

GENERAL SPECIFICATION

CORROSION

GS EP COR 221

Three layer polypropylene external coating for pipelines

09	06/2012	Update following the EP reorganization, March 2012
08	01/2011	General review
07	10/2009	Cancel requirement for wet Tg measurements
06	10/2008	Specification becomes limited to EP - Inclusion of pipe coating line travel velocity monitoring and change of testing requirements for epoxy primer
00	03/2001	First issue
Rev.	Date	Purpose of the revision

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1. General

1.1 Scope

This specification covers the manufacturing of 3 layer polypropylene (3LPP) based external anticorrosion coatings for onshore or offshore pipelines transporting oil, gas, or water.

The coating shall be plant applied and suitable from -20°C up to +110°C (depending on the type of epoxy primer used).

The actual pipeline maximum service temperature will be given in the particular specification or in the Contract.

Applications requiring resistance to temperatures outside these ranges have to be specifically treated by Company. Possibilities up to 130°C exist with some adapted coating products.

The purpose of this specification is to define the following:

- Applicator's obligations
- Composition of coating and characteristics of the epoxy primer, the adhesive and the polypropylene
- Application of the epoxy primer, the adhesive and the extruded polypropylene
- Repair system
- Characteristics of the finished coating
- Prequalification and qualification testing
- Fabrication testing and Inspection
- Handling, transport and storage rules.

Field joint coatings to be applied after girth welding of pipes and field repairs of 3LPP coated pipes are specified in [GS EP COR 420](#).

Requirements from [NF A49-711](#) standard shall be followed when they are not in conflict with those of the present document.

1.2 Definitions of main parties involved

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

1.2.1 Manufacturer

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

1.2.2 Applicator

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

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1.2.3 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".

2. Reference documents

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

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
ASTM D 4940	Standard test method for conductimetric analysis of water soluble ionic contamination of blasting abrasives
ASTM D 570	Standard Test Method for Water Absorption of Plastics
CSA Z245-20	External fusion bond epoxy coating for steel pipes
ISO 1133-1	Plastics - Determination of the melt-mass flow rate (MFR) and melt-volume flow rate (MVR) of thermoplastics – Part 1 Standard method
ISO 11357-1	Plastics - Differential scanning calorimetry (DSC) - Part 1: General principles
ISO 11357-3	Plastics - Differential scanning calorimetry (DSC) - Part 3: Determination of temperature and enthalpy of melting and crystallization
ISO 1183	Plastics - Methods for determining the density and relative density of non-cellular plastics
ISO 179-2	Plastics - Determination of Charpy impact properties - Part 2: Instrumented impact test
ISO 2808	Paints and varnishes - Determination of film thickness
ISO 2811-1	Paints and varnishes - Determination of density - Part 1: Pycnometer method
ISO 306	Plastics - Thermoplastic materials - Determination of Vicat softening temperature
ISO 4287	Geometrical Product Specifications (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters
ISO 4892-2	Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps

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Reference	Title
ISO 527-1	Plastics - Determination of tensile properties - Part 1: General principles
ISO 527-2	Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics
ISO 8130-6	Coating powders - Part 6: Determination of gel time of thermosetting coating powders at a given temperature
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 8502-3	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ISO 8502-6	Preparation of steel substrates before application of paints and related products. Tests for the assessment of surface cleanliness - Part 6: extraction of soluble contaminants for analysis - The Bresle method
ISO 8502-9	Preparation of steel substrates before application of paints and related products. Tests for the assessment of surface cleanliness - Part 9: Field method for conductometric determination of water-soluble salts
ISO 8503-4	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates - Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile - Stylus instrument procedure
ISO 868	Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness)
NACE RP0274	High-Voltage Electrical Inspection of Pipeline Coatings
NF A49-711	Steel pipes. External coating with three layer polypropylene based coating: application by extrusion

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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 420	External field joint coating of pipelines
GS EP PLR 410	Concrete coating for submarine pipelines

3. Obligations of Applicators and Manufacturers

3.1 Company requirements regarding coating products

The Applicator shall, in his tender, submit the data sheets of its selected products concerning the epoxy primer material, the adhesive material, the polypropylene and the repair products for approval. He will also provide a written notice attesting that the epoxy primer material, the adhesive material, the polypropylene and the repair products delivered shall meet the required characteristics as set forth in § 4 according to the specified methods.

