EAU

TECHNICAL DOCUMENT

Control and safety valves

Technical document 079-01

Additional specifications applicable to all product families

Document technique rév. 01
17/08/2023

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MODIFICATION HISTORY

Revision no	Date	Modifications
01	**17/08/2023**	- Chapter 2: Withdrawal of certain normative references. - Chapter 3: Addition of three new definitions (designated areas, average and local coating thickness). - Chapter 4.2: addition of specifications for coating repairs. - Chapter 4.3: definition of a new specification and new requirements. - Chapter 4.4: Modification of a requirement for polyester coatings. - Chapter 4.6: Modification of the procedure. - Part II: Modification of Table 3. Part II: Addition of a table 4 and definition of in-process requirements.

Part II of this document replaces part I of the "Control and safety valves" technical management appendix dated 24/05/22.

TABLE OF CONTENTS

I. SPECIFICATIONS AND MINIMUM REQUIREMENTS FOR THE CORROSION PROTECTION OF WATER DISTRIBUTION SYSTEM FITTINGS

Purpose

The purpose of the first three parts of this document is to define :

- the minimum technical performance required of anti-corrosion coatings

- the corresponding test and assessment methods

- the controls to be implemented for the initial qualification of the coating and the process, as well as production monitoring (see Part II of this document).

Verification of the compatibility of materials or coatings in contact with drinking water is not included in this document (ACS).

The coating must meet requirements in terms of appearance, functional properties and ageing behaviour.

1. Field of application

This protection can be used as an internal and external lining for valves and fittings in water distribution networks (gate valves, fire hydrants, hydrants, etc.).

2. Normative references

NF EN ISO 4628-1 : 2016	Paints and varnishes - Evaluation of coating degradation - Designation of quantity and size of defects, intensity of uniform changes in appearance - Part 1: General introduction and designation system
NF EN ISO 4628-2 : 2016	Paints and varnishes - Evaluation of coating degradation - Designation of quantity and size of defects, and intensity of uniform changes in appearance - Part 2: Evaluation of degree of blistering
NF EN ISO 4628-3 : 2016	Paints and varnishes - Evaluation of coating degradation - Designation of quantity and size of defects, and intensity of uniform changes in appearance - Part 3: Evaluation of degree of curling.
NF EN ISO 2808 : 2019	Paints and varnishes - Determination of film thickness.
NF EN ISO 4624 : 2016	Paints and varnishes - Tensile test.
NF EN ISO 2812-2 : 2018	Paints and varnishes - Determination of resistance to liquids - Part 2: Water immersion method.
NF EN ISO 2813 : 2014	Paints and varnishes - Determination of gloss index at 20°, 60°, 85°.
NF EN ISO 2409 : 2020	Paints and varnishes - Grid tests.
NF EN ISO 16474-2 : 2014	Paints and varnishes - Methods of exposure to laboratory light sources - Part 2: Xenon arc lamps.
NF EN ISO 11664-4 : 2011	Colorimetry - Part 4: Colour space L*b*CIE 1976
NF ISO 9227 :2017	Corrosion tests in artificial atmospheres - Salt spray tests.

NF EN ISO 8501-1 : 2007	Preparation of steel substrates prior to application of paints and related products - Visual assessment of substrate cleanliness - Part 1: Degrees of rust and degrees of preparation of uncoated steel substrates and steel substrates after stripping of the entire surface of previous coatings
NF EN ISO 11357-1 : 2016	Plastics - Differential Scanning Calorimetry (DSC) - Part 1: General principles.
NF EN ISO 29601 : 2011	Paints and varnishes - Anti-corrosion paint systems - Evaluation of the porosity of a dry film

3. Terms and definitions (added)

Organic coating (paint)

Coating of paints, liquids or powders, applied to a base material.

Pre-treatment before coating

Mechanical and/or chemical treatment designed to remove impurities from the surface (grease, dirt, corrosion products) and promote adhesion of the paint system.

Designated areas

Areas of a moulded part where, due to assembly tolerance restrictions, testing difficulties or the presence of a gasket, etc., a lower level of coating performance is unavoidable (bolt holes, ribs, edges, etc.).

Average coating thickness

Arithmetic mean of all thickness measurements taken on a coated component.

