
**Petroleum and natural gas industries —
External coatings for buried or
submerged pipelines used in pipeline
transportation systems —**

Part 2:

Fusion-bonded epoxy coatings

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*Industries du pétrole et du gaz naturel — Revêtements externes des
conduites enterrées ou immergées utilisées dans les systèmes de
transport par conduites —*

ISO 21809-2:2007
*Partie 2: Revêtements à base de résine époxydique appliquée par
fusion*
<https://standards.iteh.ai/catalog/standards/sist/8a64232d-4fd2-474d-82cf-93a79cab8b7c/iso-21809-2-2007>



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 21809-2 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

ISO 21809 consists of the following parts, under the general title *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems*:

- *Part 1: Polyolefin coatings (3-layer PE and 3-layer PP)*
- *Part 2: Fusion-bonded epoxy coatings*
- *Part 3: Field joint coatings*
- *Part 4: Polyethylene coatings (2-layer PE)*
- *Part 5: External concrete coatings*

Bitumen, asphalt and coaltar, liquid, thermal insulation, and epoxy polyamide powder coatings are to form the subjects of future parts 6, 7, 8 and 9.

Introduction

Users of this part of ISO 21809 should be aware that further or differing requirements might be needed for individual applications. This part of ISO 21809 is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This can be particularly applicable if there is innovative or developing technology. If an alternative is offered, the vendor should identify any variations from this part of ISO 21809 and provide details.

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Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems —

Part 2: Fusion-bonded epoxy coatings

1 Scope

This part of ISO 21809 specifies the requirements for qualification, application, testing and handling of materials for plant application of single-layer fusion-bonded epoxy (FBE) coatings applied externally for the corrosion protection of bare steel pipe for use in pipeline transportation systems for the petroleum and natural gas industries as defined in ISO 13623.

High-temperature coatings with a glass transition of above 120 °C or FBE primer coatings for three- or multi-layer polyethylene or polypropylene coatings are not covered by this part of ISO 21809.

NOTE Pipes coated in accordance with this part of ISO 21809 are considered suitable for additional protection by means of cathodic protection.

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2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 31-0:1992, *Quantities and units — Part 0: General principles*

ISO 8130-2, *Coating powders — Part 2: Determination of density by gas comparison pyknometer (referee method)*

ISO 8130-3, *Coating powders — Part 3: Determination of density by liquid displacement pyknometer*

ISO 8501-1:2007, *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 paint 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 the 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 8503-5, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 5: Replica tape method for the determination of the surface profile*

ISO 10474:1991, *Steel and steel products — Inspection documents*

ISO 11124 (all parts), *Preparation of steel substrates before application of paints and related products — Specifications for metallic blast-cleaning abrasives*

ISO 11357-1, *Plastics — Differential scanning calorimetry (DSC) — Part 1: General principles*

ISO 13623:2000, *Petroleum and natural gas industries — Pipeline transportation systems*

EN 10204:2004, *Metallic products — Types of inspection documents*

SSPC-AB 1¹⁾, *Mineral and Slag Abrasives*

SSPC-AB 2, *Cleanliness of Recycled Ferrous Metallic Abrasives*

SSPC-AB 3, *Ferrous Metallic Abrasive*

SSPC-SP 1, *Solvent cleaning*

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3 Terms and definitions

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

3.1 applicator
<https://standards.iteh.ai/catalog/standards/sist/8a64232d-4fd2-474d-82ef-93a79eab8b7c/iso-21809-2-2007>
company that undertakes the coating application in accordance with the provisions of this part of ISO 21809

3.2 batch
quantity of epoxy powder produced using the same formulation and raw materials of the same source during a continuous production run of not more than 8 h

3.3 batch certificate
certificate of analysis issued by the manufacturer

3.4 by agreement
agreed between manufacturer and purchaser

[ISO 14313:—]

3.5 certificate of compliance
document issued according to ISO 10474 or EN 10204 stating compliance with the purchase order for coated pipes, but without mention of any test results, issued in accordance with the purchasing requirements

3.6 cutback
length of pipe left uncoated at each end for joining purposes

1) SSPC: The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburg, PA 15222-4656, USA.

