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

Part 5:

External concrete 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 21809-5:2010
Partie 5: Revêtements extérieurs en béton

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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 21809-5 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 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, it is the responsibility of the vendor to 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 5: External concrete coatings

1 Scope

This part of ISO 21809 specifies the requirements for qualification, application, testing and handling of materials required for the application of reinforced concrete coating externally to either bare pipe or pre-coated pipe for use in pipeline transportation systems for the petroleum and natural gas industries as defined in ISO 13623.

The external application of concrete is primarily used for the negative buoyancy of pipes used in buried or submerged pipeline systems and/or for the mechanical protection of the pipe and its pre-coating.

This part of ISO 21809 is applicable to concrete thicknesses of 25 mm or greater.

2 Normative references

[ISO 21809-5:2010](https://standards.iteh.ai/catalog/standards/sist/8f0dce39-396b-4868-b6a2-fc5a3712a285/iso-21809-5-2010)

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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 1920-5: 2004, *Testing of concrete — Part 5: Properties of hardened concrete other than strength*

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

EN¹⁾ 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

EN 206-1, *Concrete — Part 1: Specification, performance, production and conformity*

EN 450-1, *Fly ash for concrete — Part 1: Definition, specifications and conformity criteria*

EN 450-2, *Fly ash for concrete — Part 2: Conformity evaluation*

EN 934-2, *Admixtures for concrete, mortar and grout — Part 2: Concrete admixtures — Definitions, requirements conformity, marking and labelling*

EN 1008, *Mixing water for concrete — Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete*

1) CEN, European Committee for Standardization, Central Secretariat, Rue de Stassart 36, B-1050, Brussels, Belgium.

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EN 10080, *Steel for the reinforcement of concrete — Weldable reinforcing steel — General*

EN 10016-2, *Non-alloy steel rods for drawing and/or cold rolling — Part 2: Specific requirements for general purpose rod*

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

EN 10244-2, *Steel wire and wire products — Non-ferrous metallic coatings on steel wire — Part 2: Zinc or zinc alloy coatings*

EN 12390-2, *Testing hardened concrete — Part 2: Making and curing specimens for strength tests*

EN 12390-3, *Testing hardened concrete — Part 3: Compressive strength of test specimens*

EN 12390-7, *Testing hardened concrete — Part 7: Density of hardened concrete*

EN 12504-1, *Testing concrete in structures — Cored specimens — Taking, examining and testing in compression*

EN 12620, *Aggregates for concrete*

EN 13055-1, *Lightweight aggregates — Part 1: Lightweight aggregates for concrete, mortar and grout*

EN 13263-1, *Silica fume for concrete — Part 1: Definitions, requirements and conformity criteria*

ACI²⁾ 308.1-98, *Standard Specification for Concrete*

ASTM³⁾ A82/A82M, *Standard Specification for Steel Wire, Plain, for Concrete Reinforcement*

ASTM A185, *Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete*

ASTM A641, *Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire*

ASTM A810, *Standard Specification for Zinc-Coated (Galvanized) Steel Pipe Winding Mesh*

ASTM C31/C31M, *Standard Practice for Making and Curing Concrete Test Specimens in the Field*

ASTM C33, *Standard Specification for Concrete Aggregates*

ASTM C39, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*

ASTM C40, *Standard Test Method for Organic Impurities in Fine Aggregates for Concrete*

ASTM C42/C42M, *Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete*

ASTM C128, *Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate*

ASTM C150, *Standard Specification for Portland Cement*

ASTM C171, *Standard Specification for Sheet Materials for Curing Concrete*

ASTM C172, *Standard Practice for Sampling Freshly Mixed Concrete*

2) American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331, USA.

3) American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA.

- ASTM C309, *Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete*
- ASTM C330, *Standard Specification for Lightweight Aggregates for Structural Concrete*
- ASTM C331, *Standard Specification for Lightweight Aggregates for Concrete Masonry Units*
- ASTM C332, *Standard Specification for Lightweight Aggregates for Insulating Concrete*
- ASTM C494, *Standard Specification for Chemical Admixtures for Concrete*
- ASTM C595, *Standard Specification for Blended Hydraulic Cements*
- ASTM C617, *Standard Practice for Capping Cylindrical Concrete Specimens*
- ASTM C618, *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*
- ASTM C637, *Standard Specification for Aggregates for Radiation-Shielding Concrete*
- ASTM C642, *Standard Test Method for Density, Absorption, and Voids in Hardened Concrete*
- ASTM C989, *Standard Specification for Slag Cement for Use in Concrete and Mortars*
- ASTM C1157, *Standard Performance Specification for Hydraulic Cement*
- ASTM C1176, *Standard Practice for Making Roller-Compacted Concrete in Cylinder Molds using a Vibrating Table*
- ASTM C1240, *Standard Specification for Silica Fume Used in Cementitious Mixtures*
- ASTM C1435, *Standard Practice for Molding Roller-Compacted Concrete in Cylinder Molds Using a Vibrating Hammer*
- ASTM C1602, *Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete*
- ASTM C1604/C1604M, *Standard Test Method for Obtaining and Testing Drilled Cores of Shotcrete*
- ASTM D2216, *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*
- ASTM D4643, *Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating*
- ASTM D4959, *Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating*
- ASTM D6176, *Standard Practice for Measuring Surface Atmospheric Temperature with Electrical Resistance Temperature Sensors*