Local coating thickness

Measurement of the thickness at any point on a coated component outside the designated areas.

Application techniques

The choice of application technique depends on :

- of the coating (powder or liquid),
- of the parts: shape, dimensions and quantities of the parts to be treated,
- the desired coating thickness.

3.1. Coating by dipping in a fluidised bath

The part is pre-heated to a temperature higher than that of the powder, then dipped into a tank where the powder is suspended by air blowing. The powder melts on contact with the part and forms a film.

The thickness of the coating is determined by the immersion time in the bath and the pre-heating temperature of the part.

Post-heating is necessary for large parts (where the heat retained is insufficient to harden the polymer).

3.2. Electrostatic spray coating

The electrically charged powder is sprayed directly onto the pre-heated part. On contact with the workpiece, the powder melts, forms a homogeneous layer and then polymerises under the action of the heat..

3.3. Spray coating

The purpose of the spray gun is to break up the paint jet into a multitude of small droplets and deposit them on the substrate.

Cataphoresis coating

The part is immersed in a bath of water-soluble paint. A DC voltage is established between this part, which acts as a cathode, and a counter-electrode, causing the particles suspended in the bath to migrate. The paint particles are deposited uniformly over the entire immersed surface, giving a deposit of equal thickness over the entire part.

Un passage en étuve assure la polymérisation du revêtement.

Applicateur de revêtement

C'est l'entité qui applique le revêtement sur le support.

Polymérisation

Réaction chimique entre l'époxy et un durcisseur permettant de former le revêtement.

Porosité

Discontinuité dans un revêtement.

4. Test methods

The methods described below are used to test finished products.

When it is not possible to carry out the tests on the product itself, the tests are carried out on test specimens made from the same material, the same grade and which follow the same processing cycle as the product to be tested (see Erreur ! Source du renvoi introuvable.).

Edges or singular points (interface, holes, markings, etc.) are not taken into account when assessing the quality of the coating.

4.1. Surface preparation

The condition of the surface must ensure that the coating adheres well.

Before coating, the surface to be covered must be clean and free of oil, grease and moisture.

The surface must meet at least the Sa 2½ standard of EN ISO 8501-1.

Verification is carried out visually on the basis of the manufacturer's instructions.

4.2. Appearance and uniformity of the coating

The coating must :

- evenly cover the entire surface of the room,

- be uniform in colour and gloss,

- be free from defects (blisters, pitting, scratches, etc.) likely to impair its function.

Variations in colour due to exposure during storage and to retouching are permitted.

In the case of repair operations, the materials used to repair defects must be suitable for the service conditions of the coated products and be compatible in every respect with the original coating.

The final repair must comply with the values specified in the manufacturer's data sheet. The coating thickness of the repaired area must not be less than the manufacturer's specifications (see 4.3).

4.3. Coating thickness

The thickness of the coating must be measured using one of the methods described in standard

NF EN ISO 2808.

The manufacturer's inspection procedures must specify :

- the method used,

- the frequency of the measurement,

- the measurement points on each part inspected (see appendix 3).

In its inspection plan, the manufacturer must define its minimum and maximum local and average thickness specifications, as well as those for the designated zones.

During an inspection, no measured value should be less than the minimum value and greater than the maximum value specified by the manufacturer. A minimum of ten measurements uniformly distributed over the product under test shall be taken with a measuring instrument accurate to within +/- 5%.

4.4. Checking the degree of polymerisation

The test consists of checking that the coating has cured properly.

The check is based on a solvent resistance test and a differential thermal analysis if necessary.

The test is carried out on a part at an ambient temperature of less than 50°C.

4.4.1. Solvent resistance test

The test involves rubbing a portion of the coated surface with a white cotton cloth.

The prescribed solvent is a ketone-type solvent (MIBC, MEC, etc.) or one specified by the coating manufacturer. It can be applied directly or indirectly to the coated surface.

The manufacturer's test procedures must specify :

- the method and solvent used,

- the frequency of testing and

- the scale for assessing the degree of polymerisation and the means used to obtain it.

