

GENERAL SPECIFICATION

CORROSION

GS EP COR 420

External field joint coatings of pipelines

08	10/2012	Alignment with ISO 21809-3 – Approval of liquid product for onshore field joints
07	01/2011	Addition of requirements to avoid damages due to overheating during field joint coating application (§ 7.7)
06	10/2009	Removal of 1C type Change in Table 2 Addition of new requirements for HSS application Addition of salt contamination and dust level control
05	10/2008	Specification becomes limited to EP
00	10/2002	First issue
Rev.	Date	Purpose of the revision

Owning entity: DEV/TEC	Managing entity: DEV/TEC/COR
------------------------	------------------------------

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 2 of 29

Contents

1. Scope	4
2. Reference documents.....	4
3. Definitions of main parties involved.....	6
3.1 Company	6
3.2 Contractor	6
3.3 Manufacturer.....	6
3.4 Applicator	6
3.5 Inspector	6
4. Information to be supplied by the Company	6
5. Applicator's Obligations	7
5.1 Approval of coating method and products	7
5.2 Supply of coating products	7
5.3 Qualification of the coating systems	8
5.4 Qualification of Operators	9
5.5 Notification prior starting coating work.....	9
5.6 Other requirements	9
5.7 Acceptance certificates	10
6. Choice of field joint coatings	10
6.1 Types of field joint coatings	10
6.2 Possible choices of field joint coatings depending on plant applied tube coatings	10
6.3 Documents.....	11
7. Common requirements for application of field joint coatings	12
7.1 Preparation of the steel surface before coating	12
7.2 Preparation of the factory applied coating	13
7.3 Provisions before field coating application.....	13
7.4 Appearance of the coating	13
7.5 Inspection and testing	13
7.6 Additional mechanical protection.....	14

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 3 of 29

7.7	Potential damages to factory applied coatings during FJC application	14
7.8	Repair of field joint coating	14
7.9	Preliminary quality inspection	14
8.	Coatings from cold applied adhesive polymeric tapes or heat-shrinkable materials	15
8.1	General	15
8.2	Definition of the types of coating systems	15
8.3	Surface preparation	15
8.4	Application of the coating	15
8.5	Characteristics of the coatings applied	17
9.	Polypropylene based coatings	19
9.1	Definition of the types of coatings	19
9.2	Surface preparation	20
9.3	Application of the coating	20
9.4	Characteristics of the coatings applied	21
10.	Fusion-bonded epoxy powder coating (FBE)	24
10.1	Surface preparation	24
10.2	Application of the coating	24
10.3	Characteristics of the coatings applied	25
11.	Coatings from liquid epoxy (EP) or polyurethane (PUR) resins	26
11.1	Definition of the coatings	26
11.2	Surface preparation	27
11.3	Application of the coating	27
11.4	Characteristics of the coatings applied	27
12.	Coating repairs on job site	29

1. Scope

This specification covers the external field joint coatings applied for ensuring the continuity of anticorrosion to the steel surface which is left bare when plant coated seamless or welded pipes are joined by welding to constitute pipelines used for onshore or offshore oil, gas or water transportation. Parent pipe coating shall normally be in compliance with [GS EP COR 220](#), [GS EP COR 221](#), [GS EP COR 222](#) and [GS EP COR 225](#).

Pipelines coated with these types of coatings are protected by means of cathodic protection.

As requested in [ISO 13623](#), field joints shall be protected with a coating system which is compatible with the line pipe coating and allow satisfactory application under the predicted field conditions. The performance of field joint coating should ideally meet or exceed the factory applied coating on line pipes.

This specification defines the possible different types of coatings for buried and immersed pipelines as described in Table 1 as a function of the plant coating existing on the pipes as defined in Table 2.

The type(s) of field joint coating(s) accepted for a given project is/are specified in a Project Specification in reference with the codification given in the present document.

For examples:

- Polyethylene based heat shrinkable sleeves applied on liquid epoxy primer: Field joint coating type 1B
- Flame sprayed polypropylene applied on a FBE primer: Field joint coating type 3A.

In absence of a Project Specification or specific requirement in the tender or order, the field joint coating type(s) accepted are given in Table 2 as a function of the plant coating of tubes.

Except when otherwise stated in the present document, requirements of [ISO 21809-3](#) fully apply for the different types of field joint coatings.

For each of the field joint coating type, the present document specifies the minimum requirements for the following:

- Applicator's obligations
- Nature, description and composition of coatings
- Application of coatings
- Characteristics of coatings
- Qualification testing
- Pre-production and production testing and inspection.

Repairs of plant and field joint coatings are also addressed in the present document.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External field joint coatings of pipelines

Rev.: 08

Effective date: 10/2012

Page: 5 of 29

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
EN 10204	Metallic products - Types of inspection documents
ISO 11357-6	Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature
ISO 13623	Petroleum and natural gas industries - Pipeline transportation system
ISO 21809-3	Petroleum and natural gas industries – external coatings for buried or submerged pipelines used in pipeline transportation systems – Part 3: Field joint coatings.
ISO 8501-1	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8502 (Parts 3; 6; 9)	Preparation of steel substrates before application of paint and related products. Tests for the assessment of surface cleanliness - Parts 3; 6; 9
ISO 868	Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness)

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP COR 220	Three layer polyethylene external coating for pipelines
GS EP COR 221	Three layer polypropylene external coating for pipelines
GS EP COR 222	Fusion Bonded Epoxy (FBE) external coating for pipelines
GS EP COR 225	Polyethylene and Polypropylene coatings for bends and fittings

3. Definitions of main parties involved

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

3.1 Company

Total or its subsidiary or agent acting on its behalf shall be referred to herein as the "Company".

3.2 Contractor

The Company, or their agents, designated in the Contract as being the selected main Contractor for the job to be performed, i.e. pipelines laying operations, shall be referred to herein as the "Contractor".

3.3 Manufacturer

The Company which produces and sells the products used for the field joint coating shall be referred to herein as the "Manufacturer".

3.4 Applicator

The Company in charge of the field joint coating application and quality control which is eventually sub-contracted by the Contractor shall be referred to herein as the "Applicator".

3.5 Inspector

The Company's representatives or members from Company elected Inspection Bodies for the time being or from time to time duly appointed in writing by the Company to act as its representatives for the purpose of the Contract shall be referred to herein as the "Inspector".

