure (see 5.9).

5.8.7 In case of repeated failures to meet specified requirements, production shall be discontinued. Contractor shall then carry out an examination of the cause(s) of the failure and issue a 'non-conformance report'.

5.8.8 All data from inspection and testing of FJCs / CFRs and 'infills', major repairs and stripping of FJC, recordings of essential operating parameters, calibration of testing and monitoring equipment and time of completed application shall be noted in the 'daily log'. The log shall be updated on a daily basis and be available for Purchaser's review at any time during coating work.

5.9 Repairs and stripping

5.9.1 Permissible FJC and 'infill' repairs, if applicable, as well as requirements to documentation of repairs shall be agreed (see 1.3.2). All repairs shall be carried out and inspected according to a qualified procedure (5.2).

5.9.2 Stripping of unrepairable FJC for recoating shall be carried out according to a procedure accepted by Purchaser. It shall be demonstrated during the PQT that the stripping does not damage the adjacent linepipe coating. If heating is applied, the temperature control shall ensure that heating of the pipe above 270°C is avoided.

5.10 Documentation and marking

5.10.1 Requirements to pipe tracking, marking and documentation format and schedule for supply of documentation shall be specified in purchase document, as applicable.

5.10.2 For documentation to be submitted by Contractor prior to start of coating activities, including the PQT, reference is made to 5.1 to 5.3.

5.10.3 Results from inspection and testing during qualification and production shall be documented and be traceable to unique pipe numbers and individual coating material batches or lots. For specific requirements to the 'daily log', see 5.8.8.

5.10.4 After completed work, Contractor shall issue an inspection document corresponding to the requirements given in EN 10204 inspection certificate 3.1.B, or ISO 10474 inspection certificate 5.1.B. The document shall contain all results from inspection and testing, coating material certificates, and records from any repairs and recoating.

Guidance note:

If any inspection and testing of individual FJCs is carried out by Purchaser, copies of the reports should be submitted to Contractor for inclusion in the final documentation.

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5.11 Handling and storage of pipes

5.11.1 Pipes shall be handled and stored such that damage to coated as well as uncoated surfaces is avoided. Stainless steel pipes require special considerations to avoid surface contamination (e.g. from unintended use of C-steel tools and handling equipment). The applicable procedure is subject to acceptance by Purchaser. Purchaser may further require documentation (e.g. by calculations) that a specified maximum stack height of large diameter pipes cannot cause any damage.

Guidance note:

Handling, transportation and storage of pipes is not normally included in Contactor's scope of work.

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5.11.2 Damage to coatings during handling or storage shall be repaired according to 5.9, whilst any damage to linepipe material shall be reported to Purchaser. (Pipes with damage to linepipe material shall be separated and quarantined).

6. ANNEX 1 FJC/CFR Coating Data Sheets

FJC / CFR Data Sheet No. 1A
Adhesive Tape (PVC/PE Backing) on Steel Substrate Without Previous Coating

1 Coating Configuration

Dual layer tape with bitumenous adhesive, overlap min. 25 mm	Typical as-applied thickness, 1.5-2.5 mm

2 Coating Materials

2.1 Inner layer (bituminous adhesive type), as-supplied property

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			Coating Material Qualification	*Production*
Thickness	according to CDS	min. 1.0 mm	to be included	each batch/lot
Softening point (ring and ball)	ASTM D36	min. 105°C	to be included	by agreement
Lap shear strength at 20°C	ASTM D1002	min. 3 N/mm^2	to be included	by agreement
at max. operating temperature		by agreement	by agreement	by agreement

2.2. Outer layer (PVC/PE), as-supplied property

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			Coating Material Qualification	*Production*
Thickness	according to CDS	min. 1.0 mm	to be included	each batch/lot
Tensile strength at 20°C	EN 12068, Annex A or ASTM D638	min. 15 N/mm^2	to be included	each batch/lot
Tensile strength at max. operating temperature		by agreement	by agreement	by agreement
Elongation at break	EN 12068, Annex E or ASTM D638	min. 200%	to be included	each batch/lot
Thermal degradation	EN 12068, Annex E or ASTM D638	tensile properties as above to be met after 30 days at 150 °C	by agreement	not applicable
Specific electrical insulation resistance	EN 12068, Annex J	by agreement	by agreement	not applicable
Microbiological resistance	EN 12068, Annex M	by agreement	by agreement	not applicable

3 Surface Preparation, Coating Application and Final Inspection / Testing

3.1 Surface Preparation

Item/Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			PQT	*Production*
Initial steel surface condition	visual examination	dry and free from contamination (oil, grease, etc.) and surface defects	to be included	every FJ
Steel surface temperature and relative humidity	according to MPS/ITP	min. 3°C above dew point	to be included	minimum once per hour
Salt contamination after brush or blast cleaning (FJC only)	ISO 8501-2 and ISO 8502-6 or agreed method	max. 30 mg NaCl/m^2	to be included	first FJ per shift, then every 10th
Steel surface cleanliness	ISO 8501-1	Sa 2.5 or St 3	to be included	every pipe
Steel surface cleanliness	ISO 8502-3	rating max. 2	to be included	first FJ per shift, then every 10th
Linepipe coating condition (overlap area)	visual examination	according to MPS/ITP	to be included	every FJ

3.2 Coating Application and Final Testing

Item/Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			PQT	*Production*
Pre-heat temperature	according to ITP	according to ITP	to be included	every FJ
General appearance of FJC	visual examination	according to ITP	to be included	every FJ
Parent coating overlap	ruler	minimum 50 mm	to be included	every FJ
Thickness	according to ITP	min. 1.5 mm (min. 0.6 mm on top of weld bead)	to be included	first FJ per shift, then every 10th

FJC / CFR Data Sheet No. 1A Adhesive Tape (PVC/PE Backing) on Steel Substrate Without Previous Coating (Continued)				
Holiday detection	NACE RP0274	no indication at 5 kV + 5 kV/ mm (max. 15 kV)	to be included	every FJ
Adhesion to steel substrate	EN 12068, Annex C or ASTM D1000	min. 20 N/cm	to be included	by agreement
Adhesion layer to layer	EN 12068, Annex E	according to standard	to be included	by agreement
Adhesion to parent coating	EN 12068, Annex C	according to standard	to be included	by agreement
Lap shear strength	EN 12068. Annex D	according to standard	to be included	by agreement
Impact resistance	EN 12068, Annex H	according to standard	to be included	by agreement
Indentation resistance	EN 12068, Annex G	according to standard	by agreement	by agreement
Cathodic disbonding, at room temperature or at 65°C	EN 12068, Annex K or ASTM G8	max. 7 mm disbonding, 48 hrs at 65°C or 28 days at room temperature	to be included	by agreement
“according to ITP”, “to be included”, “to be agreed” and “by agreement” are explained in 5.3.3				

END OF DATA SHEET No 1A

FJC / CFR Data Sheet No. 1B
Heat Shrink Sleeve (PE Backing) on Steel Substrate Without Previous Coating

1 Coating Configuration

Heat shrink sleeve with bitumenous adhesive	Typical as-applied thickness, 1.5-2.5 mm