The Applicator shall inform by writing the Manufacturers of the epoxy, the adhesive and the polypropylene of the Company requirements related to:

- Test certificates, properties requirements and conformity certificates as detailed in the present document. A copy of this written notice shall be sent to Company
- The packaging of the epoxy powder: The Manufacturer shall deliver the product in waterproof plastic bags to prevent water contamination and absorption of humidity during storage and transportation.

Once approved the epoxy primer material, the adhesive material, the polypropylene and the repair products shall not be changed by the Applicator.

Approval of the products by the Company shall not, under any circumstances, be considered as a guarantee from the Company with respect to coating materials and repair products but simply as an authorisation for use.

3.2 Qualification of Applicator's plant and coating system

Qualification of the proposed application plant, personnel, coating method and products shall be carried out in due time through a Procedure Qualification Trials (PQT). Qualification shall be organised jointly by the Contractor and the Applicator, and witnessed by a Company representative. Qualification testing shall be organised at least 2 months before the works start in order to ensure that a suitable solution can be implemented in case of test results fail to meet the requirements of this specification.

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Qualification shall consist of the following step:

- Raw materials (epoxy, adhesive, PP):
 - Conformity certificates (see § 4) and tests results for materials requirements (see § 4) shall be submitted to Company for approval prior to the start of qualification process of the coating.
 - Certificate of analysis (see § 4) for each batch of product used for qualification process shall be submitted to Company.
 - For PP only: Tests results (from an independent laboratory) for thermal and UV ageing resistance as per Appendix 2 and Appendix 3 shall be submitted to Company for approval. The tests results shall be coming from coated pipe samples. Tests results shall not be older than three years.

Note: It is requested that Applicator provide the data listed in Appendix 4 to Company or its representative on site during either qualification or start up.

Coating process: Witnessed by Company representative and in accordance with § 5 Coating process parameters shall be fully recorded during PQT. Same parameters shall be used for production, with a maximum discrepancy of 5% for each parameter. Of special interest here is the pipe travel speed for blasting and coating operations, which shall be strictly monitored to be equal during PQT and production (within the 5% margin).

- Coating properties: Witnessed by Company representative and in accordance with § 6

A summary of Qualification tests as well as acceptance criteria and frequency is given in Appendix 1. The Contractor and Applicator shall submit a complete joint report of the Qualification test results to the Company for approval.

Once approved, the system (considered as the three components as a whole) will be considered as qualified on the corresponding coating line. Any change in the components of the system or the application of a qualified system on a new coating line shall lead to a new qualification process. The qualification of the system on the coating line is valid for a duration of three years. Renewal of the qualification is based on a technical visit and/or track record. A new PQT can be requested in case of quality issues noted on the line during the three years duration.
- At start of production a PPT (Pre Production Test) shall be carried out, consisting mainly of reinforced test frequency over the first pipes of the first shift of production, as described in Appendix 1 (typically five pipes, but can be more, subject to Company decision).

3.3 Notification prior starting coating work

The Contractor shall notify the Company, at least eight working days before production start up, for the dates of starting coating process to allow mobilisation of the Company designated Inspector.

The Inspector shall have free access to the workshops, storage yards and laboratory of the Applicator who shall also provide him with all the facilities necessary for the proper execution of his work (i.e. office, telephone and fax, handling equipment, measuring instruments with calibration certificates, etc.).

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Upon arrival at the coating plant, the Inspector shall receive from the main Contractor the documents supplied by the Manufacturer.

3.4 Acceptance certificates

The Contractor and the Applicator shall sign jointly with the Inspector the coated pipes acceptance certificate including the results of all tests and inspection as set forth in this specification.