4.4.1.1 1 Operating procedure

a) Direct method

- On a coated, horizontal surface, deposit 5 drops of solvent.
- Cover the drops with a watch glass and leave it to work for about 30 seconds.
- Wipe by rubbing the surface with a white cotton cloth, completing at least 5 full back-and-forth swipes.
- Note the appearance as well as the colour of the cloth and the surface of the coating.

b) Indirect method

- Take a piece of white cotton cloth soaked with solvent.
- Wipe by rubbing the surface, completing at least 5 full back-and-forth swipes.
- Note the appearance as well as the colour of the cloth and the surface of the coating.

4.4.1.2 Evaluation

The following two assessment methods are applicable:

1st method: comparison of results on the basis of a test carried out by the manufacturer on a reference sample. In the case of colour transfer to the wipe and/or if the coating surface shows discolouration, matting or soiling, the appearance and colour of the wipe and the coating surface must be compared with the discolouration, matting and soiling limits defined by the wiping of the reference sample of the coating product (see Annex 4).

2nd method: comparison of results on the basis of a transfer scale supplied by the powder manufacturer. Considering that the colour transfer is linked to the powder formulation and not to poor polymerisation, it should be compared with the transfer assessment scale provided by the powder manufacturer.

4.4.1.3 Required characteristics

For an assessment, according to the 1st method, the required characteristics are those defined in table 1 below:

Table 1 – Polymerisation quality assessment scale

Scale	Comment	Evaluation
Level 1	No loss of the coating's gloss. No transfer of colour onto the cloth.	Good polymerisation
Level 2	Slight loss of the coating's gloss. Colour transfer slightly perceptible.	
Level 3	Mat film. Colour transfer very clearly perceptible on the cloth.	Poor polymerisation, requires additional tests.
Level 4	Very mat and considerably softened film. Very definite transfer of colour onto the cloth.	

For an evaluation according to the 2nd method, the transfer must comply with the indications of the powder manufacturer.

In the case of colour transfer onto the cotton cloth (for example, levels 3 and 4 for the first method), verifying the following is recommended:

- the parameters of the process since they influence polymerisation (specifications pertaining to temperature, duration of polymerisation, etc.).
- the polymerisation by measuring the temperature of the glass transition (ΔTg) of the coating in the uncertain zone and comparing it to the one given by the manufacturer.

4.4.2 Glass transition temperature measurement by differential thermal analysis or DSC (Differential Scanning Calorimeter)

The test principle consists of monitoring consecutive enthalpy variations during physical or chemical transformations undergone by the material subjected to temperature cycling.

Refer to standard NF EN ISO 11357-1 for the test method.

The operating conditions are:
- Taking an epoxy scale sample ~ 5 à 10mg,
- Preconditioning the sample at 80°C in the boat to be used for analysis,
- Raising first the temperature from 25°C to 250°C at 10°C/min (nitrogen flushing),
- Determining the glass transition temperature TG1-mid-point,
- Cooling the temperature down quickly to 25°C,
- Then raising the temperature from 25°C to 250°C at 10°C/min,
- Determining the glass transition temperature TG2-mid-point,
- Noting the difference (ΔTg=TG2 - TG1).

The coating is polymerised if the difference between the two glass transition temperatures (ΔTg) is ≤ 5°C.

4.5. Checking the Bonding Strength of the Film

The test consists of measuring the bonding level of a coating on a base structure.

The method for checking the bonding strength and the corresponding specification depend on the film's thickness:

4.4.2. Checking the glass transition temperature by differential thermal analysis or DSC (Differential Scanning Calorimeter)

The principle of the test is to monitor the enthalpy variations resulting from the physical or chemical transformations undergone by the material when subjected to a temperature cycle.

Refer to standard NF EN ISO 11357-1 for the test method.

The operating conditions are :

- take an epoxy flake ~ 5 to 10 mg,

- precondition the sample at 80°C in the test vessel,

- carry out a 1st temperature rise from 25°C to 250°C at 10°C/min (sweeping under nitrogen)

- determine the glass transition temperature TG1-mid point

- cool rapidly to 25°C

- perform a 2nd temperature rise from 25°C to 250°C at 10°C/min

- determine the glass transition temperature TG2-mid point

- note the difference (□Tg=TG2 -TG1)

The coating is polymerised if the difference between the two glass transition temperatures (□Tg) is ≤ 5°C.

4.5. Checking film adhesion

The test involves measuring the adhesion of a coating to the substrate.

