BRITISH STANDARD

BS EN
10301:2003

Steel tubes and fittings for on and offshore pipelines — Internal coating for the reduction of friction for conveyance of non corrosive gas

The European Standard EN 10301:2003 has the status of a British Standard

ICS 23.040.99; 25.220.60; 75.180.10

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 10301:2003.

The UK participation in its preparation was entrusted by Technical Committee ISE/16, Protective coatings and linings of metal pipes and fittings, to Subcommittee ISE/16/-/10, Internal coatings and linings for steel pipes and fittings, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Steel tubes and fittings for on and offshore pipelines - Internal coating for the reduction of friction for conveyance of non corrosive gas

Tubes en acier et raccords pour canalisations enterrées et immergées - Revêtement interne antifriction pour le transport de gaz non corrosifs

Stahlrohre und -formstücke für On- und Offshore-Rohrleitungen - Innenbeschichtung zur Verringerung der Reibung beim Transport von nicht korrosivem Gas

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CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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Contents

page

Foreword 4

1 Scope 5

2 Normative references 5

3 Terms and definitions 6

4 Coating material 6
4.1 General 6
4.2 Qualification of coating materials 6
4.2.1 General 6
4.2.2 Non-volatile matter (by mass) 8
4.2.3 Viscosity at (23 ± 2) °C 8
4.2.4 Density 8
4.2.5 Ash content 9
4.2.6 Pot-life 9
4.2.7 Appearance 9
4.2.8 Dry film thickness 9
4.2.9 Adhesion test – Cross-cut test 9
4.2.10 Buchholz hardness 9
4.2.11 Resistance to neutral salt spray 9
4.2.12 Ageing test 10
4.2.13 Bend test - Conical mandrel 10
4.2.14 Resistance to gas pressure variation 10
4.2.15 Resistance to hydraulic blistering 11
4.2.16 Resistance to water immersion 11
4.2.17 Chemical resistance 11
4.2.18 Infrared analysis 12
4.3 Technical documentation 12
4.4 Packaging 12

5 Information to be supplied by the purchaser 13

6 Application of the coating 14
6.1 Surface preparation 14
6.2 Composition of the coating 14
6.2.1 Coating material preparation 14
6.2.2 General requirements for coating material application 14

7 Requirements of the applied coating 15
7.1 General 15
7.2 Appearance 15
7.3 Dry film thickness 15
7.4 Curing test 15
7.5 Porosity test 15

8 Inspection 16
8.1 General 16
8.2 Documents 16
8.3 Sampling 16
8.4 Nature and frequency of testing and control 16
8.5 Retests 17

9 Repairs 18

10 Marking 18

11 Handling, transportation and storage 18

11.1 Handling 18
11.2 Transportation to the storage area 18
11.3 Storage 18
11.4 Loading of tubes for delivery 18

Annex A (normative) **Ash content** 19
A.1 General 19
A.2 Apparatus 19
A.3 Procedure 19
A.4 Results 19

Annex B (normative) **Dry film thickness** 20
B.1 General 20
B.2 Apparatus 20
B.3 Procedure 20
B.4 Results 20

Annex C (normative) **Resistance to gas pressure variations** 21
C.1 General 21
C.2 Apparatus 21
C.3 Procedure 21
C.3.1 Cyclic pressure test 21
C.3.2 Decompression blistering test 22
C.4 Results 23

Annex D (normative) **Resistance to hydraulic blistering** 24
D.1 General 24
D.2 Apparatus 24
D.3 Procedure 24
D.4 Results 25

Annex E (normative) **Porosity of the film on glass panels** 26
E.1 General 26
E.2 Apparatus 26
E.3 Procedure 26
E.3.1 Sample preparation 26
E.3.2 Wet film porosity 26
E.3.3 Dry film porosity 26
E.4 Results 26

Annex F (normative) **Wet sponge test** 27
F.1 General 27
F.2 Apparatus 27
F.3 Procedure 27
F.4 Results 27

Bibliography 28

Foreword

This document EN 10301:2003 has been prepared by Technical Committee ECISS/TC 29 “Steel tubes and fittings for steel tubes”, the secretariat of which is held by UNI/UNSIDER

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2004, and conflicting national standards shall be withdrawn at the latest by February 2004.

Annexes A, B, C, D, E and F are normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the application requirements and methods of test of liquid applied epoxy paints on the internal surface for the reduction of friction of tubes and pipeline fittings for conveyance of non-corrosive gas.

Other paints or paint systems are not excluded provided they comply with the requirements given in this standard.

The coating consist of one layer of liquid product, normally shop applied onto abrasive blast cleaned steel by airless spray or conventional spray techniques. Brush application may be used only for repairs.

The coating qualified in accordance with this standard is considered suitable for operating temperatures between – 20 °C and + 110 °C.

In this European Standard the word "components" is used for tubes and fittings.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN ISO 1513, *Paints and varnishes - Examination and preparation of samples for testing (ISO 1513:1992)*.

EN ISO 1514, *Paints and varnishes - Standard panels for testing (ISO 1514:1993)*.

