INTERNATIONAL STANDARD

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Paints and varnishes — Friction-reduction coatings for the interior of on- and offshore steel pipelines for non-corrosive gases

Peintures et vernis — Revêtements réduisant le frottement pour l'intérieur de gazoducs en acier enterrés et immergés pour le transport de gaz non corrosifs

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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.ch
Web www.iso.ch

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15741 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 14, *Protective paint systems for steel structures*.

Annexes A, B, C, D, E, F and G form a normative part of this International Standard.

Introduction

Internal coating of pipelines is used to reduce friction and improve the flow conditions when conveying non-corrosive gases, and to offer sufficient corrosion protection during storage and transport of the pipes. The reduction in friction depends on various parameters like the pressure and temperature of the gas, and the diameter of the pipe. Therefore it is not possible to give a single figure for this reduction in friction.

In order to establish sufficient corrosion protection and to ensure optimum performance of the internal coating in the steel pipes, it is necessary for owners of pipelines, planners, consultants, companies carrying out the work, inspectors of protective coatings and manufacturers of coating materials to have at their disposal state-of-the-art information in concise form including requirements for the coating. Such information has to be as complete as possible, unambiguous and easily understandable to avoid difficulties and misunderstandings between the parties concerned.

Paints and varnishes — Friction-reduction coatings for the interior of on- and offshore steel pipelines for non-corrosive gases

1 Scope

This International Standard specifies requirements and methods of test for liquid epoxy paints and internal coatings of such paints in steel pipes and fittings for the conveyance of non-corrosive gas. It also deals with the application of the paint. Other paints or paint systems are not excluded provided they comply with the requirements given in this International Standard. The coating consists of one layer, which is normally shop-applied on blast-cleaned steel by airless spray or other suitable spraying techniques. The applied and cured paint film must be smooth to give the desired reduction in friction. Brush application is only used for small repair jobs.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2409:1992, *Paints and varnishes — Cross-cut test*

ISO 2431:1993, *Paints and varnishes — Determination of flow time by use of flow cups*

ISO 2808:1997, *Paints and varnishes — Determination of film thickness*

ISO 2811 (all parts), *Paints and varnishes — Determination of density*

ISO 2812-1:1993, *Paints and varnishes — Determination of resistance to liquids — Part 1: General methods*

ISO 2812-2:1993, *Paints and varnishes — Determination of resistance to liquids — Part 2: Water immersion method*

ISO 2815:—[1)], *Paints and varnishes — Buchholz indentation test*

ISO 3233:1998, *Paints and varnishes — Determination of percentage volume of non-volatile matter by measuring the density of a dried coating*

ISO 3251:—[2)], *Paints, varnishes and plastics — Determination of non-volatile-matter content*

ISO 6743-4:1999, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems)*

ISO 6860:1984, *Paints and varnishes — Bend test (conical mandrel)*

ISO 7253:1996, *Paints and varnishes — Determination of resistance to neutral salt spray (fog)*

1) To be published. (Revision of ISO 2815:1973)

2) To be published. (Revision of ISO 3251:1993)

ISO 8501-1:1988, *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 8503-1:1988, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces*

ISO 8503-2:1988, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel — Comparator procedure*

3 Terms and definitions

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

3.1
coat
a continuous layer of a coating material resulting from a single application

[ISO 4618-1]

3.2
coater
the company which is responsible for application of the coating material in accordance with the provisions of this International Standard

3.3
coating material manufacturer
the supplier of the coating material

3.4
corrosion
physico-chemical interaction between a metal and its environment which results in changes in the properties of the metal and which may often lead to impairment of the function of the metal, the environment or the technical system of which these form a part

[ISO 8044]

3.5
dry film thickness (DFT)
the thickness of a coating remaining on the surface when the coating has hardened

[ISO 12944-5]

3.6
natural gas
complex mixture of hydrocarbons, primarily methane, but generally also including ethane, propane and higher hydrocarbons in much smaller amounts and some non-combustible gases, such as nitrogen and carbon dioxide

[ISO 14532]

3.7
nominal dry film thickness
NDFT
the dry film thickness specified for each coat or for the whole paint system to achieve the required durability

[ISO 12944-5]