The acceptance certificate of coated pipes shall certify that all tests and inspections have been performed by the Applicator under the responsibility of the Contractor for all Company ordered pipes and have been witnessed by the Inspector.

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

4. Coating system and characteristics of the raw materials and repair products

For each raw material (epoxy, adhesive and PP), the requirements are as follow:

- Nature and type of raw material
- Technical requirements
- Content of conformity certificate
- Content of certificate of analysis.

4.1 Coating System

The three layer polypropylene coating shall consist of:

- One epoxy primer
- One adhesive coat
- One extruded polypropylene coat.

4.2 Marking and identification

Raw materials shall be clearly identified with the following markings (whatever the packaging of the product):

- Name of Manufacturer
- Production plant
- Name of product
- Batch number
- Date of manufacture (epoxy only)
- Shelf life (epoxy only). For PP and adhesive, a shelf life of one year (starting at reception of material by Applicator) shall be considered, provided the product is stored according to Manufacturer's recommendation (To be found in Materials Safety Data Sheets).

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4.3 Characteristics of epoxy primer

4.3.1 Nature and type

The epoxy primer shall be 100% solid powder form. The use of a liquid epoxy is not allowed.

4.3.2 Technical requirements

The epoxy primer shall meet the technical requirements specified in Table 1.

Table 1 - Technical requirements for epoxy primer

Characteristic	Methods	Units	Acceptable Values
Moisture content	Powder: 20 g Temperature: 105°C Time: 30 min	%	0.5 (max.)
Glass transition temperature *	Differential Scanning Calorimeter (DSC)	°C	100°C minimum and equal or higher than service temperature for fully cured material
Bend test	CAN/CSA Z245-20, Clause 12.11 2.5° at minimum temperature		No holiday
Water absorption (demineralised water)	ASTM D 570 on a free film of 500 microns ± 50 thickness	% wt	Less than 15% of weight uptake after 28 days at 80°C

* Tg shall be understood here as inflection point.

4.3.3 Content of conformity certificate

The conformity certificate is a document issued by the raw material Manufacturer (specific to each raw material). It is a list of physical or chemical characteristics controlled for every production batches. For each of these characteristics, a conformity range is reported by the Manufacturer.

The conformity certificate shall include the following information (as a minimum, but not limited to):

- Name of Manufacturer
- Name of product
- Manufacturing plant
- Date of issue
- Name, function and signature of the person issuing the document.

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Characteristics	Methods	Units	Conformity range
Gel time	ISO 8130-6	Seconds	Manufacturer specification
Density	ISO 2811-1	g/ml	Manufacturer specification
Glass transition T°			
First heating		°C	Manufacturer specification
Second heating		°C	Manufacturer specification and as per Table 1
Enthalpy		J/g	Manufacturer specification
IR Spectra			Manufacturer specification
Particle size analysis	Manufacturer		Manufacturer specification
Moisture content	Manufacturer		Manufacturer specification and as per Table 1

Conformity certificate shall be considered valid for one year, provided there is no change of any kind for the product for that period.

When submitted to Company for approval during qualification, Company reserves the right to ask for changes with regards to Manufacturer's specification ranges for each characteristic.

4.3.4 Content of certificate of analysis

The certificate of analysis is issued by raw material Manufacturer with every batch of product. It reports all characteristics controlled on the corresponding batch.

The content of certificate of analysis shall be equivalent to the conformity certificate, except that measured values shall be reported instead of conformity range or Manufacturer specification.

4.4 Characteristics of the adhesive material

4.4.1 Technical requirements

The Company requirements are given in Table 2.

Table 2 - Technical requirements for adhesive

Characteristics	Standards	Units	Acceptable values
Elongation at break	ISO 527-1 and ISO 527-2	%	≥ 400
VICAT Softening point (9.8 N)	ISO 306	°C	> 120
Melting point	ISO 11357-1 and ISO 11357-3	°C	> 140