EN ISO 1519, *Paints and varnishes - Bend test (cylindrical mandrel) (ISO 1519:2002).*

EN ISO 2409, *Paints and varnishes - Cross-cut test (ISO 2409:1992)*.

EN ISO 2431, *Paints and varnishes - Determination of flow time by use of flow cups (ISO 2431:1993, including Technical Corrigendum 1:1994)*.

EN ISO 2555, *Plastics - Resins in the liquid state or as emulsions or dispersions - Determination of apparent viscosity by the Brookfield Test method (ISO 2555:1989)*.

EN ISO 2808, *Paints and varnishes - Determination of film thickness (ISO 2808:1997)*.

EN ISO 2811, Paints and varnishes - Determination of density (ISO 2811:1997).

EN ISO 2812-1, *Paints and varnishes - Determination of resistance to liquids - Part 1: General methods (ISO 2812-1:1993).*

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

EN ISO 2815, *Paints and varnishes - Buchholz indentation test (ISO 2815:1973)*.

EN ISO 3251, *Paints and varnishes - Determination of non-volatile matter of paints, varnishes and binders for paints and varnishes (ISO 3251:1993)*.

EN ISO 6860, *Paints and varnishes - Bend test (conical mandrel) (ISO 6860:1984).*

EN ISO 7253, Paints and varnishes - Determination of resistance to neutral salt spray (fog) (ISO 7253:1996).

EN ISO 8501-1, *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 8501-1:1988).*

EN 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 8503-4:1988).*

3 Terms and definitions

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

3.1
coating material manufacturer
supplier of the coating material

3.2
coater
person responsible for applying the coating material to the components to be coated in accordance with the provisions of this standard

3.3
purchaser
company that buys the coated tubes and fittings

3.4
tack free
state of the coating when a finger touching the surface no longer leaves any pronounced marks

3.5
roughness
roughness parameter, R_{y5} (roughness depth average of 5 successive evaluation areas), in micrometres

[EN ISO 8503-4:1995]

4 Coating material

4.1 General

The coating material is generally composed of two packs: base and hardener.

The coating material shall not contain any substances that will be released from the paint film after it is cured and are proven to be detrimental to the operations of the pipeline.

The coating material shall be qualified in accordance with 4.2 and shall not be changed after qualification.

The applied and cured paint film shall be smooth to obtain a reduction in the friction.

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

4.2 Qualification of coating materials

4.2.1 General

This subclause describes the laboratory tests required for qualification of coating materials by the coating material manufacturer.

The properties required for qualification of the coating are given in Table 1 and the tests reported shall be carried out on coating material and test panels (steel panels) that, unless otherwise specified, have been prepared and coated according to EN ISO 1513 and EN ISO 1514 and the requirements of the coating material manufacturer.

The dry film thickness of the coating on the panels shall be measured in accordance with 4.2.8.

Coating applied to glass and steel panels shall be conditioned in accordance with one of the following cycles, depending on the test method:

— cycle A;

  — sample: glass panel;

  — at (23 ± 2) °C with a relative humidity ≤ 80 %, until the coating is at least "tack free" (see 3.4);

  — heat for 30 min in a circulating air oven at (75 ± 5) °C.

— cycle B

  — sample: steel panel;

  — at (23 ± 2) °C with a relative humidity ≤ 80 %, until the coating is at least "tack free" (see 3.4);

  — heat for 30 min in a circulating air oven at (150 ± 5) °C.

Other conditioning cycles are allowed by agreement.

Table 1 — Qualification of the coating material

Properties		Subclause	Method of test
Non-volatile matter (by mass)		4.2.2	EN ISO 3251
Viscosity at (23 ± 2) °C		4.2.3	EN ISO 2431 or EN ISO 2555 [a]
Density		4.2.4	EN ISO 2811
Ash content		4.2.5	Annex A
Pot-life		4.2.6	-
Appearance		4.2.7	Visual
Dry film thickness		4.2.8	Annex B
Adhesion test Cross-cut test		4.2.9	EN ISO 2409
Buchholz hardness		4.2.10	EN ISO 2815
Neutral salt spray		4.2.11	EN ISO 7253
Ageing test		4.2.12	-
Bend test - Conical mandrel		4.2.13	EN ISO 6860
Resistance to gas pressure variations		4.2.14	Annex C
Resistance to hydraulic blistering		4.2.15	Annex D
Resistance to water immersion		4.2.16	EN ISO 2812-2
Chemical resistance	Hydrocarbons	4.2.17	EN ISO 2812-1
	Diethylenic or triethylenic glycol solution		
	Lubricating oil [b]		
	Pure methanol		
Infrared spectrograms		4.2.18	-

NOTE Other scheme of qualification may be requested by the purchaser.

[a] ISO 2555 can be used only during qualification.

[b] Commercial lubricating oil unless otherwise required by the purchaser.

4.2.2 Non-volatile matter (by mass)

When determined in accordance with EN ISO 3251, the non-volatile matter (by mass) of the coating material shall comply with the value specified by the manufacturer in the technical data sheet.