3.7**glass transition**

reversible change in an amorphous polymer or in amorphous regions of a partially crystalline polymer from (or to) a viscous or rubbery condition to (or from) a hard and relatively brittle one

[ISO 11357-2:1999]

3.8**glass transition temperature**

approximate midpoint of the temperature range over which the glass transition takes place

NOTE The assigned glass transition temperature, T_g , can vary, depending on the specific property and on the method and conditions selected to measure it.

[ISO 11357-2:1999]

3.9**holiday**

coating discontinuity that exhibits electrical conductivity when exposed to a specific voltage

3.10**laboratory-coated test specimen**

specimen taken from a laboratory-prepared panel

3.11**manufacturer**

company responsible for the manufacture of coating material(s)

3.12**manufacturer's specification**

document that specifies the characteristics, test requirements and application recommendations for the coating materials

3.13**pipe diameter length**

any length along the pipe axis equal to the specified outside diameter of the pipe

3.14**pipeline**

those facilities through which fluids are conveyed, including pipe, pig traps, components and appurtenances, up to and including the isolating valves

[ISO 13623:2000]

3.15**pipeline transportation system**

pipeline with compressor or pump stations, pressure control stations, flow control stations, metering, tankage, supervisory control and data acquisition system (SCADA), safety systems, corrosion protection systems, and any other equipment, facility or building used in the transportation of fluids

3.16**purchaser**

company responsible for providing the product order requirements

3.17**test report**

document that provides the quantitative test results for tests conducted in accordance with the requirements of this part of ISO 21809

3.18
test ring

sample taken from production-coated pipe

3.19
Inspection certificate 3.1.B
Inspection certificate 3.1

document in accordance with ISO 10474 or EN 10204 giving the results of the testing of coated pipes, supplied and signed by a representative of the applicator authorized to issue such documents

4 Symbols and abbreviated terms

4.1 Symbols

| | |
|--------------|---|
| C | percentage conversion of FBE coating |
| d | thickness |
| ΔH | exothermic heat of reaction |
| M | mass |
| T_g | glass transition temperature in degrees Celsius ($^{\circ}\text{C}$) |
| ΔT_g | variation of the glass transition temperature in degrees Celsius ($^{\circ}\text{C}$) |
| w_{ep} | mass fraction of the epoxy powder retained on a sieve, expressed as a percent of total sample |
| w_m | mass fraction of moisture, expressed as a percent |

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4.2 Abbreviations

| | |
|------|-----------------------------------|
| d.c. | direct current |
| DSC | differential scanning calorimetry |
| FBE | fusion-bonded epoxy |
| HRC | Rockwell "C" scale hardness |
| ID | inner diameter |
| OD | outer diameter |
| ppd | per pipe diameter |

5 General requirements

5.1 Rounding

Unless otherwise stated in this part of ISO 21809, to determine conformance with the specified requirements, observed or calculated values shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with ISO 31-0:1992, Annex B, Rule A.

NOTE For the purposes of this provision, the rounding method of ASTM E29 is equivalent to ISO 31-0:1992, Annex B, Rule A.

5.2 Compliance to standard

A quality system and an environmental management system should be applied to assist compliance with the requirements of this part of ISO 21809.

NOTE ISO/TS 29001 gives sector-specific guidance on quality management systems and ISO 14001 gives guidance on the selection and use of an environmental management system.

The applicator shall be responsible for complying with all of the applicable requirements of this part of ISO 21809. It shall be permissible for the purchaser to make any investigation necessary in order to be assured of compliance by the applicator and to reject any material and/or coating that does not comply.

6 Information supplied by the purchaser

6.1 General information

The purchase order shall include the following information:

- a) number of this part of ISO 21809 and year of publication (ISO 21809-2:2007);
- b) pipe quantity, outside diameter, minimum wall thickness, minimum, maximum and nominal length, grade of steel;
- c) bare pipe standard or specification designation, e.g. ISO 3183;
- d) minimum thickness and maximum permissible thickness of the coating;
- e) cutback length and tolerances for both ends of pipe;
- f) maximum pipeline design temperature (°C).

6.2 Additional information

The purchase order shall indicate which of the following provisions apply for the specific order item:

- a) additional surface treatments;
- b) plant inspection by the purchaser;
- c) increased test ring length;
- d) test ring location;
- e) test frequency for additional test rings;
- f) additional markings;
- g) handling procedures;
- h) storage procedures;
- i) waiver of test reports;
- j) other special requirements.