2 Coating Materials

2.1 Inner Layer (bituminous adhesive), as-supplied property

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			Coating Material Qualification	*Production*
Thickness	according to CDS	min. 1.0 mm	to be included	each batch/lot
Softening point, ring and ball	ASTM D36	min. 105°C	to be included	by agreement
Lap shear strength, at room temperature	EN 12068	≥150 N/cm^2	not applicable	every batch/lot

2.2. Outer Layer (PE backing), as-supplied property

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			Coating Material Qualification	*Production*
Thickness	according to CDS	min. 1.0 mm	to be included	each batch/lot
Tensile strength at 23°C	EN 12068, Annex A or ASTM D638	min. 15 N/mm^2	to be included	each batch/lot
Tensile strength at max. operating temperature	EN 12068, Annex E or ASTM D638	by agreement	by agreement	by agreement
Elongation at break	EN 12068, Annex E or ASTM D638	min. 200%	to be included	each batch/lot
Thermal degradation	EN 12068, Annex E or ASTM D638	tensile properties as above to be met after 30 days at 150°C	by agreement	by agreement
Specific electrical insulation resistance	EN 12068, Annex J	by agreement	by agreement	by agreement
Microbiological resistance	EN 12068, Annex M	by agreement	by agreement	by agreement

3 Surface Preparation, Coating Application and Final Inspection / Testing

3.1 Surface Preparation

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			PQT	*Production*
Initial steel surface condition	visual examination	dry and free from contamination (oil, grease, etc.) and surface defects	to be included	every FJ
Steel surfcae temperature and relative humidity	according to MPS/ITP	min. 3°C above dew point	to be included	minimum once per hour
Salt contaminnation after brush or blast cleaning (FJC only)	ISO 8501-2 and ISO 8502-6 or other agreed method	max. 30 mg NaCl/m^2	to be included	first FJ per shift, then every 10th
Steel surface cleanliness	ISO 8501-1	Sa 2 ½ or St 3	to be included	every pipe
Steel surface cleanliness	ISO 8502-3	rating max. 2	to be included	first FJ per shift, then every 10th
Linepipe coating condition (overlap area)	visual examination	according to MPS/ITP	to be included	every FJ

3.2 Coating Application and Final Testing

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			PQT	*Production*
Pre-heat temperature	according to ITP	according to ITP	to be included	every FJ
General appearance of FJC	visual examination	according to ITP	to be included	every FJ
Parent coating overlap	ruler	minimum 50 mm	to be included	every FJ
Thickness	according to ITP	min. 1.5 mm (min. 0.6 mm on top of weld bead)	to be included	first FJ per shift, then every 10th
Holiday detection	NACE RP0274	no indication at 5 kV + 5 kV/mm (max. 15 kV)	to be included	every FJ
Adhesion to steel substrate at 23°C	EN 12068, Annex C or ASTM D1000	min. 15 N/cm	to be included	by agreement
Adhesion to steel substrate at max. operating temperature		by agreement	by agreement	by agreement

FJC / CFR Data Sheet No. 1B **Heat Shrink Sleeve (PE Backing) on Steel Substrate Without Previous Coating (Continued)**				
Adhesion to parent coating	EN 12068, Annex C	according to ITP	by agreement	by agreement
Impact resistance	EN 12068, Annex H	according to standard	to be included	by agreement
Indentation resistance	EN 12068, Annex G	according to standard	by agreement	by agreement
Cathodic disbonding, at room temperature or at 65°C	EN 12068, Annex K or ASTM G8 or other agreed method	max. 7 mm disbonding, 48 hrs at 65°C or by agreement	by agreement	by agreement
“according to ITP”, “to be included”, “to be agreed” and “by agreement” are explained in 5.3.3				

END OF DATA SHEET No 1B

FJC / CFR Data Sheet No. 2A
Polyethylene (PE) Heat Shrink Sleeve on Top of Liquid Epoxy (LE) Layer

1 Coating Configuration

Liquid epoxy (heat cured)	min. 100 μm, (max. value to be agreed for inclusion in ITP)
Polyethylene adhesive layer	min. 1.5 mm
Polyethylene outer sheath (backing) layer	min. 1.0 mm
Total thickness (as applied)	min. 2.5 mm

2 Coating Materials

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			Coating Material Qualification	*Production*
2.1.1 LE material, raw material property				
Viscosity of base and hardener	ISO 2655	according to PDS	not applicable	every batch/lot
Volume solids of the base and hardener	ISO 1515	according to PDS	not applicable	every batch/lot
2.1.2 LE material, processed (as-applied) material property				
not applicable				
2.2.1 PE sleeve adhesive layer, as-supplied property				
Density	ASTM D792	0.91-0.95	not applicable	every batch/lot
Lap shear strength, at room temperature at max. operating temperature	EN 12068	≥100 N/cm^2 ≥5 N/cm^2	not applicable not applicable	every batch/lot every batch/lot
Softening point	ASTM E28	min. 90°C HOLD	by agreement	by agreement
Viscosity change (250 hrs at max. operating temperature +10°C)	ASTM D1084	<15%	by agreement	by agreement
2.2.2 PE sleeve outer layer, as-supplied property				
Density	ASTM D792	0.91-0.95 kg/dm^3	not applicable	every batch/lot
Melt flow index/rate	ISO 1133 or ASTM D1238	according to PDS	not applicable	every batch/lot
Melting point by DSC	ASTM D3418	≥110°C	by agreement	by agreement
Hardness	ASTM D785 or ISO 868	≥48 Shore D	to be included	by agreement
Tensile properties, room temperature	ASTM D638	tensile strength at yield ≥20 MPa elongation at break ≥400%	to be included	by agreement
Flexural modulus	ASTM D790 or ISO 178	≥700 MPa	by agreement	not applicable
Brittleness temperature	ASTM D746	<-20°C	by agreement	not applicable
UV resistance	EN 12068, Annex F or ISO 4892-2 or DIN 30670 or	by agreement (ISO) or according to standard)	by agreement	not applicable
Fungi resistance	ASTM G21 or EN 12068, Annex M	according to standard	by agreement	not applicable
Bacteria resistance	ASTM G22 or EN 12068, Annex M	according to standard	by agreement	not applicable
Water absorption	ASTM D570 or ISO 817	<0.5% per 24 hours	by agreement	not applicable
Water vapour permeability (as transmission rate)	ASTM E96	<0.5 g/m^2 per 24 hours per mm	by agreement	not applicable
Volume resistivity	ASTM D257	≥10^{16} ohm cm	by agreement	not applicable
Dielectric strength	ASTM D149	≥25 kV/mm	by agreement	not applicable

3 Coating Application and Final Inspection / Testing

3.1 Surface Preparation

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			PQT	*Production*
Steel surface, initial condition	visual examination	dry and free from contamination (oil, grease, etc.) and surface defects	to be included	every FJ and repair