4.2.3 Viscosity at (23 ± 2) °C

The viscosity shall be determined in accordance with the method defined in EN ISO 2431 or EN ISO 2555.

The acceptance criterion shall be based on the viscosity value specified by the coating material manufacturer in the technical data sheet.

4.2.4 Density

The density shall be determined in accordance with the method defined in EN ISO 2811.

The acceptance criterion shall be based on the value specified by the coating material manufacturer in the technical data sheet.

4.2.5 Ash content

The ash content shall be determined in accordance with the method defined in Annex A.

The acceptance criterion shall be based on the value specified by the coating material manufacturer in the technical data sheet.

4.2.6 Pot-life

When determined by the method specified by the manufacturer, the pot-life of the ready mixed coating material shall comply with the value specified by the manufacturer in the technical data sheet.

4.2.7 Appearance

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

The coating shall have uniform colour, a smooth appearance and shall be free of holidays, or other defects such as runs.

4.2.8 Dry film thickness

The coating thickness shall be measured in accordance with the number of measurements and the procedure given in Annex B.

If checked on glass panels or steel panels, the applied coating shall be subjected to the conditioning cycle A or B respectively, in accordance with 4.2.

If checked on glass panels, the dry film thickness shall be measured in accordance with the methods 2 or 3 defined in EN ISO 2808:1999.

4.2.9 Adhesion test – Cross-cut test

Testing shall be carried out on coated steel panels previously subjected to conditioning cycle B in accordance with 4.2.

The adhesion shall be determined in accordance with the method defined in EN ISO 2409 and shall be lower than or equal to Grade 1. Testing shall be carried out on two samples.

4.2.10 Buchholz hardness

Testing shall be carried out on coated steel panels previously subjected to conditioning cycle B in accordance with 4.2.

This test shall be carried out in accordance with the method defined in EN ISO 2815.

In any case, the minimum Buchholz hardness shall be equal to or greater than 94.

4.2.11 Resistance to neutral salt spray

Testing shall be carried out on coated steel panels previously subjected to conditioning cycle B in accordance with 4.2.

The performance of the coating in salt spray fog shall be assessed in accordance with the method defined in EN ISO 7253.

The test duration shall be 480 h.

Testing shall be carried out on two samples. Panels subjected for testing shall have a dry film thickness between 60 µm and 75 µm.

Each panel shall be marked with an "X-cut" through the coating to the steel substrate, located at least 20 mm from any edge.

After the test the panels shall be allowed to dry for at least 30 min at (23 ± 2) °C with a relative humidity ≤ 80%.

The coating shall be free from any signs of deterioration, such as blistering (apart from within 3,0 mm of the X cut), cracking and staining. The corrosion shall extend not more than 2 mm 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.

4.2.12 Ageing test

This test shall be performed on coated specimens measuring approximately 100 mm × 50 mm × 0,8 mm.

After coating the specimens shall be subjected to the following conditioning cycle:

— 10 days at 18-25 °C with a relative humidity ≤ 80 %;

— heating for 24 h in a circulating air oven at (50 ± 2) °C.

The specimens shall be then subjected to thermal ageing at (80 ± 5) °C in a circulating air furnace for 4 days followed by conditioning for 24 h at a temperature between 18 °C and 25 °C

If special curing requirements are given in Table 2, the specimens shall be subjected to these before conditioning and ageing as detailed above.

After ageing, the specimens shall be subjected to the bend test described in 4.2.13.

4.2.13 Bend test - Conical mandrel

Testing shall be carried out on coated steel panels previously subjected to conditioning cycle B in accordance with 4.2 by unaided visual inspection.

The test shall be carried out in accordance with the method defined in EN ISO 6860.

The maximum length of cracking along the panel from the small end of the mandrel shall not exceed 13 mm.

4.2.14 Resistance to gas pressure variation

Testing shall be carried out on coated steel panels previously subjected to conditioning cycle B in accordance with 4.2.

The test pressure is fixed at a minimum of 100 bar.

After being subjected to the test described in Annex C and conditioned at (23 ± 2) °C for 24 h, 48 h and 72 h , the general appearance of the coating shall meet the requirements of 4.2.7 and the adhesion value shall conform to 4.2.9.

4.2.15 Resistance to hydraulic blistering

Testing shall be carried out on coated steel panels previously subjected to conditioning cycle B in accordance with 4.2.

Tests shall be carried out in accordance with the method defined in Annex D.

After removal from the chamber the samples shall be inspected visually within 3 min, according to 4.2.7.

The coating shall not exhibit any blistering and/or any appreciable softening.

A change in the coating colour or in its brightness shall not be considered as an alteration of the coating quality.

After removal from the chamber and conditioning at (23 ± 2) °C for 24 h, the coating adhesion value shall conform to 4.2.9.

4.2.16 Resistance to water immersion

Testing shall be carried out on coated steel panels previously subjected to conditioning cycle B in accordance with 4.2.

Panels subjected to the test shall have a dry film thickness of (60 – 75) µm.