3.8
paint
a pigmented coating material in liquid or in paste or powder form which, when applied to a substrate, forms an opaque film having protective, decorative or specific technical properties

[ISO 4618-1]

3.9
pinhole
film defect characterized by small pore-like flaws in a coating which extend entirely through the applied film and have the general appearance of pinpricks when viewed by reflected light

3.10
pot life
the maximum time during which a coating material supplied as separate components should be used after they have been mixed together

[ISO 4618-1]

3.11
purchaser
the organization or individual that buys the coated pipes and fittings

3.12
substrate
the surface to which the coating material is applied or is to be applied

[ISO 4618-1]

3.13
tack-free
the state of a coating when a finger touching the surface no longer leaves a pronounced mark

4 Coating material

4.1 General

The coating material shall typically be a two-pack epoxy paint. It shall not contain any substances which will be released from the paint film after it has cured and are proven to be detrimental to the operation of the pipeline and the quality of the gas.

Unless otherwise agreed, the coating material shall be qualified in accordance with 4.2 and 4.3 and shall not be changed after qualification.

The manufacturer of the coating material shall provide on request infrared spectrograms of the base component and the curing agent component (see 4.2.8).

In addition, the manufacturer shall provide a product data sheet (see 4.6), a health and safety data sheet and a certificate stating the test results obtained in accordance with 4.2 and 4.3 respectively and, if applicable, deviating test conditions.

The manufacturer shall also provide with every batch of the coating material a batch test certificate stating the information as given in 4.8.

Unless otherwise agreed, the applied coating shall provide corrosion protection during storage and transport for a minimum period of one year without significant breakdown of the coating.

The typical operating-temperature range for this type of coating is between −20 °C and 110 °C.

Where, subsequently, external coatings have to be applied, care shall be taken not to allow the internal coating to be damaged by the elevated temperatures which may occur.

4.2 Particular requirements for qualification of the coating material

4.2.1 General

The following subclauses describe the laboratory test methods which are required for qualification of the coating material.

4.2.2 Non-volatile matter (by mass)

When determined in accordance with ISO 3251, the non-volatile matter (by mass) of the coating material shall comply with the value specified by the coating material manufacturer in the qualification certificate (Table 2).

4.2.3 Non-volatile matter (by volume)

When determined in accordance with ISO 3233, the non-volatile matter (by volume) of the coating material shall comply with the value specified by the coating material manufacturer in the product data sheet (Table 1).

4.2.4 Viscosity

When determined by the method specified by the manufacturer, the viscosity of the ready-mixed coating material shall comply with the value specified by the coating material manufacturer in the qualification certificate (Table 2).

The viscosity should preferably be measured in accordance with ISO 2431.

4.2.5 Density

When determined in accordance with one of the parts of ISO 2811, the density of the coating material shall comply with the value specified by the coating material manufacturer in the product data sheet (Table 1).

4.2.6 Ash (residue on ignition)

When determined in accordance with the method described in annex A, the ash (residue on ignition) of the coating material shall comply with the value specified by the coating material manufacturer in the qualification certificate (Table 2).

4.2.7 Pot life

The pot life is considered to be the time taken by the ready-mixed coating material to reach a condition at which it can no longer be applied satisfactorily. The pot life shall be specified in the product data sheet (see 4.6).

4.2.8 Infrared spectrograms

Infrared spectrograms of the base component and the curing agent component shall be submitted on request.

4.2.9 Appearance

The appearance and continuity of the coating shall be inspected visually without any magnification.

4.3 Particular requirements for qualification of the cured paint film

4.3.1 Preparation of test panels

Perform the tests specified in 4.3.3 to 4.3.12 on coatings applied to the required dry film thickness specified in 4.3.3 by spraying on to test panels (steel or glass). Prepare steel test panels as specified in 5.2 and glass panels as specified in annex E. Apply the paint in accordance with the instructions of the coating material manufacturer. Perform each test at least in duplicate.

4.3.2 Conditioning of test panels

If specified, condition the coated test panels using one of the following cycles, depending on the substrate and on the individual test. Cycle B and cycle C are optional and the choice of the conditioning cycle depends on the time available to perform the test procedure.