FJC / CFR Data Sheet No. 2A Polyethylene (PE) Heat Shrink Sleeve on Top of Liquid Epoxy (LE) Layer (Continued)				
Steel surface temperature and relative humidity	according to MPS/ITP	min. 3°C above dew point	to be included	minimum once per hour
Steel surface, final condition	visual examination	free from surface defects	to be included	every FJ and repair
Salt contamination after blast cleaning	ISO 8502-02, -6 or agreed method	max. 20 mg NaCl/m^2	to be included	first FJ/repair per shift, then every 10^{th}
Surface cleanliness	ISO 8501-1	A/B ≥ Sa 2 ½.	to be included	first FJ/repair per shift, then every 10^{th}
Surface cleanliness	ISO 8502-3	rating max. 2	to be included	first FJ/repair per shift, then every 10^{th}
Surface roughness	ISO 8503-4	R_z min. 40 μm; max. 100 μm	to be included	first FJ/repair per shift, then every 10^{th}
Checking of blasting materials	according to MPS/ITP	according to ITP	to be included	according to ITP/MPS
Parent coating (overlap), initial condition	according to MPS/ITP	according to ITP	to be included	every FJ and repair
Parent coating (overlap), final condition	according to MPS/ITP	according to ITP	to be included	every FJ and repair
3.2 Coating Application and Final Testing				
Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			PQT	*Production*
3.2.1 LE layer				
Steel surface temperature	according to MPS/ITP	according to ITP	to be included	every FJ and repair
Epoxy material temperature	according to MPS/ITP	according to ITP	to be included	first FJ/repair per shift, then every 10^{th}
Appearance of coating	visual examination		to be included	every FJ and repair
Coating thickness	according to MPS/ITP	min. 100 μm	to be included	not applicable
3.2.2 Full Layer				
Parent coating (overlap) temperature	according to MPS/ITP	min. according to ITP max. 110°C	to be included	every FJ and repair
General appearance	visual examination	according to ITP	to be included	every FJ and repair
Parent coating overlap	ruler	minimum 50 mm	to be included	every FJ and repair
Thickness	according to ITP	according to ITP	to be included	first FJ/repair per shift, then every 10^{th}
Holiday detection	NACE RP0274, 5 kV + 5 kV/mm nominal thickness, max. 25 kV, 200-300 mm/s or NF A 49-711	no holidays	to be included, 100% surface area	every pipe, 100% surface area (visual/accoustic alarm function)
Thickness	according toMPS/ITP (method to be agreed)	according to purchase order and ITP	to be included, coverage to be defined for PQT	according to ITP (frequency and location to be agreed)
Adhesion to steel substrate (peel strength), at max. operating temperature	EN 12068, Annex C or other agreed procedure	min. 3N/cm	to be included	by agreement
Adhesion to parent coating at max. operating temperature	EN 12068, Annex C or other agreed procedure	min. 3N/cm	to be included	by agreement
Hardness	ISO 868	≥48 Shore D	to be included	by agreement
Impact resistance, at room temperature at max. operating temperature	EN 12068, Annex H or other agreed procedure	>15 J by agreement	to be included by agreement	by agreement by agreement
Indentation resistance, at max. operating temperature	EN 12068, Annex G or other agreed procedure	>0.6 mm remaining thickness	to be included	by agreement
Cathodic disbonding, at room temperature or at 65°C at max. operating temperature, if higher than 65°C	EN 12068, Annex K or ASTM G8 or GBE/CW6 or other agreed procedure	max. 7 mm disbonding, 48 hrs at 65°C or 28 days at room temperature by agreement	to be included by agreement	by agreement by agreement
Hot water soak test	GBE/CW6 Part 1, App. E (modified, cut edges freely exposed) or agreed procedure	max. 4 mm disbonding, 7 days at 80°C or at max. opertaing temperature if higher than 80°C	to be included	by agreement
Thermal degradation resistance	EN 12068, Annex E	by agreemennt	by agreemennt	by agreemennt

FJC / CFR Data Sheet No. 2A **Polyethylene (PE) Heat Shrink Sleeve on Top of Liquid Epoxy (LE) Layer (Continued)**				
Bending resistance (flexibility), at room temperature	GBE/CW6, Part 1, App. B 2% strain	no cracking or disbond-ment	by agreement	by agreement
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

END OF DATA SHEET No 2A

FJC/CFR Data Sheet No. 2B
Polypropylene (PP) Heat Shrink Sleeve on Top of Liquid Epoxy (LE) Layer

1 Coating Configuration

Liquid epoxy (heat cured)	min. 100 μm, (max. value to be agreed for inclusion in ITP)
Polypropylene adhesive layer	min. 1.5 mm
Polypropylene outer sheath (backing) layer	min. 1.0 mm
Total thickness	min. 2.5 mm

2 Coating Materials

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			Coating Material Qualification	*Production*
2.1.1 LE material, raw material property				
Viscosity of base and hardener	ISO 2655	according to PDS	not applicable	every batch/lot
Volume solids of the base and hardener	ISO 1515	according to PDS	not applicable	every batch/lot
2.1.2 LE material, processed (as-applied) material property				
not applicable				
2.2.1 PP sleeve adhesive layer, as-supplied property				
Density	ASTM D792	0.91-0.94 kg/dm^3	not applicable	every batch/lot
Melt flow index	ASTM D1238	according to PDS	not applicable	every batch/lot
Melting point	ASTM D3418	140-150°C	by agreement	by agreement
Thermostabilisation	ASTM D3895	by agreement	by agreement	by agreement
Lap shear strength, at room temperature at 110°C	EN 12068	500 N/cm^2 100 N/cm^2	not applicable not applicable	every batch/lot every batch/lot
2.2.2 PP sleeve outer layer, as-supplied property				
Density	ASTM D792	0.91-0.94 kg/dm^3	not applicable	every batch/lot
Melt flow index/rate	ISO 1133 or ASTM D1238	according to PDS	not applicable	every batch/lot
Hardness	ASTM D785 or ISO 868	≥60 Shore D	to be included	by agreement
Tensile properties, at room temperature at max. operating temperature	ASTM D638	tensile strength at yield ≥25 MPa elongation at break ≥300% by agreement	to be included by agreement	by agreement by agreement
Melting point	ISO 3146	≥150°C	by agreement	by agreement
Thermostabilisation	ASTM D3895	by agreement	by agreement	by agreement
Flexural modulus	ASTM D790 or ISO 178	≥650 MPa	by agreement	not applicable
Brittleness temperature	ASTM D746	<-20°C	by agreement	not applicable
UV resistance	EN 12068, Annex F or ISO 4892-2 or DIN 30670	according to standard	by agreement	not applicable
Abrasion resistance	ASTM D4060 or DIN 53516	by agreement	by agreement	not applicable
Fungi resistance	ASTM G21 or EN 12068, Annex M	according to standard	by agreement	not applicable
Bacteria resistance	ASTM G22or EN 12068, Annex M	according to standard	by agreement	not applicable
Water absorption	ASTM D570 or ISO 817	<0.5% per 24 hours	by agreement	not applicable
Water vapour permeability (as transmission rate)	ASTM E 96	<0.2 g/m^2 per 24 hours per mm	by agreement	not applicable
Volume resistivity	ASTM D 257	≥10^{13} ohm cm	by agreement	not applicable
Dielectric strength	ASTM D 149	≥25 kV/mm	by agreement	not applicable