4. Information to be supplied by the Company

The Company or his representative will state in his inquiry and order, by a Project Specification, the following information:

- Maximum operating temperature, minimum temperature if relevant
- Joints coated in accordance with this specification designated by reference to the temperature class
- Type(s) of coating(s) accepted in accordance with codification of Table 1 and requirements of Table 2
- More specific information on the type of coating material and application process, including approved Manufacturer and trade of product if needed
- Acceptability of repairs
- Maximum number and dimensions of repairs (if allowed)
- Repair procedure
- Type of test certificate when different from requirements of the present document

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 7 of 29

- Minimum thickness of the coating when different from requirements of the present document
- Overlap of the factory applied coating.

5. Applicator's Obligations

5.1 Approval of coating method and products

The Contractor shall, in his tender, submit the method of application and data sheets of all the coating materials selected by him for Company approval (field joint coating and coatings repair), in accordance with the present General Specification and the specific requirements given in the Project Specification, the tender or the order.

Once approved, the coating products and method shall not be changed by the Applicator without prior written authorisation of the Company.

The approval decision shall not in any case be considered as a guarantee from the Company with respect to the coating material but as most as an authorisation for use.

The time necessary for the various operations related to surface preparation, heating, coating application and testing shall be defined by Applicator and checked and approved by Contractor in order to suit with the pipeline laying operations.

5.2 Supply of coating products

The Contractor shall obtain through the Applicator from the Manufacturer(s) and submit to Company:

- The guarantee that the coating products delivered shall meet the required coating characteristics as set forth according to the specified methods
- Production test certificates for the coating products
- In case epoxy powder is used, one test certificate per batch, including respectively the test results as defined in the present document which shall be in conformity with the specified methods and acceptable values
- Standard Infra Red Scan of epoxy powder for each production batch
- Conditions of application of the coating products (field joint and repair of plant coating and field joint coating)
- Packaging and storage requirements of coating materials
- Marking on each packing of coating materials with mention of the following information:
 - Manufacturer's name
 - Name and complete identification of product including factory of origin
 - Reference to applicable coating standards
 - Production batch or cast number

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 8 of 29

- Date of production
- Limit date of use.

5.3 Qualification of the coating systems

Except if a written derogation is given by Company (for field proven coating systems as per Company's experience), the coating system, products, application process, equipment to be used for surface preparation and application of the coating system and personnel which execute the job shall be qualified, in the presence of a Company representative, based on a Procedure for Qualification Trial (PQT). These tests should be carried out either independently of a specific job or two months before production start up at the latest for a given job, and shall be organised jointly by the Contractor, the Applicator or the Manufacturer. Tests and acceptable results are those specified in the present document in the chapters related to the different field joint coating systems.

In all cases, Manufacturer(s) shall assist Applicator for ensuring the right use of the coating product(s) and train the personnel. It shall also fully endorse application procedures written by Applicator by a written statement.

- The procedure to be used shall be submitted to Company for approval before PQT.
- Operators should be already familiar with the field joint coating type application.
- PQT shall be carried out on pipes having the same diameter and the same thickness that the actual pipes.
- Tests shall be carried out on test zones distributed along an actual pipe coated with the same process as the other pipes. The length of the test zones should be equivalent to the field joint coating length.
- A girth cap weld shall be added at the centre of each of the test zones in order to mimic the field weld.
- All equipment (induction heating, abrasive blasting, coating application equipment and also inspection equipment and tools) used for PQT shall be the same as the equipment which will be used for the actual field joint coating.
- **The time for coating application on a test zone shall not exceed the estimated field joint coating time on yard or on the barge.**
- **After pqt, the time for each step of the application procedure shall be established. These time data shall then be used as process control during field joint application offshore. In no case application offshore shall be quicker than the time established during pqt.**
- If PQT is related to the field joint coating type 3A, coating samples shall be collected to measure the Oxygen Induction Time.
- In all cases, ageing tests shall be performed at PQT stage, in order to assess the durability of proposed solution and application procedure. Testing shall be as follow: 28 days soak test in deionized water at 60 and 80°C or max operating temperature of samples taken from field joint. Location of sample shall be as follow: at weld seam and at overlap with parent coating. After 2 days test, samples shall be visually inspected for any

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 9 of 29

type of disbondment (to be reported in a specific report), plus adhesion test to be carried out on both location. Results to be reported in a specific report. Typically, adhesion shall be no less than 70% of initial value and no visible disbondment shall take place. In any case, full test procedure shall be submitted to Company for approval.

The Contractor, Applicator or Manufacturer shall submit a complete report of the PQT results to the Company for approval at least one month before production start up.

5.4 Qualification of Operators

The personnel who will apply the field joint coating system and the repair products have to be individually qualified, through a Certification scheme (or during PQT). Technical assistance from the Manufacturer shall be ensured for training of personnel and verification of their qualification for a correct application of their product.

Contractor or Applicator shall not replace the qualified Applicators without informing Company. A new qualification test shall be organised for the new Applicators and at the Contractor's expense.

5.5 Notification prior starting coating work

The Contractor shall notify the Company, at least eight working days before coating application, of the dates of coating execution to permit mobilisation of the Company designated Inspector.

Upon arrival at the field joint coating facilities, the Inspector shall receive from the Contractor/ Applicator the documents supplied by the Manufacturer as specified in § 5.2.

5.6 Other requirements

The Contractor/Applicator shall supply all personnel, coating material and repair products, equipment, application material and inspection apparatuses.

The Applicator shall store the coating materials and repair products, perform coating application and inspection in conformity with the present document and all the relevant rules of practice.

The Inspector shall have free access to the field coating site. The Contractor shall provide the Inspector with all the facilities necessary for the proper execution of his mission. He will provide accommodation to him in case of offshore or remote locations.

Manufacturer shall send a representative on site at start of coating application (PPT) to ensure:

- Proper application of its product by Applicator (i.e. according to PQT procedure endorsed by all parties)
- Proper qualification of all Operators
- Test results and overall quality in accordance with this standard (and PQT).

Manufacturer shall send a representative for full supervision of all field joint activities offshore and onshore during production.

It shall be demonstrated by Contractor at PQT stage that all laying constraints have been considered and will not be detrimental to the quality of the applied field joint coating. Such constraints can be mechanical damages by stinger rollers and the likes.

5.7 Acceptance certificates

The Contractor and the Applicator shall sign jointly with the Inspector the field joint coating acceptance certificates including the results of all tests and inspection as set forth in this specification.

