INTERNATIONAL STANDARD

ISO 21809-4

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

Part 4: Polyethylene coatings (2-layer PE)

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

Partie 4: Revêtements à base de polyéthylène (PE bicouche)

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 21809-4 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*

Introduction

It is necessary that users of this part of ISO 21809 be aware that further or differing requirements can 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 where there is innovative or developing technology. Where an alternative is offered, it is the responsibility of the vendor to identify any variations from this part of ISO 21809 and provide details.

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

Part 4:
Polyethylene coatings (2-layer PE)

1 Scope

This part of ISO 21809 specifies the requirements for qualification, application, inspection, testing, handling and storage of materials for plant application of two-layer polyethylene coatings (2-layer PE) 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.

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

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 62, *Plastics — Determination of water absorption*

ISO 306, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 527-3, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets*

ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 1133, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics*

ISO 1872-2, *Plastics — Polyethylene (PE) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

ISO 1183 (all parts), *Plastics — Methods for determining the density of non-cellular plastics*

ISO 4625-1, *Binders for paints and varnishes — Determination of softening point — Part 1: Ring-and-ball method*

ISO 4892-2:2006, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

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 8502-3:1992, *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 the conductometric determination of water-soluble salts*

ISO 8503-4:1988, *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 8503-5:2003, *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, *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 11125 (all parts), *Preparation of steel substrates before application of paints and related products — Test methods for metallic blast-cleaning abrasives*

ISO 11357-6, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)*

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

ISO 15512, *Plastics — Determination of water content*

ASTM D1693, *Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics*

ASTM D3236, *Standard Test Method for Apparent Viscosity of Hot Melt Adhesives and Coating Materials*

SSPC-SP1, *Solvent Cleaning*

3 Terms and definitions

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

3.1
applicator
company that undertakes the coating application in accordance with the provisions of this part of ISO 21809

NOTE If the compounding of the top layer is done prior to or during the application process by the applicator, then he is considered as manufacturer (see 3.7).

3.2
batch
quantity of coating material as defined by the manufacturer

3.3
batch certificate
certificate of analysis issued by the manufacturer

3.4
certificate of compliance
one of the types of documents defined by ISO 10474 that is issued in accordance with the purchase requirements

3.5
cutback
length of pipe left uncoated at each end for joining purposes

3.6
holiday
coating discontinuity that exhibits electrical conductivity when exposed to a specific voltage

3.7
manufacturer
company responsible for the manufacture of coating material(s)

3.8
manufacturer's specification
document that specifies the characteristics, test requirements and application recommendations for the coating materials

3.9
maximum design temperature
maximum temperature that the coating can be exposed to during operation

3.10
pipe diameter length
any length along the pipe axis equal to the specified outside diameter of the pipe

3.11
pipeline
those facilities through which fluids are conveyed, including pipe, pig traps, components and appurtenances, up to and including the isolating valves

[ISO 13623]

3.12
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

3.13
purchaser
company responsible for providing the product order requirements

3.14
test report
document that provides the quantitative test results for tests conducted in accordance with the requirements of this part of ISO 21809

3.15
test ring
sample taken from production coated pipe

4 Abbreviated terms

BST black standard temperature

ESCR environmental stress cracking resistance

MFR melt flow rate; designated as symbol q_{MFR} for use in mathematical expressions and equations

PE polyethylene

ppd per pipe diameter

SAW submerged arc welding

UV ultraviolet

2LPE 2-layer polyethylene coating

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

5.2 Compliance with this part of ISO 21809

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) the number of this part of ISO 21809 and year of publication (ISO 21809-4:2009);

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) coating system classification and thickness;

e) cutback length and tolerances for both ends of pipe;

f) pipeline maximum design temperature, in degrees Celsius;

g) test temperature for flexibility;

h) maximum cathodic disbondment radius at maximum design temperature.

6.2 Additional information

If applicable, purchase orders shall include the following information:

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 Coating classification

7.1 General

The coating shall consist of two layers:

a) 1st layer, composed of one of the following adhesives:

- asphaltic modified rubber,
- non-asphaltic-modified rubber (e.g. butyl based),
- hot melt,
- polymeric;

b) 2nd layer, consisting of the PE top layer.

7.2 Coating systems

The coating system shall be classified in accordance with Table 1.

Table 1 — Coating systems

Coating systems	A	B	C
1st layer	Asphaltic-modified rubber adhesive	non-asphaltic-modified rubber adhesive	hot melt or polymeric adhesive
2nd layer	PE	PE	PE

NOTE Temperature resistance of coating systems varies based on the polyethylene and adhesive systems specified.

7.3 Coating thickness classes

The total thickness of the coating shall be in accordance with Table 2.

Table 2 — Minimum total coating thickness

Nominal pipe diameter mm	Coating thickness[a,b] mm		
	A minimum adhesive: 0,15	B minimum adhesive: 0,2	C minimum adhesive: 0,25
< 115	0,75	0,95	1,25
115 to 275	0,85	1,00	1,40
276 to 510	1,00	1,20	1,60
511 to 760	1,25	1,40	1,80
> 760	1,35	1,75	2,00

[a] The total thickness may be reduced by a maximum of 10 % on the weld seam for SAW welded pipes.

[b] The choice of coating thickness is dependent on the condition of the soil or ground, laying method onshore and offshore, service constraints and pipe dimensions. These are minimum values and can be changed according to country or project specific requirements.

The applicator shall identify the materials and shall confirm that the certificates comply and relate to the specified materials.

8 Materials

8.1 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 coating, e. g. temporary coating, salt contamination, slivers.

8.2 Coating materials

8.2.1 General

The applicator shall use materials that are

a) certified by the manufacturer as in accordance with the requirements of 8.2.2 and 8.2.3;

b) identified with the following:

- manufacturer's name,
- product description,
- mass of material,
- batch number,
- location of manufacture,
- temperature and humidity requirements for transportation and storage,
- the year, month and day of manufacture, and
- expiry date;

c) handled, transported and stored prior to use in accordance with the manufacturer's recommendations.

8.2.2 Adhesive

Each batch of adhesive shall be tested by the manufacturer in accordance with the requirements of Table 3 or Table 4. Test results shall be reported in accordance with ISO 10474 and shall be made available to the applicator on request. A batch certificate shall be provided by the manufacturer to the applicator.

Table 3 — Minimum requirements for adhesives in systems A and B

Properties	Requirements		Test method
	A	B	
Viscosity	Within 30 % of manufacturer's specification, expressed in millipascal·seconds	N/A	ASTM D3236
Specific gravity at (25 ± 3) °C	0,9 to 1,2	0,95 to 1,5	ISO 1183
Melt flow rate	N/A	Within 20 % of manufacturer's specification, expressed in grams per 10 min	ISO 1133
Ring and ball softening point	At least 20 °C above maximum design temperature	N/A	ISO 4625-1