When the coated panels are tested in accordance with EN ISO 2812-2 immersed for 480 h at room temperature in distilled water, the coating shall not show any blistering or appreciable softening. The first examination shall be carried out 3 min after the panels have been removed from the bath.

A change in the coating colour or in its brightness shall not be considered as an alteration of the coating quality.

After removal from the chamber and conditioning at (23 ± 2) °C for 24 h, the coating adhesion value shall conform to 4.2.9.

4.2.17 Chemical resistance

Testing shall be carried out on coated steel panels previously subjected to conditioning cycle B in accordance with 4.2.

When the coated panels are tested in accordance with EN ISO 2812-1 for 168 h at room temperature the coating shall not show any blistering or appreciable softening. The first examination shall be carried out 3 min after the panels have been removed from the test liquid.

A change in the coating colour or in its brightness shall not be considered as an alteration of the coating quality.

After removal from the chamber and conditioning at (23 ± 2) °C for 24 h, the coating adhesion value shall conform to 4.2.9.

Use the following test liquids:

— cyclohexane;

— a solution, of diethylene glycol in water – 95 % by volume;

— hexane;

— methanol;

— toluene;

— lubricating oil.

4.2.18 Infrared analysis

If requested by the purchaser, infrared analysis shall be carried out on the base and the hardener.

Reference infrared spectra of the base, hardener and mixed product obtained with a standard KBr disc or other method, shall be supplied for coating material and applicator approval.

4.3 Technical documentation

As a minimum requirement, the technical documentation drawn up by the coating material manufacturer for the technical data sheets and batch test certificates shall contain the information given in Table 2 (methods for any test detailed shall be given).

4.4 Packaging

As a minimum requirement, all materials supplied for coating operations shall be suitably marked with the following details:

— the coating material manufacturer's name;

— the name of the material;

— the batch number;

— the use-by date;

— the storage conditions;

— the colour of the material.

Table 2 — Contents of data sheets and certificates

Information	Technical data	Batch test certificate
Date of issue	X	X
Name of manufacturer	X	X
Name and type of product	X	X
Type of base	X	
Type of hardener	X	
Factory of origin		X
Batch or production lot number [a]		X
Date of manufacture and use by date [a]		X
Colour of the mixed product	X	
Physical state of the delivered product [a]	X	
Methods of application	X	
Solids by volume	X	
Solids by weight	X	X
Theoretical spreading rate (l/m^2 or kg/m^2 for a given dry film thickness)	X	
Size of container [a]	X	
Storage conditions [a]	X	

continued

Table 2 — Contents of data sheets and certificates *(concluded)*

Information	Technical data	Batch test certificate
Shelf life [a]	X	
Pot-life	X	
Surface preparation	X	
Mixing instructions	X	
Recommended cleaning solvent(s)	X	
Recommended instructions for application	X	
Range of application temperature (ambient, tube and product) and humidity	X	
Recommended thinner(s)	X	
Maximum recommended quantity of thinner(s)	X	
Recommended viscosity range during application	X	
Recommended minimum and maximum dry film thickness	X	
Range of service temperature	X	
Specific curing requirements	X	
Buchholz hardness at (23 ± 2) °C of the fully cured coating	X	
Time to complete curing	X	
Time before outdoor exposure	X	
Viscosity (23 ± 2) °C [b]	X	X
Density	X [b]	X [a]
Ash content		X
Infrared scan [a]		X
Thermal analysis data	X	
NOTE The test methods described in this standard should be used. In any case, the test method used for any test shall be given. The acceptable limits shall be given in the test certificate.		
[a] For two-component coating required for base and hardener.		
[b] For two-component coating required for base, hardener and mixed product.		

5 Information to be supplied by the purchaser

The components coated in accordance with this European Standard shall be designated by the reference to this standard.

If applicable, the reference to the standard for the component onto which the coating is applied shall be added to this designation.

EXAMPLE 5000 m of tubes – EN 10224 of 406, 4-4, 0 internal coating EN 10301

6 Application of the coating

6.1 Surface preparation

6.1.1 Prior to abrasive blast cleaning, the steel surface shall be dry and free from contamination (oil, grease, temporary corrosion protection, etc.) and visible surface defects (slivers, laminations, etc.) detrimental to the surface or to the adhesion of the coating.

6.1.2 All components shall be abrasive blast cleaned. The degree of cleanliness shall be at least Sa 2½ as given in EN ISO 8501-1.

The abrasive blast cleaned surface shall have a surface profile R_{y5} of between 25 µm and 60 µm, when measured according to EN ISO 8503-4.

6.1.3 After blast cleaning, the surface of each component shall be inspected and any surface irregularities or imperfections that may have become visible shall be removed using suitable methods.

After removal of these defects, the residual thickness of components shall satisfy the minimum tolerance requirements specified by the relevant standard. All treated areas greater than 10 cm^2 shall be prepared to provide a profile to satisfy the provisions of 6.1.2.

During and after blast-cleaning and prior to application of the coating material, the temperature of the steel surface shall be at least 3 °C above the dew point and the minimum curing temperature given by the coating material manufacturer, whichever is the greater.