The acceptance certificates shall certify that all tests and inspections have been performed by the Applicator under the responsibility of the Contractor and have been witnessed by the Inspector.

One copy of the acceptance certificates shall be transmitted to Company and one copy to the Inspector.

6. Choice of field joint coatings

6.1 Types of field joint coatings

The coatings of joints concerned by this document are classified into major types according to Table 1 which gives a code for each of them. Any other coating system may be subjected to Company's approval based on a documented file containing results of qualification tests carried out by third party laboratories.

Table 1 - Types of coating

Code	Type of coating
1A	Heat-shrinkable materials, polyethylene based
1B	Heat-shrinkable materials, polyethylene based, applied over a liquid epoxy primer
1D	Heat shrinkable materials, polypropylene based, applied over a liquid epoxy primer
2	Cold-applied polyethylene or polyvinylchloride plastic tapes
3A	Flame-sprayed polypropylene applied over an epoxy primer
3B	Chemically modified polypropylene tapes hot- applied over a fusion-bonded epoxy powder primer
3C	Injection applied polypropylene
4	Fusion-bonded epoxy powder
5 ^a	Liquid epoxy resin
6 ^a	Liquid polyurethane

a The epoxy resins and polyurethanes cover the tar-epoxy and the polyurethane bituminous or other modifications.

6.2 Possible choices of field joint coatings depending on plant applied tube coatings

The nature and the characteristics of the plant applied coating shall be known to the Applicator.

In absence of particular requirements concerning the accepted coating(s) type(s) for a given project specified in a Project Specification, in the tender or in the order, the accepted type(s) of field joint coating(s) are given in Table 2 under the symbol ▲. Any other solution shall be submitted to the written approval of Company and should belong to combinations given in Table 2 with the symbol X.

**Table 2 - Types of field joint coatings
as a function of plant applied coatings used on pipes**

Type of plant applied coating	PE Shrinkable sleeves (1A)	Liquid epoxy + PE Shrinkable sleeves (1B)	Liquid epoxy + PP Shrinkable sleeves (1D)	Cold-applied PE or PVC plastic tapes (2)	Polypropylene based coatings (3A, 3B, 3C)	Epoxy powder (4)	Liquid epoxy resin (5)	Liquid polyurethane (6)
3-layer polyethylene coating (onshore application)		▲					▲	▲
3-layer polypropylene coating (onshore application)			▲		▲		▲	X
3-layer polyethylene coating (offshore application)		▲					X	X
3-layer polypropylene coating (offshore application)		▲	▲		▲		x	x
Bituminous coatings	▲			▲				▲
Epoxy powder						▲	X	X

6.3 Documents

6.3.1 Information for the Applicator

Information concerning the coating materials is given by Manufacturer's data sheets. It shall be in accordance with [ISO 21809-3](#) requirements.

The minimum content of a data sheet required is indicated in the chapters related to the different field joint coating systems of [ISO 21809-3](#).

6.3.2 Test certificates for the coating

Inspection operations shall be carried out as agreed between Company and Applicator at the time of enquiry and order. The inspection documents should be in accordance with [EN 10204](#).

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 12 of 29

7. Common requirements for application of field joint coatings

7.1 Preparation of the steel surface before coating

7.1.1 General

Surface preparation shall be carried out in accordance with the recommendations of the Manufacturer and the present specification.

The surface to be coated shall be, at the time of application of the coating, dry and free of any contamination (such as former coating, paint and non adhering particles, grease and oil, salt, etc.) detrimental to surface preparation or to adhesion of the coating on the steel.

If appropriate, cleaning shall be carried out to remove the following in particular:

- Greasy substances (using a totally volatile solvent, as required) or other contamination such as soluble salts
- Weld spot, slag, burrs that can pierce the coating (by grinding or filing); areas of rust or scaling shall be treated in the same way.

7.1.2 Abrasive blast cleaning

Abrasive blast cleaning is carried out to obtain a surface condition which corresponds at least to the quality of surface preparation Sa 2 1/2 defined in [ISO 8501-1](#).

The cleaned surface shall have a roughness of at least 50 microns in Ry5. It is measured according to a method given in the coating application and repair procedure.

After abrasive blast cleaning, the surface of the joints shall be inspected. All slivers, laminations, weld spot and other surface imperfections made visible by the cleaning and which are detrimental to the quality of coating are removed, by agreement with the Company.

After removal of these imperfections, the residual thickness of the steel shall satisfy the minimum tolerance requirements of the tube standard.

7.1.3 Brush cleaning

Oxidation and rust are removed by mechanically using rotary steel brushes or any other appropriate means, which do not affect the quality of the item to be coated. The dust created by this operation shall be removed efficiently.

After cleaning, the appearance of the steel shall comply with surface condition St 3 of [ISO 8501-1](#). The surface shall have a roughness as specified by the Manufacturer. It is measured according to a method given in the coating application and repair procedure.

7.1.4 Surface cleanliness

Dust level as per [ISO 8502-3](#), maximum level of 2.

Salt contamination: As per [ISO 8502-6](#) and [ISO 8502-9](#), or alternatively, SMC400 method: 2 micrograms per square centimetre maximum.

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 13 of 29

7.1.5 Reconditioning

If, after preparation of the surface of the joint to be coated, it is contaminated or covered in rust, the joint shall undergo further partial or total surface preparation in order to be able to apply the coating that corresponds to all aspects of the provisions of this document.

7.2 Preparation of the factory applied coating

The factory applied coating area close to the field joint to be coated shall be prepared to facilitate the adhesion of the field joint coating and prevent any cracking or disbondment due to aging of adhesion. The method is described in the chapters treating the different coating systems.

7.3 Provisions before field coating application

The temperature of the joint shall be at least 3°C above the dew point.

Before applying the coating, the surface of the joint shall be cleaned of any residual dust by a method given in the coating application and repair procedure. Any chloride contamination detrimental to the bonding of coating to steel shall be prevented.

Any conversion chemical pre-treatment of the steel to supplement the surface preparation is subject to CPY approval.

The coating of the joint is applied by qualified personnel, in accordance with the specified procedure qualified by the Company.

Induction heating equipment for pipe pre heating is mandatory. No heating by gas torch is accepted.

The joint shall not be exposed to high temperature conditions which could result in oxidation of its surface, detrimental to the quality and adhesion of the coating.