FJC/CFR Data Sheet No. 2B **Polypropylene (PP) Heat Shrink Sleeve on Top of Liquid Epoxy (LE) Layer (Continued)**				
3 Coating Application and Final Inspection / Testing				
3.1 Surface Preparation				
Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			PQT	*Production*
Steel surface initial condition	visual examination	dry and free from contamination (oil, grease, etc.) and surface defects	to be included	every FJ and repair
Pipe temperature and relative humidity	according to MPS/ITP	pipe temperature min. 3°C above dew point	to be included	minimum once per hour
Steel surface final condition	visual examination	free from surface defects	to be included	every FJ and repair
Salt contamination after blast cleaning	ISO 8502-02, -6 or agreed method	max. 20 mg NaCl/m^2	to be included	first FJ/repair per shift, then every 10th
Surface cleanliness	ISO 8501-1	A/B ≥ Sa 2 ½.	to be included	first FJ/repair per shift, then every 10th
Surface cleanliness	ISO 8502-3	rating max. 2	to be included	first FJ/repair per shift, then every 10th
Surface roughness	ISO 8503-4	R_z min. 40 μm; max. 100 μm	to be included	first FJ/repair per shift, then every 10th
Checking of blasting materials	according to MPS/ITP	according to ITP	to be included	according to ITP/MPS
Parent coating (overlap) initial condition	according to MPS/ITP	according to ITP	to be included	every FJ and repair
Parent coating (overlap) final condition	according to MPS/ITP	according to ITP	to be included	every FJ and repair
3.2 Coating Application and Final Testing				
to be agreed	*Test method*	*Acceptance criteria*	*Frequency of testing*	
			PQT	*Production*
3.2.1 LE layer				
Steel surface temperature	according to MPS/ITP	according to ITP	to be included	every FJ and repair
Epoxy material temperature	according to MPS/ITP	according to ITP	to be included	first FJ/repair per shift, then every 10th
Appearance of coating	visual examination		to be included	every FJ and repair
Coating thickness	according to MPS/ITP	min. 100 μm	to be included	not applicable
Adhesion			to be included	not applicable
3.2.2 Full Layer				
Parent coating (overlap) temperature	according to MPS/ITP	according to ITP	to be included	every FJ and repair
General appearance	visual examination	according to ITP	to be included	every FJ and repair
Parent coating overlap	ruler	minimum 50 mm	to be included	every FJ and repair
Thickness	according to ITP	according to ITP	to be included	first FJ/repair per shift, then every 10th
Holiday detection	NACE RP0274, 5 kV/mm+ 5 kV/mm nominal thickness, max. 25 kV, 200-300 mm/s	no holidays	to be included, 100% surface area	every pipe, 100% surface area (visual/accoustic alarm function)
Thickness	according toMPS/ ITP (method to be agreed)	according to purchase order and ITP	to be included, coverage to be defined for PQT	according to ITP (frequency and location to be agreed)
Adhesion to steel substrate (peel strength), at 100°C	NF A 49-711, E.3 or DIN 30670/30678 or EN 12068, Annex C or other agreed procedure	>40 N/cm	to be included	by agreement
at 115°C (if max. operating temperature is between 100 and 115°C)		>20 N/cm	to be included (if applicable)	by agreement
at max. operating temperature, if larger than 115°C		to be agreed (if applicable)	to be included (if applicable)	by agreement
Adhesion to parent coating at 100°C	NF A 49-711, E.3 or DIN 30670/30678 or EN 12068, Annex C or other agreed procedure	>40 N/cm	to be included	by agreement
at max. operating temperature, if larger than 100°C		to be agreed (if applicable)	to be included (if applicable)	by agreement
Hardness	ISO 868	≥60 Shore D	to be included	by agreement

FJC/CFR Data Sheet No. 2B **Polypropylene (PP) Heat Shrink Sleeve on Top of Liquid Epoxy (LE) Layer (Continued)**				
Impact resistance, at room temperature at max. operating temperature,	NF A 49-711 or DIN 30670/30678 or EN 12068, Annex H or other agreed procedure	no indication by holiday detection (see above) after impact of 9 Nm per mm coating thickness by agreement	to be included by agreement	by agreement by agreement
Indentation resistance, at 23°C at 110°C at max. operating temperature (if larger than 110°C)	NF A 49-711 or DIN 30670/30678 or EN 12068, Annex G or other agreed procedure	 max. 0.10 mm, 23°C max. 1.0 mm, 110°C	 to be included by agreement	 by agreement by agreement by agreement
Cathodic disbonding, at 65°C at 95°C (if max. operating temperature is between 65 and 95°C) at max. operating temperature, if higher than 95°C	EN 12068, Annex K or other agreed procedure	max. 7 mm disbonding, after 48 hrs	 to be included by agreement by agreement	 by agreement by agreement by agreement
Hot water soak test	GBE/CW6 Part 1, App. E (modified, cut edges freely exposed) or agreed procedure	max. 4 mm disbonding, 7 days at 80°C or at max. operating temperature if higher than 80°C	to be included	by agreement
Thermal degradation resistance	EN 12068, Annex E	by agreemennt	by agreemennt	by agreemennt
Bending resistance (specimen) at room temperature	GBE/CW6, Appendix B (min. 2% strain)	no cracking or disbondment	by agreement	by agreemennt
Bending resistance (full scale FJC) at room temperature	by agreement	by agreement	by agreement	not applicable
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

END OF DATA SHEET No 2B

FJC / CFR Data Sheet No. 3A
Fusion Bonded Epoxy Coating (Liquid Epoxy for Repairs)

1 Coating Configuration

Epoxy layer	FBE: min. 350 μm, max. 500 μm LE: min. 100 μm, (max. thickness to be agreed)

2 Coating Materials

Item / Property to be tested	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1.1 FBE material, raw material property				
Density	ISO 2811	according to PDS	not applicable	every batch/lot
Particle size	according to PDS	according to PDS	not applicable	every batch/lot
Max. moisture content	according to PDS	according to PDS	not applicable	every batch/lot
Gel time	ISO 8130-6	according to PDS	not applicable	every batch/lot
Thermal analysis	NF A 49-711 or GBE/CW6 part 1, App. A	according to PDS	not applicable	by agreement
Infrared scan	by agreement	by agreement	by agreement	by agreement
2.1.2 FBE material, processed (as-applied) property				
Glass transition temperature	by agreement	min. 95°C and min. 5°C above pipeline max. operating temperature	to be included	not applicable
Water resistance	ASTM D870, 3000 hrs at 85°C or GBE/CW6 part 1, App. E	no blistering, loss of hardness <10% according to standard	to be included	not applicable
Flexibility (bending) test	GBE-CW6 Part 1 or CAN/CSA 245.20	according to standard or by agreement	to be included	not applicable
Impact resistance	ASTM G14 or GBE/CW6 part 1, App. D	>13 Joules according to standard	by agreement	not applicable
Salt spray test	ISO 7253, 4000 hrs or BS 3900, Part F4	no rusting, no blistering	by agreement	not applicable
Cathodic disbonding	ASTM G8 or GBE/CW6, part 1, App. F or or other agreed procedure	by agreement	by agreement	not applicable
Abrasion resistance	ASTM D4060	<0.050g/1000 cycles	by agreement	not applicable
2.1.1 LE material, raw material property				
Viscosity of base and hardener	ISO 2655	according to PDS	not applicable	every batch/lot
Volume solids of the base and hardener	ISO 1515	according to PDS	not applicable	every batch/lot
2.1.2 LE material, processed (as-applied) material property				
Not applicable				