6.1.4 Surface contaminants (e.g. residual abrasive dust) shall be removed prior to coating.

6.2 Composition of the coating

6.2.1 Coating material preparation

The coating shall be applied in accordance with the established procedure.

The data sheets shall contain the items required in Table 2.

The coating material shall be rejected if there is contamination or hard settlement of solids in the coating material manufacturer's container or if any other indication of defective material is found.

Each pack shall be stirred or agitated to a homogeneous state before any is withdrawn from its container.

Mixing of the coating material shall be carried out with power equipment that is able to agitate the entire contents of the container and not excessively entrain air in the material. After the material have been mixed, it shall be agitated continuously at a slow speed and, if necessary, diluted according to the coating material manufacturer’s instructions.

6.2.2 General requirements for coating material application

The surface to be coated shall be checked to ensure that it conforms to the specified surface preparation grade and profile.

The paint shall be applied in a covered or enclosed space shielded from wind, blowing dust and inclement weather, using process parameters recommended by the coating material manufacturer.

The ambient temperature and humidity and the temperature of the steel surface during application and subsequent drying/curing shall comply with the recommendations of the coating material manufacturer and the temperature of the steel shall be at least 3 °C above the dew point. In the case of accelerated curing, the temperature shall be as agreed between the coating material manufacturer and the coater.

The paint shall be applied continuously and uniformly to the steel surface. The applied coating shall be uniform and particular attention shall be given to achieve the specified dry film thickness. Unless specified or agreed otherwise, a cutback of (20 ± 5) mm shall be maintained.

When desired, the wet film thickness may be measured in accordance with EN ISO 2808, method 7B. Measure the dry film thickness in accordance with EN ISO 2808, method 6A or 6B.

7 Requirements of the applied coating

7.1 General

The required properties of applied coatings are given below:

— appearance and continuity;

— dry film thickness;

— adhesion test – cross-cut test;

— Buchholz hardness;

— bend test;

— curing test;

— porosity test/wet-sponge test.

The required properties of applied coatings are given in Table 3 and the required controls during production are given in Table 4.

The following tests are not described in 4.2.

7.2 Appearance

The coating shall be inspected visually for uniformity of colour, smoothness and freedom from runs, holidays, or other defects that are detrimental to the quality of the coating.

7.3 Dry film thickness

The dry film thickness shall correspond to 60 µm to 100 µm unless otherwise agreed by the purchaser.

The coating thickness shall be measured in accordance with the method defined in Annex B. -

7.4 Curing test

The coating material shall be applied to steel panels and conditioned the coated panels using the method specified (conditioning cycle B).

Unless otherwise agreed, the resistance of the coating to the thinner recommended for the coating material shall be tested for 4 h according to EN ISO 2812-2.

No softening, wrinkling or blistering of the film shall be observed after a recovery period of 30 min at (23 ± 2) °C.

7.5 Porosity test

The porosity of the wet and dry films shall be checked on glass panels, conditioning cycle A, according to the method defined in Annex E.

A maximum number of 1 pore in the wet film and/or 5 pores in the dry film are allowed.

A pore is considered to be any defect through which light can pass directly.

If the porosity test on glass panel is deemed negative, a wet sponge test according to Annex F shall be carried out on the component related to the glass panel.

At least on ten areas on the coating shall be tested and, excluding welding, the coating shall not have more than one indication per 100 cm^2.

Table 3 — Summary of required properties for production controls

Properties	Requirements		Subclause
Appearance and continuity			7.2
Dry film thickness	60 µm minimum 100 µm maximum		7.3
Adhesion test Cross-cut test	min Grade 1		4.2.9
Buchholz hardness	min 94 [a]		4.2.10
Bend test			4.2.13
Curing test			7.4
Porosity test on glass panels	Wet film	maximum 1 pore	7.5
	Dry film	maximum 5 pores	7.5
Wet-sponge test [b]	max 1 pore / 100 cm^2		Annex F

[a] The acceptance criterion shall be based on a value discussed during coating qualification (see 5.2).

[b] Test is carried out if porosity test on glass panel is deemed negative.

8 Inspection

8.1 General

Inspection shall be carried out when the coating is fully cured in accordance with the data sheet (see Table 2).

8.2 Documents

Inspection operations shall be carried out by the coater as agreed at the time of enquiry and order. A representative appointed by the purchaser may witness these operations (see EN 10021).

The results of these inspection operations shall be recorded by the coater and made available to the representative of the purchaser.

8.3 Sampling

The purchaser's representative, or the coater's inspection representative shall select the components on which the specified tests shall be carried out.

8.4 Nature and frequency of testing and control

The nature and the minimum frequency of the testing and control shall conform to Table 4.