At the time of application, the temperature at the surface of the joint shall be within the temperature range specified by the Manufacturer. The temperature of the joint shall be monitored using suitable means in order to make sure that the application conditions are fully satisfied (steel substrate and plant applied coating).

During bad weather (rain, wind, etc.) cleaning operations may only continue if effective protective awnings are installed.

7.4 Appearance of the coating

During the visual inspection, the appearance of the coating applied shall be homogenous across the entire surface, in particular no surface defects detrimental to the quality of the coating (grit, foreign particles, pitting, blisters, etc.) shall be observed.

7.5 Inspection and testing

For each field joint coating project, a Pre-Production Trial (PPT) shall be carried out on site in actual conditions of pipe, plant-coating, equipment, material and personnel before commencement of the job. In addition, a Production Testing programme shall be implemented to verify the conformity of quality during execution of the job.

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 14 of 29

Procedures, frequency and acceptable results of testing and inspections during PPT and Production Testing are indicated in the chapters related to the different field joint coating systems.

Manufacturer shall send a representative for full supervision of all field joint activities offshore and onshore during production.

7.6 Additional mechanical protection

Additional mechanical protection may be used as required in the Project Specification (e.g. rockshield or infill of concrete coated pipes). It is not covered in this document.

7.7 Potential damages to factory applied coatings during FJC application

When the steel and/or factory applied coating needs to be heated up to or above 100°C during manufacture of the FJC, the following requirements shall apply:

- Heat protection shall be installed over the factory applied coating during steel heating to avoid any degradation or waxing of the factory applied coating.
- During the heating process of the steel and factory applied coating, the temperature shall be closely monitored (at PQT, PPT and during production) to ensure that the interface FBE-steel of the factory applied coating is always below 100°C. The temperature of the top coat shall also remain below the wax or melt formation temperature.
- During PQT, PPT and production, a close inspection of the overlap areas on the factory applied coating and its vicinity shall be performed to ensure that no disbondment, blisters, bubbles, wrinkles, melting or any other kind of physical or visual degradation appears on the factory applied coating due to FJC application process (and specifically overheating). As a minimum, a simple method such as a tapping test shall be performed in the sensitive areas at all stage (PQT, PPT, production) to monitor any voids or bubbles or blister formations. NO DEGRADATION, DISBONDMENT, BLISTER, WRINKLES, BUBBLES OR ANY KIND OF VISUAL DEGRADATION ARE ALLOWED AT ANY TIME.

7.8 Repair of field joint coating

The acceptability of field joint coating repair and the repair procedure is subject to agreement between the Company and the Applicator.

7.9 Preliminary quality inspection

The Applicator shall make sure that:

- The products comply with the specification
- The storage instructions are followed.

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 15 of 29

8. Coatings from cold applied adhesive polymeric tapes or heat-shrinkable materials

8.1 General

Information concerning the coating materials is given by the Manufacturer. The information has to be in accordance with [ISO 21809-3](#) requirements.

An APS (Application Procedure Specification) shall be provided in accordance with chap 7.1 of [ISO 21809-3](#), taking into account the specific requirements of this General Specification. The minimum overlap of tapes and shrinkable materials on factory coating shall be at least 50 mm.

8.2 Definition of the types of coating systems

Type 1 of field joint coatings: Coatings from polyolefin-based heat-shrinkable materials include either a polyethylene (**Types 1A, 1B**) or polypropylene (**Type 1D**) based backing with an adhesion coating on one side.

The heat-shrinkable materials come in one of the forms of the following:

- Tubular sleeve
- Wrap around sleeve
- Pre-formed material (assembly for complex configuration parts).

Heat-shrinkable materials are applied without a primer (**Type 1A**) or with a liquid epoxy primer (**Type 1B and 1D**), depending on the nature of adhesive, the use and the practical possibilities (see Table 2).

Type 2 of field joint coatings: Cold applied adhesive polymeric tape coatings generally include a bonding primer and one or several plastics tapes made of polyethylene or PVC. They are generally composed of a layer of anti-corrosion tape and a layer of mechanical protection tape.

8.3 Surface preparation

Surface preparation shall be carried out in accordance with the recommendations of the Manufacturer. The minimum requirement is that the area to be coated has to be cleaned with a powered wire brush until a degree of cleanliness St 3 is achieved. The edges of the wrapping shall be beveled with a fine file and a length of 50 mm (± 5 mm) of the plant applied coating shall be roughened to guaranty a good adhesion of the field joint coating.

Abrasive blast cleaning to a quality of surface preparation Sa 2 1/2 as defined in [ISO 8501-1](#) and roughness Ry5 50 microns minimum is **mandatory for coatings Types 1B and 1D and for high operating temperature (> 50°C)**, whatever the coating type.

8.4 Application of the coating

8.4.1 Application of the primer

Application of the (eventual) primer shall be carried out in accordance with the recommendations of the Manufacturer and chap 7.1 of [ISO 21809-3](#).

For liquid primers, the supply shall be in pre-packed/pre-measured kits and not in bulk.

8.4.2 Application of heat-shrinkable sleeves

As a general guide, the following procedure shall be adhered to:

- Before welding, position an adhesive polyethylene shrinkable sleeve just beside the weld or use an open type shrinkable sleeve.
- After welding, clean the area with the approved cleaning method.
- Preheat the area to be coated to a temperature adapted to the material (about 70°C for Types 1A and 1B).
- Position the sleeve so as to provide a 50 mm overlap, on both sides, on the sound coating when shrinking is completed.
- By external side heat sleeve to a surface temperature adapted to the specific product to be applied (from 90 to 240°C) with a hot air ring unit or a gas torch. Heat progressively and regularly, starting from the middle of the sleeve and going towards the ends to avoid forming air pockets.
- The closure tape application shall be carefully monitored. After cool down, it shall be demonstrated that no shear has happened at this specific location nor any slippage of the overlap of both ends of the heat shrinkable sleeve underneath the closure tape has taken place.

8.4.3 Application of cold applied tapes

As a general guide, the following procedure shall be adhered to:

- After welding, clean the area with the approved cleaning method
- Apply a thin coat of compatible primer (if any), allow the primer to dry enough
- Spirally wrap the area with tapes of an adequate width, employing the right overlap and using sufficient tension to ensure a complete conformability of the coating. A manual application tool shall be used to achieve these goals. Cigarette wrapping may be used in certain circumstances (in particular for offshore laying on a conventional barge).