3 Terms and definitions

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

- 3.1 aggregate**
(fine and coarse) granular material such as sand, crushed stone, iron blast furnace slag, magnetite, ilmenite, or hematite used with a cement medium to form concrete or mortar
- 3.2 anode**
sacrificial metallic attachment that is electrically connected to the steel pipe
- 3.3 applicator**
company which undertakes the coating application in compliance with the provisions of this part of ISO 21809
- 3.4 cementitious material**
inorganic material or a mixture of inorganic materials that sets and develops strength by chemical reaction with water by formation of hydrates and is capable of doing so under water
- 3.5 certificate of compliance**
document issued in accordance with ISO 10474 or EN 10204, stating compliance with the purchase order for concrete coated pipes, but without mention of any test results, issued in accordance with the purchasing requirements
- 3.6 compression wrap process**
process by which the concrete mix is discharged into a coating head and applied in a continuous helical strip with pressure onto rotating pipe
- 3.7 compressive strength**
maximum compressive stress at the point of failure
- 3.8 concrete admixture**
material, other than aggregate, water, cement or supplementary cementitious material, or fibre reinforcement, that is added as an ingredient to the concrete mix or one of its components, to enhance or modify the properties of the concrete or application process
- 3.9 concrete coated pipe weight**
weight of the concrete coated pipe in air after the concrete cutback has been completed
- 3.10 core**
cylindrical specimen of a specific or designated diameter drilled from hardened concrete coating to be tested in compression or examined petrographically
- 3.11 cover**
distance between the surface of the reinforcement and the outer surface of the concrete
- 3.12 cube**
specimen of specific dimensions prepared from fresh concrete to be tested in compression

3.13**curing**

action taken to maintain moisture and temperature conditions in a freshly placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so that the required properties of the mix can develop

3.14**cutback**

length of pipe left without concrete coating at each end

3.15**cylinder**

cylindrical specimen prepared from fresh concrete to be tested in compression

3.16**electrical isolation**

absence of electrical continuity between the steel pipe and reinforcement

3.17**field specimen**

cores, cubes, cylinders, prisms or *in situ* specimens taken from the hardened concrete coating

3.18**form process****pour process**

process by which the concrete mix is poured into a mould on a stationary pipe

3.19**gap**

annular separation between the concrete coating and the underlying substrate

3.20**holiday**

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

3.21**impact resistance**

resistance of concrete coating against interference and accidental loads

3.22**impingement process**

process by which the concrete is discharged at high velocity onto a rotating pipe

3.23**mix design**

unique blend of aggregates, cement, water, and supplementary cementitious materials and/or admixtures that will result in a concrete mix

3.24**negative buoyancy**

weight of the concrete coated pipe less the positive buoyancy of the concrete coated pipe when considered as a closed cylinder immersed in the service environment

3.25**NPS**

nominal pipe size in USC units (inches)

3.26

phi tape

pi tape

tape used to measure the diameter of the concrete coated pipe

3.27

pre-coating

any coating or coating system applied to the external surface of the steel pipe prior to the application of the concrete coating

3.28

purchaser

company responsible for providing the product order requirements

3.29

reclaimed concrete

concrete that is reintroduced into the mix and does not require processing before reuse

3.30

recycled concrete as aggregate

concrete that has been reprocessed for use as aggregate

3.31

shear resistance

resistance against relative displacement (movement) along the interface between the concrete coating and the underlying pre-coating

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3.32

slip form process

process whereby the concrete is applied to a vertical pipe by means of a slip form mould

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3.33

specific gravity

ratio of mass of a volume of material to the mass of an equal volume of distilled water at a stated temperature

3.34

steel reinforcement

bars, wires, fibres, or strands, which are embedded in the concrete coating in such a manner that the reinforcement and the concrete act together in resisting forces

3.35

supplementary cementitious material

SCM

natural or man-made siliceous or siliceous and aluminous materials that can be used to either partially substitute Portland cement or increase the total content of cementitious material in concrete mixes to improve the strength and durability of concrete

EXAMPLE

Fly ash, ground granulated blast furnace slag, silica fume, calcined shale or metakaolin.

3.36

supplier

provider or manufacturer of supplies or materials used in the application of concrete coating

3.37

test report

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