The method of testing adhesion and the corresponding specification depend on the thickness of the film.

Grid test

This test is only applicable for coating thicknesses ≤ 250 µm..

It is carried out as described in standard NF EN ISO 2409..

How it works

- Make a grid on the coated surface with a notch spacing of :
  - 1 mm for coatings of thickness: 0 <e ≤ 60 µm
  - 2 mm for coatings of thickness: 60 <e ≤ 120 µm
  - 3 mm for coatings of thickness: 120 <e ≤ 250 µm
- Apply adhesive tape to each of the squared areas, exerting even pressure over the entire surface,
- Then tear off the tape,
- Examine the squared surface of the coating with the naked eye,
- Assess the adhesion of the coating against the results classification table (NF EN ISO 2409, Table 1).

Required features

Surfacing adhesion must meet classification 1 corresponding to "Detachment of small flakes of surfacing at the intersections of the incisions. Less than 5% of the grid area is affected".

Tensile test

This test is only applicable for coating thicknesses > 250 µm..

How it works

It is carried out as described in standard NF EN ISO 4624

- Stick a 20 mm diameter stud onto the flooring,
- Wait for the adhesive to dry,

- Score the edge of the bond,
- Measure the force required to lift the stud from the surface.

Required features

The adhesion of the coating must reach a value of at least 8 MPa.

4.6.Non-porosity

The test consists of looking for any porosities in the coating.

Two types of detector can be used depending on the average thickness:

- Low-voltage wet sponge detector (9V or 90 V to be agreed between the interested parties) for average thicknesses of less than 500 µm,
- High-voltage electrical brush detector (1 kV to 30 kV) for average thicknesses of 250 µm or more,

Procedure

Carry out the tests on the basis of the procedure in standard NF EN ISO 29601 (chapter 5).

Required characteristics

Absence of porosity over the entire surface tested.

Electric broom test:

When testing with an electric broom, the voltage is set to the value given in the table below corresponding to the average thickness determined by the tests described in 4.3.
If a spark is observed during this preliminary test, the test will be repeated using the average thickness value specified by the manufacturer. Compliance will be assessed on this second test.

Table 2 – Voltage scale for non-porosity test

Average thickness measured (µm)	Test voltage (kV)
E ≤ 500	2,3
500<E≤600	2,9
600<E≤700	3,5
700<E≤800	4
800<E≤900	4,5
900<E≤1000	5
1000<E≤1100	5,5
1100<E≤1200	6,5
1200<E≤1300	7

4.7.Checking impact resistance

The test consists of checking the resistance of the coating to the impact of a given mass falling perpendicular to the surface at a given height to generate a shock with an energy of 5Nm ± 5%.

How it works

- he test is carried out on a room at an ambient temperature of (23 ± 2) °C and a humidity of 50 ± 10 %,
- Carry out a roughness test beforehand to check that there are no defective spots,
- Carried out in accordance with standard NF EN ISO 6272-1, on a flat surface with :

- a steel mass weighing 1 kg, fitted with a spherical penetrator (20 □ 0.3) mm in diameter, dropped from a height of 0.5 m,

or

- a steel mass weighing 0.5 kg, fitted with a spherical penetrator (20 □ 0.3) mm in diameter, dropped from a height of 1 m.

Required features

- Examine the coating with the naked eye. There must be no cracks, delamination or other visible defects at the point of impact,
- Check the continuity of the coating by a non-porosity test (article Erreur ! Source du renvoi introuvable.).

4.8. Corrosion resistance test

Salt spray test

This test is designed to qualify the external protective coating with respect to the ambient atmosphere.

It must be carried out in accordance with standard NF ISO 9227,

- outside the retention and run-off zone,
- for 480 hours
- Neutral Salt Spray (NSR) for ferrous substrates

How it works

On each sample, the coating should be etched down to the metal of an inverted "V" (Λ) (see Appendix 2):

- over a minimum line width of 1 mm,,
- over a height of at least 50 mm
- and form an angle of approximately 60°.

Required characteristics

At the end of the test, the parts are examined and assessed according to :

- standard NF EN ISO 4628-2, for blistering,
- standard NF EN ISO 4628-3 for winding characterisation,
- and standards NF EN ISO 2409 or NF EN ISO 4624 for film adhesion.