The minimum overlap from tape to tape while spiral wrapping the tape is given in Table 3. The Applicator shall always respect the overlap given by the Manufacturer if it results in overlap greater than that given below.

The width of the material used depends on the diameter of the tubes. For all types of manual application, an appropriate width should be chosen to avoid folding the material which would occur if the material was too wide.

Table 3 - Overlap of tapes

Tape width	Overlap
< 50 mm	≥ 50%
≥ 50 mm	≥ 25 mm

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 17 of 29

8.5 Characteristics of the coatings applied

The tests detailed below shall be carried out, either for qualification (PQT) or during Pre-production trial (PPT) or for Production testing. They are summarised in Table 4. Other tests like impact resistance, indentation at ambient and maximum operating temperature, electrical insulation resistance, lap shear strength, resistance to thermal ageing and to UV radiation, etc. have also to be carried out for Qualification. For these tests, methods and acceptable values are those of [ISO 21809-3](#).

8.5.1 Thickness

The minimum value of the thickness of the coating measured on the body shall be not less than 90% of the nominal thickness agreed by the Company. The nominal thickness is the calculated sum of the thickness of all the layers of the coating before application.

The minimum value measured on top of the weld bead shall be not less than 75% of the nominal thickness.

Thickness shall be measured as follow: On both sides of the weld, make measurement with appropriate and calibrated device, around a circumference in 4 equally spaced location. In case one measurement is below the specified and agreed value, make 4 new measurements in the vicinity of failed measurement, and calculate arithmetic average of these 4 measurements + the failed one. If below requirement, then it will be considered as failure.

4 measurements shall be taken separately over the weld seam, equally spaced around the pipe. If arithmetic average below the specified and agreed value for weld seam, it shall be considered as a failure.

Note: The thickness on the weld bead is normally less than the thickness on the body because part of the polymeric adhesive flows during and after the application from the weld bead to the body. This effect is necessary in order to avoid voids and it is not detrimental for the corrosion protection.

Table 4 - Testing of tapes or shrinkable materials

Properties	§	Method of testing	Frequency	
			PQT and PPT ^a	Production
Visual inspection of the cleaned surface	7.1	ISO 8501-1	3 joints	Each joint
Roughness	7.1	Testex tape	3 joints	Once per shift
Salt contamination	7.1	SMC400	1 joint	Once per shift
Dust level	7.1	ISO 8502-3	1 joint	Once per shift
Temperature of the surface to be coated	7.3	-	3 joints	Each joint
Visual inspection of the coating	7.4	-	3 joints	Each joint
Inspection of thickness	8.5.1	ISO 21809-3 Annex A	3 joints	Once per shift
Holiday detection test	8.5.2	ISO 21809-3 Annex B	3 joints	Each joint
Peel strength test at ambient temperature	8.5.3	ISO 21809-3 Annex D	3 joints (D1 and D2 resp)	^b
Peel strength test at maximum operating temperature	8.5.3	ISO 21809-3 Annex D	3 joints (D1 and D2 resp)	
Cathodic disbonding at ambient temperature	8.5.4	ISO 21809-3 Annex F	3 joints (28 days for PQT only)	
Cathodic disbonding at maximum operating temperature	8.5.4	ISO 21809-3 Annex F	3 joints (PQT only)	

a All the tests in this column should be carried out every three years for every type of coating (see Table 1) and technical process.

b During production, proper application shall be checked as follow: A qualitative adhesive test shall be performed on both sides of the overlap area. Hand-peeling shall be performed on a 2 cm strip or so, in order to assess a cohesive peel takes place within the adhesive layer. The test shall be performed during PQT and PPT for agreement by all parties. The frequency of the test shall be at CPY inspection discretion and at least at start of production or in case of long production stop. It is acceptable not to repair the peel strip. Proper peel test with Table 5 acceptance criteria to be performed during PQT.

8.5.2 Holiday detection

The absence of holidays on the entire surface of field joint coating is checked at a voltage of 5 kV/mm + 5 kV at a maximum of 15 kV. No holidays are allowed unless otherwise agreed between Company and Contractor/Applicator.

8.5.3 Peel strength

The minimal waiting period between application of the coating and the peel force test is 48 hr for heat-shrinkable materials and 72 hr for cold applied tapes.

The test shall be carried out according to the method D1 (qualification) and D2 (production) defined in Annex D of ISO 21809-3.

The peel strength on the steel of the coated joint shall be greater than the values given in Table 5 for ambient temperature and maximum operating temperature.

The peel strength on the plant coating and the peel strength between the different coats of tapes shall be greater than 75 N/50 mm at ambient temperature and greater than 10 N/50 mm at maximum operating temperature.

Table 5 - Minimum values for peel strength and cathodic disbonding tests

Coating type	Peel resistance (N / 50 mm)	Peel resistance (N / 50 mm)	Cathodic disbonding (radius mm)	Cathodic disbonding (radius mm)
	Ambient T	Max. T	Ambient T	Max. T
Coatings from heat shrinkable materials (Type 1A)	> 100	> 20	< 10 (28 days) < 7 (48 hr at 65°C)	< 15 (28 days)
Coatings from PE heat shrinkable materials on liquid epoxy primer (Type 1B)	> 250	> 30	< 8 (28 days) < 5 (48 hr at 65°C)	< 12 (28 days)
Coatings from PP heat shrinkable materials on liquid epoxy primer (Types 1D)	> 400	> 80	< 7 (28 days) < 5 (48 hr at 65°C)	< 10 (28 days)
Coatings from polymeric tapes (Type 2)	> 50	> 15	< 12 (28 days) < 10 (48 hr at 65°C)	< 20 (28 days)

8.5.4 Cathodic disbonding

The test shall be carried out according to the method defined in Annex F of [ISO 21809-3](#). Duration of 48 hr instead of 28 days is used for PPT with temperature increased to 65°C. Duration of 28 days and 48 hours is mandatory for PQT.

The cathodic disbonding radius on the steel of the coated joint shall be less than the values given in Table 5 for ambient temperature (28 days), 65°C (48 hr) and maximum operating temperature (28 days).

9. Polypropylene based coatings

See also § 7.7 for specific requirements.

9.1 Definition of the types of coatings

9.1.1 Coatings from flame spray polypropylene (Field joint coating type 3A)

It consists of the application of a powder epoxy resin primer coat, covered with a coat of modified polypropylene powder applied by spraying or flame spraying.

This coating type shall follow the requirements of [GS EP COR 225](#).