Cycle A

Substrate: steel or glass

— condition at 18 °C to 25 °C and $\leqslant$ 80 % relative humidity until the coating is at least tack-free (see 3.13);

— dry for 30 minutes in a circulating-air oven at (75 ± 2) °C;

— condition for a minimum of 30 minutes at 18 °C to 25 °C and $\leqslant$ 80 % relative humidity before testing.

Cycle B

Substrate: steel or glass

— condition at 18 °C to 25 °C and $\leqslant$ 80 % relative humidity until the coating is at least tack-free (see 3.13);

— dry for 30 minutes in a circulating-air oven at (150 ± 2) °C;

— condition for a minimum of 30 minutes at 18 °C to 25 °C and $\leqslant$ 80 % relative humidity before testing.

Cycle C

Substrate: steel or glass

— condition at 18 °C to 25 °C and $\leqslant$ 80 % relative humidity until the coating is at least tack-free (see 3.13);

— dry for 30 minutes in a circulating-air oven at (40 ± 2) °C;

— condition for a minimum of 30 minutes at 18 °C to 25 °C and $\leqslant$ 80 % relative humidity before testing.

4.3.3 Dry film thickness

Unless otherwise agreed, the dry film thickness of the coating, applied on a glass or steel panel, shall be between 60 µm and 100 µm except for the test described in 4.3.6 (resistance to neutral salt spray).

Unless otherwise agreed, the dry film thickness shall be measured in accordance with ISO 2808:1997, Method No. 2 for glass and Method No. 10 for blast-cleaned steel, following the procedure given in annex B.

4.3.4 Adhesion

When determined in accordance with ISO 2409, the cross-cut classification of the coating applied on steel panels and conditioned using cycle B or C (see 4.3.2) shall be equal to or lower than 1.

4.3.5 Buchholz hardness

When determined in accordance with ISO 2815, the Buchholz hardness of the coating, applied on glass or steel panels and conditioned using cycle B or C (see 4.3.2) shall have a value of 94 or more.

4.3.6 Resistance to neutral salt spray

The coating, applied on steel panels with a dry film thickness of 60 μm to 75 μm, conditioned using cycle B or C (see 4.3.2), and with an X-cut down to the substrate located at least 20 mm from any edge, shall be tested in accordance with ISO 7253 for 480 h.

After the test, allow the test panels to dry for at least 30 min at 18 °C to 25 °C and ⩽ 80 % relative humidity.

The coating shall be free from any signs of deterioration, for example blistering (except in the area within 2,0 mm from the X-cut), cracking and staining. Any corrosion shall extend not more than 2,0 mm at the most from the X-cut. It shall not be possible to remove by means of clear plastic tape more than 3,0 mm of the coating in any direction from the area around the X-cut.

4.3.7 Resistance to artificial ageing

Prepare two different sets of coated test panels, each set consisting of 3 steel panels. The dimensions of the panels shall be approx. 100 mm × 50 mm × 0,8 mm.

Carry out the following procedure:

— condition set 1 using cycle C (see 4.3.2);

— condition set 2 using cycle C (see 4.3.2) and then age the panels at 80 °C in a circulating-air oven for 100 h, followed by conditioning for 24 h at 18 °C to 25 °C and ⩽ 80 % relative humidity;

— after ageing, subject the test panels to a bend test in accordance with 4.3.8.

The result of the bend test shall comply with the requirement specified in 4.3.8.

4.3.8 Bend test (conical mandrel)

Prepare steel panels and condition them using cycle B or C (see 4.3.2). When the panels are tested in accordance with ISO 6860, the maximum extent of cracking along the panel from the small end of the mandrel shall be less than or equal to 13 mm, and there shall be no loss of adhesion.

4.3.9 Resistance to gas pressure variations

Prepare steel panels and condition them using cycle B or C (see 4.3.2). When the panels are tested in accordance with annex C, they shall have a generally good appearance when examined in accordance with 4.2.9 and shall not show any blistering. The adhesion value shall fulfil the requirements as given in 4.3.4 after conditioning for 24 h and 40 h at 18 °C to 25 °C and ⩽ 80 % relative humidity.

4.3.10 Resistance to water immersion

Prepare steel panels and condition them using cycle B or C (see 4.3.2). When the panels are tested in accordance with ISO 2812-2 for 480 h, the coating shall not show any blistering or appreciable softening. The examination shall be carried out 3 min after the panels have been removed from the test liquid.