The corresponding specifications depend on the thickness of the film as shown below:

Evaluation criteria and specifications	**e ≤ 70 µm**	**e > 70 µm**
Degree of winding	≤ Ri 2	≤ Ri 1
Degree of blistering	Dimension ≤ S2 et degré ≤ 2	
Film adhesion (grid)	Class ≤ 1	Class ≤ 1 (e ≤ 250 µm)
Film adhesion (peel adhesion)		> 6 MPa (e > 250 µm)
Rust spreading under the coating at the level of the primer in Λ	≤ 10 mm au total	

Water immersion test

This test is designed to qualify the interior protective coating against immersion in water. It must be carried out on the basis of standard NF EN ISO 2812-2

- Temperature: 40°C

- Exposure time: 480 hours, whatever the external environment of the material (buried or overhead products)

- Demineralised water.

Procedure

On each sample, the coating must be etched to the metal of an inverted "V" (Λ) (see appendix 2):

- over at least 1 mm of line width,

- over a height of at least 50 mm

- and form an angle of approximately 60°.

Required characteristics

At the end of the test, the parts are examined and assessed in accordance with the following standard(s):

- NF EN ISO 4628-2 for blistering

- NF EN ISO 4628-3 for winding characterisation,

- and NF EN ISO 2409 or NF EN ISO 4624 for film adhesion.

Edges or singular points (interfaces, holes, etc.) are not taken into account.

The corresponding specifications depend on the thickness of the film as shown below:

Evaluation criteria and specifications	**e ≤ 70 µm**	**e > 70 µm**
Degree of winding	≤ Ri 2	≤ Ri 1
Degree of blistering	dimension ≤ S2 et degré ≤ 2	
Film adhesion (grid)	class ≤ 1	class ≤ 1 (e ≤ 250 µm)
Film adhesion (peel adhesion)		> 6 MPa (e > 250 µm)
Propagation of rust under the cladding level of the primer in Λ	≤ 10 mm in total	

II. VERIFICATION OF CONFORMITY

1. Initial and follow-up qualification tests

The purpose of these tests is to assess the ability of the anti-corrosion protection system to meet the performance requirements of the application technique and the application process.

The following definitions apply

- qualification test: an initial type test of the product carried out to prove that the product meets the performance requirements. It is carried out before the product is placed on the market and after each significant change in a parameter or component which may have an influence on the quality of the coating.

- qualification follow-up test: a test carried out during a periodic inspection (at least once a year) to ensure that the performance of the process and the final product remains constant.

The Error! Source of the reference not found. below summarises the tests to be carried out as part of

Table 3 - Qualification and follow-up tests

Document article	**Exterior cladding (*)**	**Interior coverings (*)**	**Specimen test**
Audit, procedure and control plan	X	X	
4.3 Coating thickness	X	X	
4.4 Checking the degree of polymerisation	X	X	
4.5 Checking film adhesion	X	X	
4.6 Non-porosity (**)	X	X	
4.7 Checking impact resistance	X	X	
4.8 Corrosion resistance test Salt spray test	X		
Water immersion test		X	
(*) : The tests may be carried out on the product itself or on a sample taken from the product.. **(**) : During the follow-up qualification tests, the test is carried out initially by applying the voltage indicated in Table 2 on the basis of the average thickness measured. If a spark is observed during this preliminary test, the test will be repeated on the basis of the nominal thickness value specified by the manufacturer. Compliance will be assessed on this second test.**			

2. Products tested

The qualification procedure must define the nature of the products to be tested on the basis of the recommendations below:

- The products to be tested must be taken from a production batch which has followed the manufacturing procedures appropriate to the final destination of the product.

- The size and morphology of the products selected must be compatible with the accelerated corrosion test methods used and enable the results to be evaluated.

It is accepted that the ageing test can be carried out on test specimens whose dimensions are defined in Appendix 1. The test specimens, of the same type of material as the product, must be positioned on a typical product to follow the same surface preparation and coating process.

The product's operating accessories must also be tested.

An operating accessory is a part or device that attaches to the operating stem of the shut-off system of the fitting in question.

This accessory is designed to facilitate operation of the shut-off device.