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 20 of 29

9.1.2 Coatings from hot applied chemically modified polypropylene tapes (Field joint coating type 3B)

It consists of the application of a powder epoxy resin primer coat, covered with a coat of chemically modified polypropylene powder applied by spraying and then the coating thickness is obtained by wrapping hot polypropylene tape either in a spiral way or in cigarette way.

9.1.3 Coatings from injection moulded polypropylene (Field joint coating type 3C)

It consists of the application of a powder epoxy resin primer coat, covered with a coat of modified polypropylene powder applied by spraying and then the coating thickness is obtained injecting polypropylene in a proper mould. Content of data sheet shall be in accordance with the requirements of [ISO 21809-3](#).

9.2 Surface preparation

The areas to be coated are prepared by abrasive blast cleaning only.

The factory applied coating area is dulled and cleaned in order to obtain the surface profile and cleanliness defined in § 7.1. At least 5 cm of the adjoining factory applied coating has to be cleaned and abraded to expose a fresh surface.

9.3 Application of the coating

The method of application shall be in accordance with the recommendations of the Manufacturer and chap 7.1 of [ISO 21809-3](#) including the specific requirements of this General Specification.

9.3.1 Heating of the area to be coated

The area to be coated is heated immediately after surface preparation up to the temperature required (from raw material Supplier), by induction heating.

The holding time and the temperature shall not:

- Result in oxidation of the surface of steel and of the coating detrimental to the quality of the coating of the joint
- Damage the factory applied coating (see also § 7.7).

9.3.2 Application of the epoxy primer

The epoxy primer is applied on the steel surface by spraying of the powder with a semi automatic electrostatic coating machine or special spray guns applying, by rotation around the pipe, 150 to 250 microns of fusion bonded epoxy powder coat. FBE thickness shall not exceed 500 microns in any single measurements. No FBE shall be applied on the pipe plant coating.

9.3.3 Application of the polypropylene top coat

The overlap on the factory applied coating, excluding bevels, shall not be less than 10 mm.

It shall be applied according to the system used:

- **Type 3A:** by flame spray in a controlled gaseous atmosphere; the chemically modified polypropylene powder is sprayed onto the surface to be coated preferably during the

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 21 of 29

primer gel time, but in any case before the primer is fully cured, to get a 2 to 2.5 mm thickness coat. The Applicator shall provide Company with the test results showing that they are able to meet the Company requirement related to the Oxygen Induction Time for the applied polypropylene which is 22 minutes $\pm$ 2 minutes at 220°C for 1 gram of sample under 350 mbar of oxygen. An adequate distribution of the polypropylene particles size is an important parameter for preventing heavy oxidation of the powder during application. The Applicator shall control the powder quality. Additional heat may be added during application of the polypropylene via low pressure hot air or gas flame heated guns.

- **Type 3B:** by wrapping a hot tape, either spiral wrap or cigarette wrap; a proper heating system has to be used to obtain a good welding on the factory applied coating and between the tape overlapping. Preheat the tape in an oven for one hour at 120-140°C, then the field joint area temperature shall be raised to approximately 240°C by induction heating. The pipe coating shall be protected by masking tapes during induction heating. Following the FBE application and before the gel time of the FBE has elapsed, the chemically modified polypropylene layer shall be applied. The thickness shall be 100 to 200 microns. The thickness along the longitudinal weld (if any) can be up to 400 microns. Wrap the field joint area with the preheated PP tape by means of a manually operated semi-automatic machine. The overlap between two successive layers shall be at least 66%. Sufficient runs of tape shall be applied to reach around 2.5 mm thick coating. The tape shall be wrapped with enough tension to avoid any fold or any trapping of air between tapes. The tape shall be heated with a torch. The green adhesive layer should be visible at the tape overlaps. The temperature control at this stage is essential for the adequate coating adhesion. With a hand held roller, gently apply pressure to the tape along the toe of the longitudinal weld (if any) at the intersection of the girth weld.
- **Type 3C:** by injection of molten polypropylene; a proper heating system has to be used to obtain a good welding on the factory applied coating.

9.4 Characteristics of the coatings applied

The tests detailed below shall be carried out after curing. They are summarised in Table 6.

External field joint coatings of pipelines

Rev.: 08

Effective date: 10/2012

Page: 22 of 29

Table 6 - Testing of polypropylene based coatings

Properties	§	Method of testing	Frequency	
			PQT and PPT ^a	Production
Visual inspection of the blast cleaned surface	9.3	ISO 8501-1	3 joints	Each joint
Roughness	7.1	Testex tape	3 joints	Once per shift
Salt contamination	7.1	SMC400	1 joint	Once per shift
Dust level	7.1	ISO 8502-3	1 joint	Once per shift
Examination of the dulled factory applied coating	9.3	Visual	3 joints	Each joint
Temperature of the surface to be coated	9.4.1	-	3 joints	Each joint
Application criteria	9.4		3 joints	Continuously
Visual inspection of the coating	7.4	-	3 joints	Each joint
Inspection of the thickness	9.4.1	ISO 21809-3 Annex A	3 joints	Each joint
Holiday detection test	9.4.2	ISO 21809-3 Annex B	3 joints	Each joint
Peel strength test at 90°C or maximum operating temperature if > 100°C	9.4.3	ISO 21809-3 Annex D	3 joints (D1)	-
Peel strength test at 90°C	9.4.3	ISO 21809-3 Annex D	-	One per shift (D2)
Degree of cure of epoxy layer	9.4.4	GS EP COR 220 Appendix 5	3 joints	-
Cathodic disbonding at ambient temperature	9.4.5	ISO 21809-3 Annex F	3 joints	-
Cathodic disbonding at maximum operating temperature	9.4.5	ISO 21809-3 Annex F	3 joints (PQT)	-
Impact resistance test	9.4.6	ISO 21809-3 Annex G	3 joints	-
Indentation resistance test at ambient temperature and 90°C	9.4.7	ISO 21809-3 Annex H	3 joints	-
Oxygen Induction Time (for type 3A)	9.4.8	ISO 11357-6	3 joints	-
Voids/Bubbles check (for type 3C)	9.4.9	Manufacturer's specific	3 joints	

^a All the tests in this column should be carried out every three years for every type of coating (see Table 1) and technical process.

9.4.1 Thickness

The minimum thickness of the coating is defined by agreement between Company and Contractor/Applicator and taking into consideration the thickness of the existing factory applied coating.