7 Materials

7.1 Pipe

The pipe being coated shall conform to the pipe standard or specification that is specified in the purchase order.

CAUTION — Pipe conforming to such standards or specifications does not necessarily have a surface condition that is appropriate for the application of FBE coating, e.g. temporary coating, salt contamination, slivers.

7.2 Epoxy powder

7.2.1 General

The applicator shall use epoxy powder that is

- a) certified by the powder manufacturer to be in accordance with the requirements of 7.2.2 and 8.1, and compatible with the requirements of 10.2.2;
- b) identified with the following:
 - powder manufacturer’s name,
 - product description,
 - mass of material,
 - batch number,
 - location of manufacture,
 - manufacturing identification number,
 - temperature requirements for transportation and storage,
 - year, month and day of manufacture,
 - expiry date;
- c) handled, transported, and stored prior to use in accordance with the powder manufacturer’s recommendations.

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7.2.2 Properties

Each batch of epoxy powder shall be tested by the manufacturer in accordance with the requirements of Table 1. Test results shall be reported in accordance with ISO 10474 and shall be made available to the applicator upon request. A batch certificate shall be provided by the manufacturer to the applicator.

Table 1 — Minimum requirements for epoxy powder

| Properties | Requirements | Test method |
|---|--|-------------|
| Cure time | within the manufacturer’s specification | Clause A.2 |
| Gel time | within the manufacturer’s specification | Clause A.3 |
| Total volatile/moisture content by mass | ≤ 0,6 % | Clause A.5 |
| Particle size | maximum retained on 150 µm and 250 µm sieves within the manufacturer’s specification | Clause A.6 |
| Density | within the manufacturer’s specification | Clause A.7 |
| Thermal characteristics | within the manufacturer’s specification | Clause A.8 |

7.2.3 Packaging

The powder shall be contained in packaging that is clearly labelled to identify the items specified in 7.2.1 b).

8 Coating qualification

8.1 Qualification by manufacturer

The coating shall be qualified by the manufacturer through testing laboratory-coated test specimens for each applicable test and by meeting the acceptance criteria. Laboratory-coated test specimens shall be prepared in accordance with 8.3.

The qualification shall be repeated if there is a change in one or both of the following:

- a) coating formulation;
- b) location of product manufacture.

The tests conducted, the number of test specimens, the test methods used and the acceptance criteria shall be as given in Table 2. These test results shall be reported in accordance with ISO 10474 and shall be made available to the applicator upon request.

Table 2 — Minimum requirements for coating qualification testing

| Properties | Acceptance criteria | Number of test specimens | Test method |
|--|---|--------------------------|-------------|
| Thermal characteristics | meets the manufacturer's specification and be at least 5 °C above maximum pipeline design temperature | 1 | Clause A.8 |
| Cathodic disbondment: 24 h, 6 °C ± 3 °C, - 3,5 V | ≤ 8 mm disbondment | 3 | Clause A.9 |
| 24 h hot-water adhesion 65 °C ± 3 °C | Rating of 1 to 2 | 3 | Clause A.15 |
| 28 day hot-water adhesion 65 °C ± 3 °C | Rating of 1 to 3 | 3 | Clause A.15 |
| Cathodic disbondment: 28 day, 20 °C ± 3 °C, - 1,5 V | ≤ 8 mm disbondment | 3 | Clause A.9 |
| Cathodic disbondment: 28 day, 65 °C ± 3 °C, - 1,5 V | ≤ 15 mm disbondment | 3 | Clause A.9 |
| Cross-section porosity | less than or equal to that illustrated in Figure A.10 | 1 | Clause A.11 |
| Interface porosity | less than or equal to that illustrated in Figure A.11 | 1 | Clause A.11 |
| Flexibility at 0 °C | no cracking at 2,0°ppd length | 5 | Clause A.12 |
| Impact | ≥ 1,5 J | 3 | Clause A.13 |
| Strained coating, cathodic disbondment 28 day, 20 °C ± 3 °C, - 1,5 V | no cracking | 3 | Clause A.14 |