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

Part 5:

External concrete coatings

iTeh STANDARD PREVIEW
(standards.iteh.ai)

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

ISO 21809-5:2017

Partie 5: Revêtements externes en béton

<https://standards.iteh.ai/catalog/standards/sis/11408100-99ac-4d56-aad0-95a5c5a98be2/iso-21809-5-2017>



iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 21809-5:2017

<https://standards.iteh.ai/catalog/standards/sist/1f408f00-99ae-4d56-aad0-95a5c5a98be2/iso-21809-5-2017>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	3
4 Symbols and abbreviated terms	6
4.1 Symbols.....	6
4.2 Abbreviated terms.....	6
5 General requirements	6
5.1 Rounding.....	6
5.2 Compliance with this document.....	6
6 Information supplied by the purchaser	7
6.1 General information.....	7
6.2 Additional information.....	7
7 Materials	7
7.1 Pipe.....	7
7.2 Cement.....	8
7.3 Supplementary cementitious materials.....	8
7.4 Aggregate — Fine and coarse.....	9
7.5 Heavyweight aggregate.....	9
7.6 Lightweight aggregate.....	9
7.7 Recycled concrete as aggregate.....	10
7.8 Water.....	10
7.9 Steel reinforcement.....	10
7.10 Concrete admixtures.....	10
7.11 Reclaimed concrete.....	10
8 Concrete mix	11
9 Coating application	11
9.1 Qualification.....	11
9.2 Application of concrete coating.....	13
9.3 Environmental conditions.....	13
9.4 Pipe.....	13
9.4.1 Pre-coated pipe.....	13
9.4.2 Bare pipe.....	14
9.5 Steel reinforcement.....	14
9.5.1 General.....	14
9.5.2 Cage reinforcement.....	14
9.5.3 Welded wire mesh reinforcement.....	14
9.5.4 Woven wire mesh reinforcement.....	14
9.5.5 Reinforcement placement.....	15
9.6 Concrete cutback.....	15
9.7 Anode installation.....	15
10 Curing methods	16
11 Inspection and testing	16
11.1 General.....	16
11.2 Test procedures.....	17
11.2.1 Concrete coating thickness — Diameter measurement.....	17
11.2.2 Placement of reinforcement.....	18
11.2.3 Pre-concrete coated pipe weight in air.....	18
11.2.4 Concrete coated pipe weight in air.....	18

11.2.5	Concrete coating density.....	19
11.2.6	Compressive strength.....	19
11.2.7	Water absorption.....	19
11.2.8	Impact resistance.....	20
11.2.9	Shear resistance.....	20
11.2.10	Visual inspection.....	20
11.3	Retesting.....	20
11.4	Test results.....	20
12	Repair of concrete coated pipe.....	21
12.1	General.....	21
12.2	Damaged areas.....	21
12.3	Cracks.....	21
12.4	Gaps.....	21
12.5	Stripping.....	21
13	Markings.....	21
14	Handling and storage.....	22
15	Test reports and inspection documents.....	22
Annex A	(normative) Water absorption test.....	23
Annex B	(normative) Shear resistance test.....	26
Bibliography	28

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 21809-5:2017

<https://standards.iteh.ai/catalog/standards/sist/1f408f00-99ae-4d56-aad0-95a5c5a98be2/iso-21809-5-2017>

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document 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*.

This second edition cancels and replaces the first edition (ISO 21809-5:2010), which has been technically revised.

A list of all parts in the ISO 21809 series can be found on the ISO website.

Introduction

It is necessary that users of this document be aware that further or differing requirements might be needed for individual applications. This document 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 document and provide details.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 21809-5:2017](https://standards.iteh.ai/catalog/standards/sist/1f408f00-99ae-4d56-aad0-95a5c5a98be2/iso-21809-5-2017)

<https://standards.iteh.ai/catalog/standards/sist/1f408f00-99ae-4d56-aad0-95a5c5a98be2/iso-21809-5-2017>

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 document 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 document is applicable to concrete thicknesses of 25 mm or greater.