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 23 of 29

Thickness shall be measured as follows: On both sides of the weld, make measurement with appropriate and calibrated device, around a circumference in 4 equally spaced location. In case one measurement is below the specified and agreed value, make 4 new measurements in the vicinity of failed measurement, and calculate arithmetic average of these 4 measurements + the failed one. If below requirement, then it will be considered as failure.

4 measurements shall be taken separately over the weld seam, equally spaced around the pipe. If arithmetic average below the specified and agreed value for weld seam, it shall be considered as a failure.

9.4.2 Holiday detection

The voltage is defined according to the nominal thickness chosen. The entire surface is monitored at a voltage of 10 kV/mm with a maximum of 25 kV, according to the method defined in [ISO 21809-3](#) Annex B.

No holidays are allowed unless otherwise agreed between Company and Applicator.

9.4.3 Peel strength

The peel strength is measured at 90°C or at maximum operating temperature if it is higher than 100°C, in accordance with the methods defined in [ISO 21809-3](#) Annex D. The acceptable value is 200 N/50 mm at 90°C and 100 N/50 mm at maximum operating temperature if it is higher than 100°C

9.4.4 Degree of cure

The degree of cure of the primer in powder is determined by differential thermal analysis of a sample of primer taken from the joint.

The test is carried out according to the method defined in Appendix 5 of [GS EP COR 220](#).

The acceptance criterion is the value of ΔT_g of $\pm 3^\circ\text{C}$.

9.4.5 Cathodic disbonding

The test is carried out in accordance with the method defined in Annex F of [ISO 21809-3](#). Duration of 48 hr instead of 28 days may be used for PPT if temperature is increased to 65°C. Duration of 28 days and 48 hrs are mandatory for PQT.

The average disbonding shall not be more than:

- 7 mm after a period of 28 days at $23 \pm 2^\circ\text{C}$ (mandatory for PQT)
- 5 mm after a period of 48 hr at $65 \pm 2^\circ\text{C}$ (PPT only, mandatory for PQT)
- 10 mm after a period of 28 days at maximum operating temperature.

9.4.6 Impact resistance

The minimum impact energy, determined according to the method defined in Annex G of [ISO 21809-3](#) shall correspond to 7 J per mm of measured thickness of the coating.

This test shall be carried out at $20 \pm 5^\circ\text{C}$ and for diameters ≥ 100 mm.

After the impact test no holidays are allowed.

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 24 of 29

9.4.7 Indentation resistance

Indentation resistance shall be determined by testing in accordance with the method defined in Annex H of [ISO 21809-3](#). The maximum indentation is given in Table 7.

Table 7 - Indentation for polypropylene coating

Testing temperature	Indentation
23 ± 2°C	≤ 0.1 mm
90 ± 2°C	≤ 0.6 mm

9.4.8 Oxygen Induction Time

Shall be done for type 3A only, in accordance with [ISO 11357-6](#) at 220°C. The minimum acceptable value of the intercept in the tangent method shall be 15 min.

10. Fusion-bonded epoxy powder coating (FBE)

The fusion-bonded epoxy powder coating shall meet the qualification requirements defined in [ISO 21809-3](#) chapter 12, except when otherwise specified in this GS. The Application Procedure Statement shall be in line with [ISO 21809-3](#).

See also specific requirements in § 7.7.

10.1 Surface preparation

The areas to be coated are prepared by abrasive blast cleaning (see § 7.1.3).

The coating area is dulled and cleaned in order to obtain the surface profile and cleanliness described in § 7.1.

At least 5 cm of the adjoining factory applied coating has to be cleaned and dulled by brushing or blasting.

10.2 Application of the coating

The method of application should be in accordance with the recommendations of the Manufacturer.

10.2.1 Heating of the area to be coated

The area to be coated is heated if necessary immediately after cleaning by induction heating or by flame up to the temperature given by the Manufacturer.

The holding time and the temperature shall not:

- Result in oxidation of the surface of steel and of the coating detrimental to the quality of the coating of the joint
- Damage the factory applied coating (see § 7.7).

10.2.2 Application of the epoxy powder

The overlap on the factory applied coating, excluding bevels, shall be not less than 50 mm, unless otherwise specified in the tender specifications and the order.

10.3 Characteristics of the coatings applied

The tests detailed below shall be carried out after curing of the material. They are summarised in Table 8.

Table 8 - Testing of FBE

Properties	§	Method of testing	Frequency	
			PQT and PPT ^a	Production
Visual inspection of the blast cleaned surface	10.1	ISO 8501-1	3 joints	Each joint
Roughness	7.1	Testex tape	3 joints	Once per shift
Salt contamination	7.1	SMC400	1 joint	Once per shift
Dust level	7.1	ISO 8502-3	1 joint	Once per shift
Examination of the dulled factory applied coating	10.1	Visual	3 joints	Each joint
Temperature of the surface to be coated	10.2.1	-	3 joints	Each joint
Visual inspection of the coating	7.4	-	3 joints	Each joint
Inspection of the thickness	10.3.1	ISO 21809-3 Annex A	3 joints	Each joint
Holiday detection test	10.3.2	ISO 21809-3 Annex B	3 joints	Each joint
Adhesion test	10.3.3	ISO 21809-3 Annex C	3 joints	Once per shift
Cathodic disbonding at ambient temperature	10.3.4	ISO 21809-3 Annex F	3 joints	-
Cathodic disbonding at maximum operating temperature	10.3.4	ISO 21809-3 Annex F	3 joints (PQT)	-

a All the tests in this column should be carried out every three years for every type of coating (see Table 1) and technical process.

10.3.1 Thickness

The minimum thickness of the coating is defined by agreement between the Company and the Applicator. As a general rule, the minimum value shall be 325 microns and the maximum value 600 microns, except in case of reel barge laying when it is 500 microns; this value applies in particular to the overlap between the plant and field coatings.

The thickness is checked according to method defined in ISO 21809-3 Annex A.

10.3.2 Holiday detection

The voltage is defined according to the nominal thickness. The entire surface is monitored at a voltage of 5 V/ μm with a maximum of 5 kV, according to the method defined in Annex B of [ISO 21809-3](#).

No holidays are allowed unless otherwise agreed between Company and Applicator.

10.3.3 Adhesion

Adhesion on the steel surface is monitored in accordance with the method C4 defined in Annex C of [ISO 21809-3](#). Results shall be level 1.