Table 4 — Nature and frequency of testing and control

Properties	Subclause	Method of test	Minimum production control	Coating material and applicator qualification [a] [b]
Surface condition before blasting	6.1.1	EN ISO 8501-1	Every component	3 components
Surface profile after blasting	6.1.2	EN ISO 8503-4	Once per shift [c]	3 components
Surface condition after abrasive blast cleaning	6.1.2	Visual	Every component	3 components
Temperature of components before coating	6.1.3	–	Twice per hour [c]	3 components
Accelerated curing conditions	6.2	–	Continuously [c]	3 components
Temperature and relative humidity during application	6.2.3	–	Continuously [c]	3 components
Viscosity during application	6.2	EN ISO 2431 or EN ISO 2555	Once each mixing [c]	3 components
Wet film thickness	6.2.2	EN ISO 2808	[d]	3 components
Porosity on glass panels of the wet film [e]	7.4	–	3 per shift [c]	3 components
Porosity on glass panels of the dry film [e]	7.4	–	3 per shift [c]	3 components
Appearance and continuity	7.1	Visual	Every component	3 components
Dry film thickness [e]	7.2	Annex B	3 per shift [c]	3 components
Buchholz hardness	4.2.10	EN ISO 2815	3 per shift	3 panels
Cut back	6.2.2	Visual	Every component	3 components
Adhesion test - Cross-cut test	4.2.9	EN ISO 2409	3 per shift [c]	3 panels
Bend test [e]	4.2.13	ISO 6860	3 per shift [c]	3 panels
Curing test	7.3	–	3 per shift [c]	3 panels

a All tests detailed for approval shall be undertaken at least every 3 years for the same system, material and significant technical process.

b The system and applicator approval may be combined with a coating production run.

c each mixing or once at start up if an automatically controlled mixing equipment is used.

d The test shall be carried out as follows :

Automatic plant: 1 tube every 5 or each fitting.

Manual application: 3 times per component.

e The test shall be carried out on both ends of the component.

8.5 Retests

If failures are recorded during production control tests, the coated components produced from the last positive test shall be deemed defective.

In such cases further appropriate testing proposed by the coater may be carried out with the approval of the purchaser.

If the coating is rejected by the purchaser, the coater shall recoat tubes in accordance with a procedure approved by all parties.

9 Repairs

Defective coating shall be repaired in accordance with the coating material manufacturer's recommendations, using a procedure agreed between the purchaser and coater.

The total area to be repaired shall not exceed 1 % of the surface of the coated component.

10 Marking

Marking shall be carried out using a suitable method such as stencil painting or printing, making possible legible and indelible identification using durable materials compatible with the later use of the components.

11 Handling, transportation and storage

11.1 Handling

Coated components shall be handled without causing damage to the coating.

11.2 Transportation to the storage area

During transportation to the storage area at the coater's works, the coater shall take all relevant precautions to avoid damage to the coating.

11.3 Storage

Coated pipes shall be stored in such a way that the coating quality will not be affected.

11.4 Loading of tubes for delivery

During loading of components in the factory, all relevant precautions shall be taken to ensure that the loading is carried out correctly to avoid damage to the components and the coating during transport.

The coater is responsible for supplying correctly coated components, which includes the coating cure.

Annex A
(normative)

Ash content

A.1 General

This test determines of determining the percentage ash content of the coating based on the non volatile matter content.

A.2 Apparatus

The apparatus shall consist of:

— porcelain crucible;

— desiccator;

— muffle furnace;

— balance (accurate to at least 1 mg).

A.3 Procedure

Weigh into a porcelain crucible between 3 g and 5 g of the ready to use paint to an accuracy of 1 mg .

Place the crucible in a hood and heat with a low flame until the contents of the crucible are a dry charred mass.

Transfer the crucible to a muffle furnace and ignite the residue at a red heat (not exceeding 600 °C) until the ash is free of carbon.

Cool in a desiccator.

Repeat the ignition and weighing of the ash until the difference in weight between successive operations is less than 1 mg.

A.4 Results

Record the ash content calculated as follows:

$$A\ (\%) = \left(\frac{M_2}{M_1}\right) \times 100$$

where

A ash content, expressed in percentage;

M_1 sample used, expressed in grams;

M_2 ash content, expressed in grams.

Annex B
(normative)

Dry film thickness

B.1 General

The test consists of measuring, by means of a non-destructive process, the thickness of the applied coating according to EN ISO 2808:1999, method 6A or 6B.

B.2 Apparatus

A magnetic or electromagnetic measuring instrument with ± 3 % accuracy shall be used.

The instrument shall be verified according to the manufacturer instructions.

The instrument shall be calibrated with respect to the abrasive blast cleaned steel when possible, on which the coating is applied in the range of thickness of the coating to be tested.

Correction factor of the surface roughness shall be determined and added to the required DFT value.

The instrument shall be zeroed on a smooth, flat surface and adjusted

A series of reading shall be taken on the unpainted abrasive blast cleaned surface to determine the correction factor on taking readings of the painted surface. The readings obtained shall be reduced by the correction factor to give the true reading of paint above the peaks.

B.3 Procedure

On each component to be tested, at least 8 values shall be recorded.

Each value shall be constituted by the arithmetic mean of 5 different measurements taken very close to the point to be measured.

In any case no measurement shall exceed the specified values by more than 20 %.