Examples include:

- square actuator;
- handwheel.
- manoeuvring assembly;
- angle transmission
- gearbox
- electric, pneumatic or hydraulic actuator
- ...

With the exception of actuators, the performance of accessories is the sole responsibility of the manufacturer of the valves to which they are fitted.

3. Production controls

These checks are designed to ensure that the products manufactured are presumed to conform to the qualified products. The basic principle is to ensure that the corrosion protection system has not changed and that its application leads to the same results.

The manufacturer must provide proof of control of the coating system and its application process.

Production control tests must be carried out in accordance with the manufacturer's quality system, with the agreement of the CSTB.

The table summarises the checks to be carried out during production and defines a minimum frequency.

Table 4 - Production controls

Type of control	Prescription	Test	Minimum frequency
4.1 Surface preparation (shot blasting and/or sand blasting) (*)	Sa 2,5	Visuel	100 %
4.1 Surface preparation (chemical treatment)	1-Monitoring bath parameters	Chemical test by bath analysis	Once a week
4.2 Appearance and uniformity of the coating	Uniform, free of punctures and bubbles	Visuel	100 %
4.3 Coating thickness	Average ≥ manufacturer's specification	Non-destructive equipment	1 time/team and/or process type
4.4 Controlling the degree of polymerisation	Appendix 4	solvant de type cétonique (MIBC, MEC...) or specified by the coating manufacturer	1 time/team and/or by type of process
4.6 Non-porosity	No spark	High or low voltage detectors depending on average thickness	1 time/team and/or by type of process
4.7 Checking impact resistance (**)	No cracks or delamination	Shock at 5 Nm	1 time/team and/or by type of process

The frequency and type of product tested should be indicated by the manufacturer in his test plan..

(*) A tape test can be carried out.

(**) These tests should be carried out when the part has returned to room temperature (<40°C) and polymerisation is complete.

III. REFERENCE FILE

The reference file, drawn up by the manufacturer, must provide precise information on:

- the corrosion protection system;
- the application process;
- the manufacturing control plan;
- performance.

The file will include:

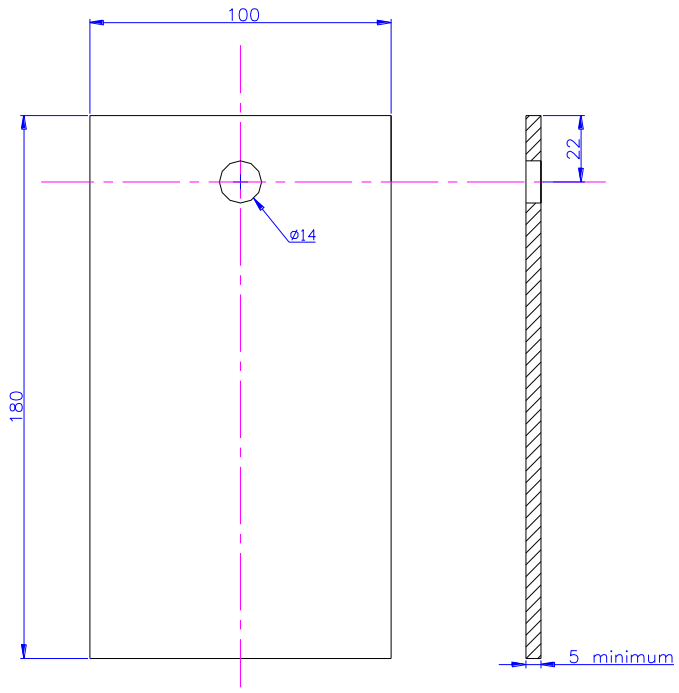
- definition of the protection system: type of coating, thickness, number of coats, etc ... ;
- the application process, part preparation range, application ranges, etc;
- the manufacturing inspection plan, specifying the inspections carried out and their frequency;
- the qualification report drawn up on the basis of the qualification tests.

Any modification to a component that affects the final result must be the subject of a new type qualification.

IV. APPENDICES

Appendix 1
Size of test pieces

The test specimens must be flat and have the dimensions defined below.