10.3.4 Cathodic disbonding

The test is carried out in accordance with the method defined in Annex F of [ISO 21809-3](#). Duration of 48 hr instead of 28 days may be used for PPT if temperature is increased to 65°C. Duration of 28 days and 48 hrs is mandatory for PQT.

The average disbonding shall not be more than:

- 5 mm after a period of 28 days at $23 \pm 2^\circ\text{C}$ (mandatory for prequalification)
- 3 mm after a period of 48 hr at $65 \pm 2^\circ\text{C}$ (mandatory for PQT, acceptable for PPT)
- 10 mm after a period of 28 days at maximum operating temperature.

11. Coatings from liquid epoxy (EP) or polyurethane (PUR) resins

The coatings shall comply with the requirements of chap 13 of [ISO 21809-3](#) except when otherwise stated below.

11.1 Definition of the coatings

The coating of joints consists in the application of one or more layers of liquid epoxy resin or liquid polyurethane, whether modified or not. A coating from EP or PUR can be used at different maximum operating temperatures and at different thickness classes. The combinations of these classes are given in Table 9.

Table 9 - Combinations of thickness and maximum operating temperatures

		Class A	Class B	Class C
EP	Thickness	400 μm	800 μm	1500 μm
	Maximum operating temperature	- 20 to 40°C	- 20 to 60°C	- 20 to 80°C
PUR	Thickness	1000 μm	1500 μm	-
	Maximum operating temperature	- 20 to 40°C	- 20 to 60°C	-

Other temperatures can be agreed. In this case, tests shall be carried out at the required temperature.

General Specification		GS EP COR 420
External field joint coatings of pipelines		
Rev.: 08	Effective date: 10/2012	Page: 27 of 29

Some cases may require extra thickness due to soil conditions (damped or rocky soils for example).

11.2 Surface preparation

The areas to be coated are prepared by abrasive blast cleaning.

At least 5 cm of the adjoining factory applied coating to be covered by field joint coating shall be dulled and cleaned by brushing or blasting in order to obtain the surface profile and cleanliness defined in § 7.1. As a base case (PE or PP factory coatings), a specific treatment (e.g. oxidising flame or corona treatment) shall be applied to achieve the right level of bonding. Its application shall be automatic whenever possible to improve reproducibility. Its efficiency shall be checked with surface tension evaluation by a proper method agreed by Company.

11.3 Application of the coating

The method of application should be in accordance with the recommendations of the Manufacturer.

11.3.1 Heating of the area to be coated

The area to be coated is heated if necessary immediately after cleaning by induction heating or by flame up to the temperature given by the Manufacturer.

The holding time and the temperature shall not:

- Result in oxidation of the surface of steel and of the coating detrimental to the quality of the coating of the joint
- Damage the factory applied coating.

11.3.2 Application of the primer

The primer if necessary is applied manually or with a machine by spraying of the liquid.

11.3.3 Application of the liquid epoxy resin or liquid polyurethane

The liquid epoxy resin or liquid polyurethane is applied in accordance with the recommendations of the Manufacturer.

The overlap on the factory applied coating, excluding bevels, shall be not less than 50 mm, unless otherwise specified in the tender specifications and the order.

11.4 Characteristics of the coatings applied

The tests detailed below shall be carried out after curing of the material. They are summarised in Table 10.

11.4.1 Thickness

The minimum thickness of the coating shall be at least in accordance with Table 12.

The thickness is checked according to method defined in [ISO 21809-3](#) Annex A.

External field joint coatings of pipelines

Rev.: 08

Effective date: 10/2012

Page: 28 of 29

11.4.2 Holiday detection

The voltage is defined according to the nominal thickness. The entire surface is monitored at a voltage of 8 V/μm with a maximum of 20 kV, according to the method defined in [ISO 21809-3](#) Annex B.

No holidays are allowed unless otherwise agreed between Company and Applicator.

Table 10 - Testing of coatings from liquid epoxy resin or liquid polyurethane

Properties	§	Method of testing	Frequency	
			PQT and PPT ^a	Production
Visual inspection of the blast cleaned surface	11.2	ISO 8501-1	3 joints	Each joint
Roughness	7.1	Testex tape	3 joints	Once per shift
Salt contamination	7.1	SMC400	1 joint	Once per shift
Dust level	7.1	ISO 8502-3	1 joint	Once per shift
Examination of the dulled factory applied coating	11.2	Visual	3 joints	Each joint
Surface tension check on parent coating	11.2	By agreement	3 joints	Each joint
Temperature of the surface to be coated	11.3.1	-	3 joints	Each joint
Visual inspection of the coating	7.4	-	3 joints	Each joint
Inspection of the thickness	11.4.1	ISO 21809-3 Annex A	3 joints	Each joint
Holiday detection test	11.4.2	ISO 21809-3 Annex B	3 joints	Each joint
Adhesion test	11.4.3	ISO 21809-3 Annex C	3 joints	Once per shift
Shore D hardness		ISO 868	3 joints	-
Cathodic disbondment test at ambient temperature	11.4.4	ISO 21809-3 Annex F	3 joints	-
Cathodic disbondment test at maximum operating temperature	11.4.4	ISO 21809-3 Annex F	3 joints (PQT)	-

a All the tests in this column should be carried out every three years for every type of coating (see Table 1) and technical process.

11.4.3 Adhesion

Adhesion on the steel surface is monitored in accordance with the method C4 defined in [ISO 21809-3](#) Annex C. Results shall be level 1.

11.4.4 Cathodic disbonding

The test is carried out in accordance with the method defined in Annex F of [ISO 21809-3](#). Duration of 48 hr instead of 28 days may be used for PPT if temperature is increased to 65°C. Duration of 28 days and 48 hours are mandatory for PQT.

External field joint coatings of pipelines

Rev.: 08

Effective date: 10/2012

Page: 29 of 29

The average disbonding shall not be more than:

- 8 mm after a period of 28 days at $23 \pm 2^{\circ}\text{C}$ (mandatory for PQT)
- 5 mm after a period of 48 hr at $65 \pm 2^{\circ}\text{C}$ (mandatory for PQT, acceptable for PPT)
- 12 mm after a period of 28 days at maximum operating temperature.

12. Coating repairs on job site

The eventual repairs to be done on job site shall be implemented as agreed between Company and Applicator if the damaged area is less than 100 cm^2 .

If the damaged area is more than 100 cm^2 heat shrinkable sleeves or tapes approved by Company should be used.