B.4 Results

The arithmetic mean of measured values shall be calculated.

NOTE In case of dispute of the result at one point, the re-calibration of the instrument should be undertaken and five measurements at this point should be carried out again very close to the point to be measured. The arithmetic mean of the results of the 5 measurements should be calculated.

Annex C
(normative)

Resistance to gas pressure variations

C.1 General

The test consists of verifying, by evaluation of visual appearance and determination of the adhesion, the behaviour of the applied coating after being subjected to pressure variations in a gaseous environment (N_2).

C.2 Apparatus

The apparatus shall consist of:

— specimens (see note below);

— a system allowing the pressure to increase by 1 bar per minute;

— nitrogen (as testing gas component);

— sealed chamber capable of resisting the test pressure for the full duration of the test.

NOTE Samples can be of two types:

— approximately 100 mm × 50 mm × 0,8 mm steel panels;

— steel lengths of pipe 100 mm long with a minimum diameter of 80 mm or, if the diameter is too large to fit into the chamber, specimens obtained from the component.

The test panels or pipes shall be surface prepared and coated at the same time and in the same way as production.

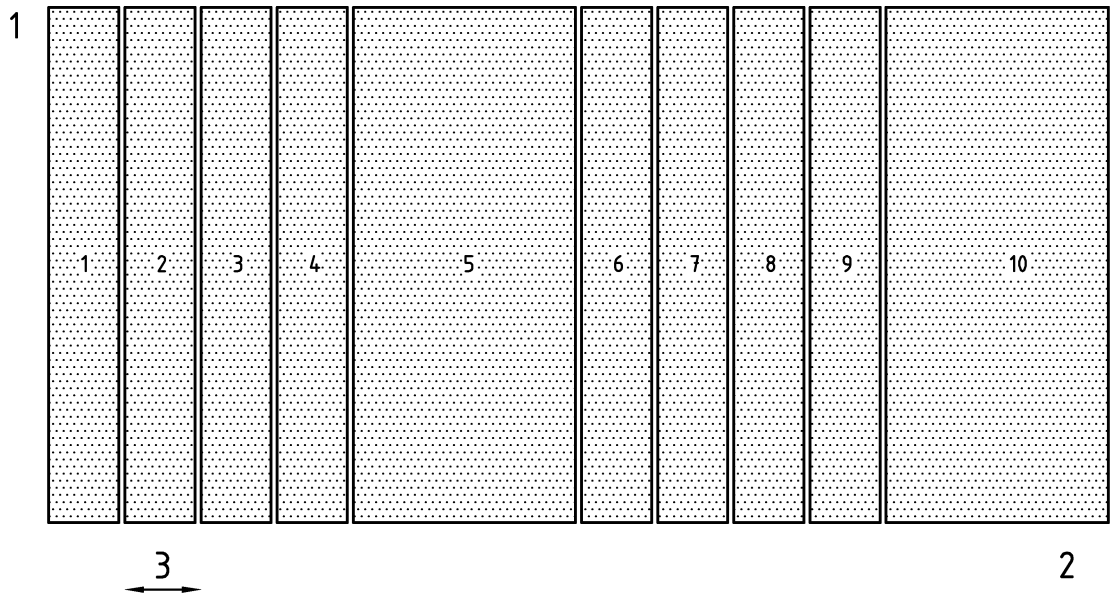
C.3 Procedure

Unless otherwise specified by the manufacturer, a period of one month shall elapse after the coating has been applied before carrying out the tests.

C.3.1 Cyclic pressure test

This test is carried out only as a qualification test on the internal coatings.

Put the specimens in the chamber and then subject them to a set of 10 test cycles, in Figure C.1 shows the composition of each cycle.



Key

1 Pressure
2 Time
3 Period of 24 h

Figure C.1 – Pressure cycles

— Progressively increase the test pressure to 100 bar:

— keep the sample at pressure for a fixed period of time in order to eventually let the testing gas diffuse into the coating:

  — 20 h from the 1st to 4th cycle and from 6th to 9th cycle;

  — 68 h for the 5th and 10th cycle;

— rapidly decrease the pressure over a few minutes (not more than 5 min);

— when gas is present, leave the coating at atmospheric pressure for the time necessary, about 3 h, in order to permit the development of eventual blisters on the coating so that the cycle lasts from 24 h to 72 h (this last period corresponds to the week-end that is from Friday to Monday).

Open the chamber at the end of the 10th test cycle and examine the appearance of the coating tested and to carry out an adhesion test according EN ISO 2409; immediately after 24 h and 48 h observe all changing in appearance (corrosion, spots, blisters...).

After removal from the chamber, an adhesion test shall be carried out according to EN ISO 2409.

C.3.2 Decompression blistering test

This test is carried out only when the coated pipes are utilised at operating pressures higher than 100 bar, the test pressure is equal to one and a half times the maximum operating pressure.

Put the specimens in the chamber and then submit them to the set pressures for 24 h so that the test gas can eventually spread in the coating.

Rapidly decrease the pressure in a few minutes (not more than 5 min).