3 Surface Preparation, Coating Application and Final Inspection / Testing

3.1 Surface Preparation

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
Steel surface initial condition	visual examination	dry and free from contamination (oil, grease, etc.) and surface defects	to be included	every FJ and repair
Pipe temperature and relative humidity	according to MPS/ITP	pipe temperature min. 3°C above dew point	to be included	minimum once per hour
Steel surface final condition	visual examination	free from surface defects	to be included	every FJ and repair
Salt contamination after blast cleaning	ISO 8502-02, -6 or agreed method	max. 10 mg NaCl/m^2	to be included	first FJ/repair per shift, then every 10th
Surface cleanliness	ISO 8501-1	A/B ≥ Sa 2 ½.	to be included	first FJ/repair per shift, then every 10th
Surface cleanliness	ISO 8502-3	rating max. 2	to be included	first FJ/repair per shift, then every 10th

FJC / CFR Data Sheet No. 3A **Fusion Bonded Epoxy Coating (Liquid Epoxy for Repairs) (Continued)**				
Surface roughness	ISO 8503-4	R_Z min. 40 μm; max. 100 μm	to be included	first FJ/repair per shift, then every 10th
Checking of blasting materials	according to MPS/ITP	according to ITP	to be included	according to ITP/MPS
Parent coating (overlap) initial condition	according to MPS/ITP	according to ITP	to be included	every FJ and repair
Parent coating (overlap) final condition	according to MPS/ITP	according to ITP	to be included	every FJ and repair
3.2 Coating Application and Final Inspection / Testing				
Item/Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
Pipe material temperature	according to ITP	according to ITP	to be included	every FJ and repair
Appearance of coating	visual examination	according to ITP	to be included, 100% surface area	every FJ and repair
Parent coating overlap	ruler	min. 50 mm or by ageement	to be included	every FJ and repair
Holiday detection	GBE/CW6 part 1, App. C or by agreement	no holidays	to be included, 100% surface area	every FJ and repair
Thickness	ISO 2808 or by agreement	according to ITP	to be included	first FJ/repair per shift, then every 10th
Degree of cure (FJC only)	FBE: differential thermal analysis according to GBE/CW6 or by agreement	FBE: ΔT_G = max. 5°C	to be included	by agreement
Adhesion (FJC only)	ISO 2409 or ISO 4624 or DIN 30671 or by agreement	classification: 0 (ISO 2409) min. 34 MPa (ISO 4624) no detachment (DIN 30671)	to be included	by agreement
Impact resistance (FJC only)	GBE/CW6 part 1, App. D or ASTM G14	to be agreed	to be included	not applicable
Hardness (FJC only)	ISO 2815	by agreement	by agreement	by agreement
Porosity (FJC only)	CAN/CSA-Z245.20	by agreement	by agreement	by agreement
Cathodic disbonding (FJC only)	ASTM G8 or GBE/CW6, part 1, App. F or other agreed procedure	max. 7 mm disbonding, 48 hrs at 65°C or 28 days at room temperature	to be included	by agreement
Hot water soak test (FJC only)	GBE/CW6 Part 1, App. E (modified, cut edges freely exposed) or other agreed procedure	max. 4 mm disbonding, 7 days at 80°C or at max. operating temperature if higher than 80 °C	to be included	by agreement
Bending resistance (specimen) at room temperature	GBE/CW6, Part 1, Appendix B (min. 2% strain)	no cracking or disbondmemt	by agreement	by agreemennt
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

END OF DATA SHEET No 3A

FJC Data Sheet No. 3B
Fusion Bonded Epoxy Coating with PE Heat Shrink Sleeve

1 Coating Configuration

Epoxy layer PE sleeve	FBE: min. 350 μm, max. 500 μm PE: min. 2.0 mm

2 Coating Materials

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1.1 FBE material, raw material property				
	As for Data Sheet 3A, 2.1.1	As for Data Sheet 3A, 2.1.1	As for Data Sheet 3A, 2.1.1	As for Data Sheet 3A, 2.1.1
2.2.1 PE sleeve adhesive layer, as-supplied property				
	As for Data Sheet 2A, 2.2.1	As for Data Sheet 2A, 2.2.1	As for Data Sheet 2A, 2.2.1	As for Data Sheet 2A, 2.2.1
2.2.3 PE sleeve outer layer, as-supplied property				
As for Data Sheet 2A, 2.2.2	As for Data Sheet 2A, 2.2.2	As for Data Sheet 2A, 2.2.2	As for Data Sheet 2A, 2.2.2	As for Data Sheet 2A, 2.2.2

3 Surface Preparation, Coating Application and Final Inspection / Testing

3.1 Surface Preparation

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
As for Data Sheet 3A, 3.1	As for Data Sheet 3A, 3.1	As for Data Sheet 3A, 3.1	As for Data Sheet 3A, 3.1	As for Data Sheet 3A, 3.1

3.2 Coating Application and Final Testing

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
3.2.1 FBE layer				
As for Data Sheet 3A, 3.2	As for Data Sheet 3A, 3.2	As for Data Sheet 3A, 3.2	As for Data Sheet 3A, 3.2	As for Data Sheet 3A, 3.2
3.2.2 Full layer				
As for Data Sheet 2A, 3.2.2	As for Data Sheet 2A, 3.2.2	As for Data Sheet 2A, 3.2.2	As for Data Sheet 2A, 3.2.2	As for Data Sheet 2A, 3.2.2

"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3

END OF DATA SHEET No 3B

FJC Data Sheet No. 3C
Fusion Bonded Epoxy Coating with PP Heat Shrink Sleeve

1 Coating Configuration

Epoxy layer	FBE: min. 350 μm, max. 500 μm
PP sleeve	PP: min. 2.0 mm

2 Coating Materials

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1.1 FBE material, raw material property				
	As for Data Sheet 3A, 2.1.1	As for Data Sheet 3A, 2.1.1	As for Data Sheet 3A, 2.1.1	As for Data Sheet 3A, 2.1.1
2.2.1 PP sleeve adhesive layer, as-supplied property				
	As for Data Sheet 2B, 2.2.1	As for Data Sheet 2B, 2.2.1	As for Data Sheet 2B, 2.2.1	As for Data Sheet 2B, 2.2.1
2.2.3 PP sleeve outer layer, as-supplied property				
As for Data Sheet 2B, 2.2.2	As for Data Sheet 2B, 2.2.2	As for Data Sheet 2B, 2.2.2	As for Data Sheet 2B, 2.2.2	As for Data Sheet 2B, 2.2.2

3 Surface Preparation, Coating Application and Final Inspection / Testing

3.1 Surface Preparation

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
As for Data Sheet 3A, 3.1	As for Data Sheet 3A, 3.1	As for Data Sheet 3A, 3.1	As for Data Sheet 3A, 3.1	As for Data Sheet 3A, 3.1

3.2 Coating Application and Final Testing

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
3.2.1 FBE layer				
As for Data Sheet 3A, 3.2	As for Data Sheet 3A, 3.2	As for Data Sheet 3A, 3.2	As for Data Sheet 3A, 3.2	As for Data Sheet 3A, 3.2
3.2.2 Full layer				
As for Data Sheet 2B, 3.2.2	As for Data Sheet 2B, 3.2.2	As for Data Sheet 2B, 3.2.2	As for Data Sheet 2B, 3.2.2	As for Data Sheet 2B, 3.2.2