2 Normative references (standards.iteh.ai)

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1920-5, *Testing of concrete — Part 5: Properties of hardened concrete other than strength*

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

ISO 16120-2, *Non-alloy steel wire rod for conversion to wire — Part 2: Specific requirements for general purpose wire rod*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

EN 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 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*

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

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*

ISO 21809-5:2017(E)

- 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 — Part 1: 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*
- ACI 308.1-98, *Standard specification for curing 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 A1064, *Standard specification for carbon-steel wire and welded wire reinforcement, plain and deformed, for concrete*
- ASTM C31, *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, *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*
- 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, *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 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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <http://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>
ISO 21809-5:2017
<https://standards.iso.org/standards/std/11809-5/ac-4d56-aad0-95a5c5a98be2/iso-21809-5-2017>

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 that undertakes the coating application in compliance with the provisions of this document

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

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 a rotating pipe

3.6

compressive strength

maximum compressive stress at the point of failure

3.7

concrete admixture

material, other than *aggregate* (3.1), water, cement or *supplementary cementitious material* (3.33), 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

3.8

concrete coated pipe weight

weight of the concrete coated pipe in air after the concrete *cutback* (3.13) has been completed

3.9

core

cylindrical specimen of a specific or designated diameter drilled from hardened concrete coating to be tested in compression or examined petrographically

3.10

cover

distance between the surface of the reinforcement and the outer surface of the concrete

3.11

cube

specimen of specific dimensions prepared from fresh concrete to be tested in compression

3.12

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

3.13

cutback

length of pipe left without concrete coating at each end

ISO 21809-5:2017
<https://standards.iteh.ai/catalog/standards/sist/1f408f00-99ac-4d56-aad0-95a5c5a98be2/iso-21809-5-2017>

3.14

cylinder

cylindrical specimen prepared from fresh concrete to be tested in compression

3.15

electrical isolation

absence of electrical continuity between the steel pipe and reinforcement

3.16

field specimen

cores (3.9), *cubes* (3.11), *cylinders* (3.14), prisms or *in situ* specimens taken from the hardened concrete coating

3.17

form process

pump process

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

3.18

gap

annular separation between the concrete coating and the underlying substrate

3.19

holiday

pre-coating (3.25) discontinuity that exhibits electrical conductivity when exposed to a specific voltage

3.20**impact resistance**

resistance of concrete coating against interference and accidental loads

3.21**impingement process**

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

3.22**mix design**

unique blend of *aggregates* (3.1), cement, water, and *supplementary cementitious materials* (3.33) and/or admixtures that will result in a concrete mix

3.23**negative buoyancy**

weight of the concrete coated pipe less the positive buoyancy of the concrete coated pipe when considered as a closed *cylinder* (3.14) immersed in the service environment

3.24**pi tape**

tape used to measure the diameter of the concrete coated pipe

3.25**pre-coating**

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

3.26**purchaser**

company responsible for providing the product order requirements

3.27**reclaimed concrete**

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

3.28**recycled concrete as aggregate**

concrete that has been reprocessed for use as *aggregate* (3.1)

3.29**shear resistance**

resistance against relative displacement (movement) along the interface between the concrete coating and the underlying *pre-coating* (3.25)

3.30**slip form process**

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

3.31**specific gravity**

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

3.32**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

**3.33
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* (3.4) 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.

**3.34
supplier**
provider or manufacturer of supplies or materials used in the application of concrete coating

**3.35
test report**
document that provides the quantitative test results for tests conducted in accordance with the requirements of this document

4 Symbols and abbreviated terms

4.1 Symbols

D_b bare pipe diameter (mm)

D_c average concrete coated pipe diameter (mm)

t_c concrete thickness (mm)

t_p pre-coating minimum thickness (mm) [ISO 21809-5:2017](#)

<https://standards.iteh.ai/catalog/standards/sist/1f408f00-99ae-4d56-aad0-95a5c5a98be2/iso-21809-5-2017>

4.2 Abbreviated terms

AWG American wire gauge

SCM supplementary cementitious materials

5 General requirements

5.1 Rounding

Unless otherwise stated in this document, 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 compliance with ISO 80000-1:2009, Annex B, Rule A.

NOTE For the purposes of this provision, the rounding method of ASTM E29 is equivalent to ISO 80000-1:2009, Annex B, Rule A.

5.2 Compliance with this document

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

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 document. It shall be permissible for the purchaser or end user to make any investigation necessary in