Open the chamber and examine the appearance of the coating tested and to carry out an adhesion test according EN ISO 2409; immediately (within 3 min) and after 24 h and 48 h observe all changing in appearance (corrosion, spots, blisters...).

C.4 Results

Record all the degradation observed immediately after removal of the sample from the chamber and indicate their evolution after 24 h and 48 h.

Check the adhesion of the coating after the test. Acceptance criterion according to 4.2.9.

Annex D
(normative)

Resistance to hydraulic blistering

D.1 General

This test examines, by evaluation of the visual appearance and coating adhesion, the behaviour of the applied coating when subjected to pressure variation in liquid environment (water/$CaCO_3$).

D.2 Apparatus

The apparatus shall consist of the following:

— the test specimens (see note below);

— a system that allows the test pressure to increase at a rate of 1 bar per minute;

— the test solution (a saturated solution of $CaCO_3$ in water) ;

— a sealed test chamber able to withstand the test pressure for the duration of the test.

NOTE The test specimens can be of two types:

— steel panels measuring approximately 100 mm × 50 mm × 0,8 mm;

— sections of steel pipe 100 mm long with a minimum diameter of 80 mm. If the diameter of the pipe is too large to fit into the chamber, specimens obtained from the pipe sliding collar.

The test specimens shall be prepared and coated at the same time and in the same manner as production pipe.

D.3 Procedure

Unless otherwise specified by the coating material manufacturer, testing shall be carried out one month after application of the coating.

If the operating pressure of the component is 100 bar or less, testing shall be carried out at 100 bar. However, if the operating pressure is greater than 100 bar, the test pressure shall be one and a half times the maximum operating pressure.

The test samples shall be placed in the chamber and subjected to the specified pressures for 24 h so that the water can eventually diffuse through the coating. At the end of the test, the pressure shall be reduced to normal rapidly, less than 5 min.

The chamber shall be opened, the appearance of the coating tested shall be examined immediately (within 3 min) and after 24 h and 48 h; any change in appearance (such as corrosion, spotting or blisters) shall be observed.

After removal from the chamber, an adhesion test conform to EN ISO 2409 shall be carried out.

D.4 Results

Any degradation in the coating immediately after removal from the chamber and the evolution of defects after 24 h and 48 h shall be recorded.

The adhesion of the coating after testing shall be checked taking into account of the acceptance criterion as given in 4.2.9.

Annex E
(normative)

Porosity of the film on glass panels

E.1 General

The test determines, by means of a visual determination, the presence of porosity in film on a glass panel coated at the same time as the steel components.

E.2 Apparatus

The apparatus shall consist of the following:

— glass test panels (approximately 75 mm × 25 mm× 1 mm) that are frosted on the side to be coated;

— an observation unit consisting of:

  — a closed support containing a 100 W bulb positioned vertically with the source facing upwards;

  — a panel support, adjusted to the dimensions of the glass panels dimensions, placed 100 mm above the bulb and such that the light may only illuminate the central area.

E.3 Procedure

E.3.1 Sample preparation

The glass panels shall be cleaned by immersion in a solvent and later by immersion in acetone and allowed to dry in air for a few seconds.

The panels shall then be placed inside the steel components with the frosted side upwards; and secured in position by means of an adhesive band or tape.

The panels shall be free from dust or pollutants immediately before the coating is applied.

E.3.2 Wet film porosity

Five minutes after the coating has been applied, the glass panel shall be placed on the observation unit and the coating checked visually for porosity without magnification.

E.3.3 Dry film porosity

After examination, the panels shall be subjected to the conditioning cycle A given in 4.2

Then the panel shall be placed again on the observation unit and a second visual examination shall be performed without using magnification

E.4 Results

The number of pores in the wet film and the dry film shall be recorded

Annex F
(normative)

Wet sponge test

F.1General

The test determines the presence of any porosity or other damage to the coating by using a scanning electrode, energized by a low-voltage.

Defects shall be detected by a sound signal caused by short circuit between the electrode (sponge) and the earth (steel component).

F.2Apparatus

The apparatus shall consist of the following:

— an adjustable low-voltage wet-sponge tester, equipped with an audible alarm;

— a wet sponge electrode connected by a probe to the body of the tester;

— conductors to connect the steel component to an earth electrode;

— tap water.

F.3Procedure

The instrument shall be connected to the electrode and the voltage set at 9 V. The earth lead shall be connected, by means of a crocodile clip, to an uncoated section of the steel component.

Once the equipment has been set up, the electrode shall be moistened with tap water, it should be noted that too much water will affect the performance. The electrode shall then be switched on and moved across the surface of the coating in continuous contact. The rate of travel of the electrode is not specified, but the operator shall demonstrate that a pore in the coating can be detected.

A high-pitched note from the audible alarm indicates the presence of a pore or other discontinuity.

F.4Results

The number of discontinuities per 100 cm^2 of coating shall be recorded.

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EN 10021, *General technical delivery requirements for steel and steel products.*

EN 10224, *Non-alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption - Technical delivery conditions*.

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