Recommended dimensions (in mm)

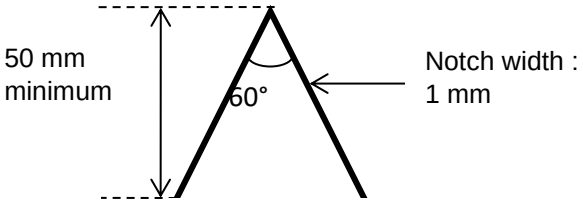
General tolerance: +/- 1 mm

Nature of material identical to that used for water system valves.

Figure 1 - Geometric characteristics of corrosion test specimens

Figure 1 - Geometric characteristics of corrosion test specimens

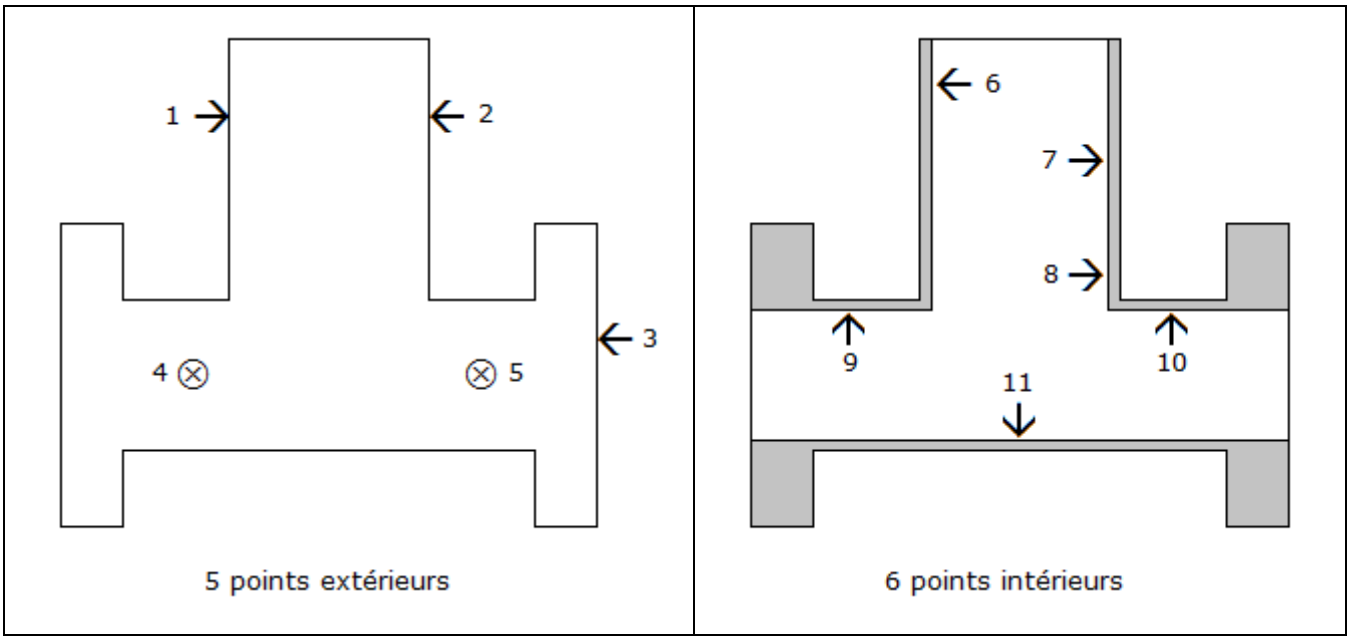
Appendix 2
Notch for corrosion test



Recommended dimensions of test specimens :

- length: 180 mm
- width 100 mm
- General tolerance: □ 1 mm

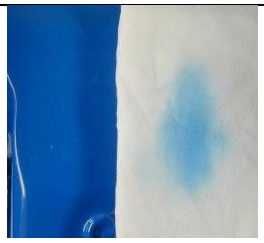
Appendix 3
Example of coating thickness control



Location of measurement points on a valve

Appendix 4

Example of a transfer scale for checking the degree of polymerisation

Level	Degree of transfer	Comment	State of the cotton cloth	Deviation Δ(Tg)
1	Unchanged	transfer		= 0
2	Slight	transfert perceptible		≤ 5
3	Medium	Very perceptible transfer additional test		> 5
4	Very definite	Ecterne transfer poor polymerisation		>> 5