"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3

END OF DATA SHEET No 3C

FJC Data Sheet No. 3D
Fusion Bonded Epoxy Coating with PP Layer Applied by Wrapping, Flame Spraying or Extrusion. Intermediate Layer of PP Adhesive (for 3-Layer and Multi-Layer PP Linepipe Coating)

1 Coating Configuration

Epoxy layer	FBE: min. 350 μm, max. 500 μm
Ahesive (modified PP) layer	acc. to MPS/ITP
Total thickness	min. 3.0 mm

2 Coating Materials

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1.1 FBE material, raw material property				
as for Data Sheet 3A, 2.1.1	as for Data Sheet 3A, 2.1.1	as for Data Sheet 3A, 2.1.1	as for Data Sheet 3A, 2.1.1	as for Data Sheet 3A, 2.1.1
2.1.2 FBE material, processed (as-applied) property				
as for Data Sheet 3A, 2.1.1	as for Data Sheet 3A, 2.1.1	as for Data Sheet 3A, 2.1.1	as for Data Sheet 3A, 2.1.1	as for Data Sheet 3A, 2.1.1
2.2.1 PP adhesive material, raw material property				
Density	ISO 1183	according to PDS	not applicable	every batch
Particle size (for spraying)	According to PDS	according to PDS	not applicable	every batch
Melt flow index/rate	ISO 1133 or ASTM D1238	according to PDS	not applicable	every batch
Softening point (Vicat)	ISO 1306 or ASTM D1525	according to PDS	not applicable	every batch
2.2.2 PP adhesive material, as-applied property				
Tensile properties, room temperature	ISO 527 ASTM D638	Tensile strength ≥12 MPa elongation at break ≥500%	by agreement	not applicable
Flexural modulus	ASTM D790	≥450 MPa	by agreement	not applicable
2.2.3 PP material, raw material property				
Density	ISO 1183	>0.89 kg/dm^3	not applicable	every batch/lot
Melt flow index/rate	ISO 1133 or ASTM D1238	according to PDS	not applicable	every batch/lot
Softening point (Vicat)	ISO 306 or ASTM D1525	≥120°C	not applicable	every batch/lot
Melting point	ISO 3146	≥150°C	not applicable	by agreement
Thermo stabilisation	ASTM D3895	by agreement	by agreement	by agreement
2.3.4 PP material, as-applied property				
Hardness	ASTM D785 or ISO 868	≥60 Shore D	to be included	by agreement
Impact resistance	NF A 49-711	according to standard	to be included	not applicable
Izod impact, room temperature	ASTM D256	by agreement	by agreement	by agreement
Tensile properties, room temperature	ASTM D638	tensile strength at yield ≥20 MPa elongation at break ≥400%	to be included	by agreement
Indentation	NF A 49-711	max. 0.3 mm at 20°C max. 0.5 mm at 110°C	to be included	not applicable
Flexural modulus	ASTM D790 or ISO 178	≥700MPa	by agreement	not applicable
Brittleness temperature	ASTM D746	<-20°C	by agreement	not applicable
Thermal degradation resistance	NF A 49-711	≥100 days	to be included	not applicable
UV resistance	ISO 4892-2 or NF A 49-711	by agreement (ISO) or according to standard (NF)	by agreement	not applicable
Abrasion resistance	ASTM D4060 or DIN 53516	by agreement	by agreement	not applicable
Fungi resistance	ASTM G21	no growth	by agreement	not applicable
Bacteria resistance	ASTM G22	no growth	by agreement	not applicable

FJC Data Sheet No. 3D **Fusion Bonded Epoxy Coating with PP Layer Applied by Wrapping, Flame Spraying or Extrusion. Intermediate Layer of PP Adhesive (for 3-Layer and Multi-Layer PP Linepipe Coating) (Continued)**				
Water absorption	ASTM D570	<0.5% per 24 hours	by agreement	not applicable
Water vapour permeability	ASTM E96	<0.1 g/m^2 per 24 hours	by agreement	not applicable
Thermal conductivity	ASTM C518	by agreement	by agreement	not applicable
Volume resistivity	ASTM D257	≥10^{13} ohm cm	by agreement	not applicable
Electrical insulation capacity	NF A 49 –711	≥10^8 ohm cm^2	by agreement	not applicable
Dielectric strength	ASTM D149	≥25 kV/mm	by agreement	not applicable
3 Surface Preparation, Coating Application and Final Inspection / Testing				
3.1 Surface Preparation				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
as for Data Sheet 3A, 3.1	as for Data Sheet 3A, 3.1	as for Data Sheet 3A, 3.1	as for Data Sheet 3A, 3.1	as for Data Sheet 3A, 3.1
3.2 Coating Application and Final Testing				
Item/Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
3.2.1 FBE layer				
as for Data Sheet 3A, 3.2	as for Data Sheet 3A, 3.2	as for Data Sheet 3A, 3.2	as for Data Sheet 3A, 3.2	as for Data Sheet 3A, 3.2
3.2.2 Adhesive layer				
Thickness	according to ITP	according to ITP	to be included	by agreement
3.2.3 PP layer and full layer				
Coating material and pipe temperatures	according to MPS/ITP	according to ITP	to be included	continuous monitoring (pipe temperature before FBE application)
FJC temperature after water quenching	according to ITP	according to ITP	to be included	continuous monitoring
General appearance of coating	visual	according to ITP	to be included, 100% surface area	every FJ and repair
Parent coating overlap	ruler	min. 50 mm or by ageement	to be included	every FJ and repair
Holiday detection	NACE RP0274, 10 kV/mm nominal thickness, max. 25 kV, 200-300 mm/s or NF A 49-711	no holidays	to be included, 100% surface area	every pipe, 100% surface area (visual/accoustic alarm function)
Thickness	according toMPS/ ITP	according to purchase order and ITP	to be included,	every FJ and repair
Adhesion to steel substrate (peel strength), at 100°C	NF A 49-711, E.3 or DIN 30670/30678 or EN 12068, Annex C or other agreed procedure	>40 N/cm, no peeling of FBE layer	to be included	by agreement
at 115°C (if max. operating temperature is between 100 and 115°C)		>20 N/cm, no peeling of FBE layer	to be included (if applicable)	by agreement
at max. operating temperature, if larger than 115°C		to be agreed (if applicable)	to be included (if applicable)	by agreement
Adhesion to parent coating at 100°C	NF A 49-711, E.3 or DIN 30670/30678 or EN 12068, Annex C or other agreed procedure	>40 N/cm	to be included	by agreement
at max. operating temperature, if larger than 100°C		to be agreed (if applicable)	to be included (if applicable)	by agreement
Hardness	ISO 868	≥60 Shore D	to be included	not applicable
Impact resistance, at room temperature	NF A 49-711 or DIN 30670/30678 or EN 12068, Annex H or other agreed procedure	no indication by holiday detection (see above) after impact of 9 Nm per mm coating thickness	to be included	first pipe and start/lead pipe [1], or by agreement
at max. operating temperature,		by agreement	by agreement	not applicable

FJC Data Sheet No. 3D **Fusion Bonded Epoxy Coating with PP Layer Applied by Wrapping, Flame Spraying or Extrusion. Intermediate Layer of PP Adhesive (for 3-Layer and Multi-Layer PP Linepipe Coating) (Continued)**				
Indentation resistance, at 23°C and at 110°C at max. operating temperature, if higher than 110°C	NF A 49-711 or DIN 30670/30678 or EN 12068, Annex G or other agreed procedure	 max. 0.10 mm, 23°C max. 1.0 mm, 110°C to be agreed	to be included to be included	first pipe for each PP batch by agreement
Tensile properties, at room temperature at max. operating temperature	ASTM D638 or ISO 527 or NF A 49-711	UTS ≥ 20 MPa, elongation ≥ 400% by agreement	to be included by agreement	first pipe for each PP batch not applicable
Cathodic disbonding, at 65°C at 95°C (if max. operating temperature is between 65 and 95°C) at max. operating temperature, if higher than 95°C	EN 12068, Annex K or other agreed procedure	max. 7 mm disbonding after 48 hrs	to be included by agreement by agreement	by agreement by agreement by agreement
Hot water soak test	GBE/CW6 Part 1, App. E (modified, cut edges freely exposed) or agreed procedure	max. 4 mm disbonding, 7 days at 80°C	to be included	by agreement
Thermal degradation resistance	EN 12068, Annex E	by agreemennt	by agreemennt	by agreemennt
Full scale bending test, at room temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, see 5.2.12)	by agreement	not applicable
at installation temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, and at 5°C below min. installation temperature, see 5.2.12)	by agreement	not applicable
Insulation capacity (Full scale test)	by agreement	by agreement	by agreement	not applicable
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

END OF DATA SHEET No 3D

FJC Data Sheet No. 4: Polychloroprene (or "Vulcanised Rubber") Coating

1 Coating Configuration

Primer	Type and thickness according to ITP
Polychloreprene	Thickness to be agreed (typically as for linepipe coating)

2 Coating Materials

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1 Primer material				
According to ITP	according to ITP	according to ITP	to be included	every batch/lot
2.2 Polychloroprene material				
Rheometer curve	ASTM D2084	according to ITP	to be included	every batch/lot
Hardness	ISO 7619 or ASTM D2240	56-68 Shore A	to be included	every batch/lot
Density	ISO 2781 or BS 903 Part A1	1.40 – 1.70 kg/dm^3	to be included	every batch/lot
Tensile strength	ISO 37	min. 11 MPa	to be included	1/20 batch/lot or by agreement
Elongation at break	ISO 37	min. 350%	to be included	1/20 batch/lot or by agreement
Compression set	ISO 815	max. 20% at 60°C or max. 30% at 70°C	to be included	1/20 batch/lot or by agreement
Tear strength	ISO 34	min. 20 N/mm	to be included	by agreement
Accelerated ageing	ISO 188	according to ITP/MPS	to be included	not applicable
Ozone resistance	ISO 1431 or ASTM D1149	by agreement	by agreement	not applicable
Seawater absorption	ISO 1817	by agreement	by agreement	not applicable
Abrasion resistance	DIN 53516	by agreement	by agreement	not applicable
Volume resistivity	ASTM D257	by agreement	by agreement	not applicable
Thermal conductivity	by agreement	by agreement	by agreement	not applicable
Penetration	ASTM G17	by agreement	by agreement	not applicable

3 Surface Preparation, Coating Application and Final Inspection / Testing

3.1 Surface Preparation

Properties	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
Initial surface condition	visual examination	free from surface contamination, temporary corrosion protection and defects	to be included	every pipe, 100% surface area
Pipe temperature and relative humidity	according to ITP	pipe temperature min. 3°C above dew point	to be included	minimum once per hour
Salt contamination after blast cleaning	ISO 8502-6	max. 20 mg NaCl/m^2	to be included	first pipe and every 10th pipe
Surface cleanliness	ISO 8501-1	A/B ≥ Sa 2 ½.	to be included	every pipe
Roughness	ISO 8503-2	grade Medium (G)	to be included	every pipe
Final surface condition	visual examination	free from surface defects	to be included	every pipe 100% surface area

3.2 Coating Application and Final Testing

Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
3.2.1 Primer Layer				
Ambient temperature and humidity	according to ITP	min. 15°C and max. 75%	to be included	every hour
Pipe temperature	according to ITP	min. 3°C above dew point	to be included	every hour
Surface appearance prior to coating	according to ITP	according to ITP	to be included	every FJ
Primer appearance	visual inspection	according to ITP	to be included	every FJ
Primer thickness	according to ITP	according to ITP	to be included	every 10th FJ
3.2.2 Polychloroprene layer				
Surface appearance prior to coating	according to ITP	according to ITP	to be included	every FJ

FJC Data Sheet No. 4: Polychloroprene (or "Vulcanised Rubber") Coating (Continued)				
Wrapping appearance (prior to vulcanising)	visual inspection	according to ITP	to be included	every FJ
Vulcanising temperature and pressure	according to ITP	according to ITP	to be included	every FJ, continuous monitoring and record-ing
Vulcanised coating appearance	visual inspection	according to ITP	to be included	every pipe, 100% surface area
Coating layer thickness	ISO 2187	according to ITP	to be included	every pipe, 3x4 locations (90° apart)
Holiday detection	BS 6374	according to ITP	to be included	every pipe, 100% surface area
Adhesion (peel strength) to steel substrate at room temperature at max. operating temperature	ISO 813 or BS 6374	according to ITP by agreement	to be included by agreement	by agreement not applicable
Adhesion to parent coating	to be agreed	to be agreed	to be agreed	not applicable
Hardness	ISO 7619 or ASTM D2240	according to ITP	to be included	by agreement
Bending resistance	by agreement	by agreement	by agreement	not applicable
Cathodic disbonding	by agreement	by agreement	by agreement	not applicable
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

END OF DATA SHEET No 4

7. ANNEX 2 Infill Data Sheets

Infill Data Sheet I: Asphalt Mastic				
1 Coating Configuration				
Mixture of asphalt and mineral aggregate, applied hot into permanently installed mould. Typical application: Medium and large diameter pipelines with asphalt or coal tar enamel corrosion coating and concrete weight coating on top				
2 Coating Materials				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1 Bitumen				
Content	according to MPS/ITP	according to MPS/ITP	by agreement	every batch/lot
Flash point	ISO 13736	min. 260°C	by agreement	every batch/lot
Density	BS 4147 Appendix C	according to BS4147 Table 6	by agreement	every batch/lot
Softening point	EN 1426	according to BS4147 Table 6	by agreement	every batch/lot
2.2 Filler and Aggregate				
Content(s)	according to MPS/ITP	according to MPS/ITP	by agreement	every batch/lot
Finess	according to MPS/ITP	according to MPS/ITP	by agreement	every batch/lot
3 Application and Final Inspection Testing				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
Application temperature	according to MPS/ITP	according to MPS/ITP	by agreement	every joint
Visual appearance	according to MPS/ITP	according to MPS/ITP	by agreement	every joint
Density	according to MPS/ITP	according to MPS/ITP	by agreement	by agreement
Full scale bending test, at room temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, see 5.2.12)	by agreement	not applicable
at installation temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, and at 5°C below min. installation temperature, see 5.2.12)	by agreement	not applicable
Impact resistance (full joint)	by agreement	by agreement	by agreement	not applicable
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

Infill Data Sheet II: Polyurethane (Solid or Foamed)				
1 Coating Configuration				
Mixture of liquid base and hardener, applied cold into permanently installed mould, with or without pre-application of a primer layer. Typical application: Small, medium and large diameter pipelines with various types of linepipe coating, with and without concrete weight coating on top.				
2 Coating Materials				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1 Polyol				
according to MPS/ITP	according to MPS/ITP	according to MPS/ITP	to be included	every batch/lot
2.2 Isocyanate				
according to MPS/ITP	according to MPS/ITP	according to MPS/ITP	to be included	every batch/lot
2.3 Aggregate				
according to MPS/ITP	according to MPS/ITP	according to MPS/ITP	according to MPS/ITP	according to MPS/ITP
3 Application and Final Inspection Testing				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
Mixing ratio	according to MPS/ITP	according to MPS/ITP	to be included	every joint
Injection pressure	according to MPS/ITP	according to MPS/ITP	to be included	every joint
Injection volume	according to MPS/ITP	according to MPS/ITP	to be included	every joint
Visual appearance	according to MPS/ITP	according to MPS/ITP	by agreement	every joint
Density	according to MPS/ITP	according to MPS/ITP	by agreement	by agreement
Full scale bending test, at room temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, see 5.2.12)	by agreement	not applicable
at installation temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, and at 5°C below min. installation temperature, see 5.2.12)	by agreement	not applicable
Impact resistance (full joint)	by agreement	by agreement	by agreement	not applicable
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

Infill Data Sheet III: Ultra Rapid Setting Concrete				
1 Coating Configuration				
Pre-mixture of cement with filler or aggregate such as sand, gravel and/or reinforcing fibres. Water added just prior to application. Injected without pre-heating into re-usable muld Typical application: Medium and large diameter pipelines with asphalt/ coal tar enamel or epoxy corrosion coating and concrete weight coating on top				
2 Coating Materials				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1 Pre-mixture				
Contents of solids	according to MPS/ ITP	according to MPS/ITP	to be included	according to MPS/ITP
Water addition	according to MPS/ ITP	according to MPS/ITP	to be included	according to MPS/ITP
3 Application and Final Inspection Testing				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
Visual appearance	according to MPS/ ITP	according to MPS/ITP	to be included	every joint
Setting time	to be agreed	according to MPS/ITP	to be included	according to MPS/ITP
Compressive strength	to be agreed	min. 5 N/mm^2 after 10 min min. 50 N/mm^2 after 1 day min. 70 N/mm^2 after 28 days	to be included	not applicable
Density	according to MPS/ ITP	according to MPS/ITP	to be included	by agreement
Full scale bending test, at room temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, see 5.2.12)	by agreement	not applicable
at installation temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, and at 5°C below min. installation temperature, see 5.2.12)	by agreement	not applicable
Impact resistance (full joint)	by agreement	by agreement	by agreement	not applicable
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

Infill Data Sheet IV: Polypropylene				
1 Coating Configuration				
Polypropylene extruded into re-usable mould. No FBE, LE or PU coating on steel substrate. Typical application: Small and medium diameter pipelines with multi-layer PP thermally insulating coating.				
2 Coating Materials				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			Coating Material Qualification	*Production*
2.1 PP material, raw material properties				
	as for FJC Data Sheet 2B, 2.2.3	as for FJC Data Sheet 2B, 2.2.3	as for FJC Data Sheet 2B, 2.2.3	as for FJC Data Sheet 2B, 2.2.3
2.1 PP material, as-applied property				
	as for FJC Data Sheet 2B, 2.2.4	as for FJC Data Sheet 2B, 2.2.4	as for FJC Data Sheet 2B, 2.2.4	as for FJC Data Sheet 2B, 2.2.4
3 Application and Final Inspection Testing				
Item / Property	*Test method*	*Acceptance criteria*	*Frequency*	
			PQT	*Production*
Visual appearance	according to MPS/ ITP	according to MPS/ITP	to be included	every joint
Hardness	ISO 868	≥60 Shore D	to be included	not applicable
Indentation resistance, at 23°C and at 110°C	NF A 49-711 or DIN 30670/30678	max. 0.10 mm, 23°C max. 1.0 mm, 110°C	to be included	first pipe for each PP batch
Full scale bending test, at room temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, see 5.2.12)	by agreement	not applicable
at installation temperature	by agreement	by agreement; (e.g. no cracking or disbonding at strain exceeding max. strain during installation by 30%, and at 5°C below min. installation temperature, see 5.2.12)	by agreement	not applicable
Impact resistance (full joint)	by agreement	by agreement	by agreement	not applicable
"according to ITP", "to be included", "to be agreed" and "by agreement" are explained in 5.3.3				

8. ANNEX 3 Specification of Amendments and Deviations

Table 8-1 Example of Purchaser specification of amendments and/or deviations to "Common Requirements" in Sec. 1 and 5 of this RP, see 1.3.6

Ref. to paragraph.	*Item / Property*	*Amendment or Deviation*	*Description*
1.3.2	FBE layer thickness	Amendment	Min. thickness 250 μm, max. thickness 450 μm
1.3.2	Full layer thickness	Amendment	Min. thickness 3.0 mm (2.7 mm allowed on girth weld)
1.3.2	FJC/parent coating overlap	Amendment	Minimum 50 mm overlap of parent coating
5.2.1	PQT	Amendment	Minimum 3 field joints and 3 full layer CFRs shall be coated and successfully tested. PQT to be carried out min. 6 weeks prior to start of production. Full PQT report to be submitted minimum 3 weeks prior to start of production. All individual operators to be qualified during PQT.
5.2.4	PQT/production	Amendment	Automatic spraying of coating powders for FJC is required
5.3.2	ITP/MIP		A "MIP" shall be prepared (ref. Guidance Note to 5.3.2)
5.4.2	Coating materials	Amendment	Purchaser list of approved products shall apply

Table 8-2 Example of Purchaser specification of amendments and/or deviations to FJC / CFR (ANNEX 1 Data Sheet No. 3D) and to infill (ANNEX 2) data sheets of this RP, see paragraph 1.3.6.

CDS ref.	*Property or Test*	*Property / Test related to:*	*Amendment or Deviation*	*Description*
2.1.1	Infrared scan (FBE)	Coating material batch/lot	Amendment	Testing of each lot/batch to be included (EN 10474, 2.2). Each lot max. 10 tonnes
2.1.2	Water resistance (FBE)	Coating material qualification	Amendment	Compliance with GBE-CW6 Part 1, App. A to be certified
2.3.2	Hardness (PP)	Coating material batch/lot	Amendment	Testing of each batch/lot to be included (EN 10474, 3.1.B). ISO 868; 60 Shore D
3.1	Salt contamination	Production	Deviation	No testing required for production (i.e. PQT only)
3.2.3	Bending test (full layer)	PQT	Amendment	One coated field joint to be tested according to Purchaser procedure
3.2.3	Cathodic disbondment test	PQT	Amendment	Testing at 100°C/48 hours according to Purchaser approved procedure. Max. 7 mm disbondment.