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Paints and varnishes — Guidelines for the introduction of scribe marks through coatings on metallic panels for corrosion testing

*Peintures et vernis — Lignes directrices pour la production de rayures
au travers du revêtement de panneaux métalliques en vue des essais
de corrosion*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17872 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

Introduction

Many International Standards deal with corrosion testing, where scribe marks are introduced through a coating to a metallic substrate. However, the method of scribe-mark introduction (scribing pattern, tools, etc.) is not standardized across these standards.

The main purposes of an intentionally inflicted damage in a coating prior to corrosion testing are as follows:

- a) to simulate and to investigate how a specific type of damage behaves during exposure;
- b) to obtain an accelerated response during a corrosion test, e.g. at quality control during production;
- c) to investigate the general durability of a coating by observation of the rate of corrosion spread after exposure.

Preliminary investigations have shown that several variants, both in terms of shape and dimensions, of scribing tools are used. This variation occurs both across countries and within countries. The effect of using different tools is the production of scribe marks with different cross-sectional shape, depth and exposed metal area. These differences will greatly affect test results obtained during corrosion tests, as the intention of introducing scribe marks into a coating system is such that oxygen and the electrolyte present during exposure testing can obtain access to a well-defined and active metal surface.

The actual method used to introduce a scribe mark depends on the coating type and thickness. However, in all cases it is preferable if the cross-section is as smooth as possible, the metallic substrate is exposed evenly and no coating remains on the exposed substrate. Additionally, it is desirable that scribing methods are consistent across related International Standards.

The scribing method greatly affects how the corrosion process occurs and the reproducibility when tests are repeated under the same conditions. In order to obtain anticorrosive results with high accuracy and reproducibility, accurate and consistent scribing is required.

Paints and varnishes — Guidelines for the introduction of scribe marks through coatings on metallic panels for corrosion testing

1 Scope

This International Standard describes methods of scribing coated steel or test-pieces for corrosion tests, where the coating system is applied at dry film thicknesses of less than 500 μm . It is intended as a guideline only, being based on the results of a collaborative trial with no subsequent corrosion testing having been carried out to determine the suitability of the introduced scribe marks for such tests.

This International Standard covers the scribing of metallic panels or test pieces made from

- steel,
- chemically treated steel,
- aluminium or aluminium alloy, and
- chemically treated aluminium.

It does not cover the scribing of galvanized or electroplated metal or clad aluminium panels.

2 Scribe marks

If not otherwise agreed or specified, a scribe mark is made as an X-shape, T-shape or single-line, through the coating to the metal substrate according to the agreed conditions. Examples of X-shaped, T-shaped and a single-line scribe mark are given in Figure 1. Typically, the suitable length of the scribed lines is in the range of 50 mm to 70 mm, depending on the coating thickness and the expected amount of corrosion.

The length of the scribe mark should be significantly more than the expected creep resulting from the corrosion test carried out.

The width of the scribe mark can also affect the result of a corrosion test. The smaller the width, the stronger is the tendency for the exposed metal surface to be passivated by deposition of sparingly soluble corrosion products. It is therefore important to select a scribing tool which will provide a suitable scribe width for the corrosion test being carried out.

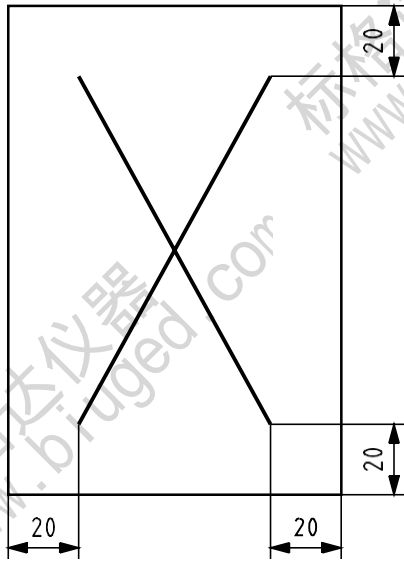
The orientation of the scribed lines is often significant in terms of affecting corrosion test results. On panels with a slight inclination from the vertical, e.g. for salt-spray tests, more salt is collected in a horizontally exposed scribe mark. Also, a horizontally exposed scribe mark will generate an even salt distribution, whereas a diagonal, or more particularly a vertical, scribe mark tends to generate a gradient, with an increasing amount of salt along the lower edge of the scribe mark. An increased amount of salt usually leads to an increased corrosion rate, but on coated steel, high salt concentration might have an inhibiting effect on corrosion since the formed corrosion products are very dense.

The cross-section of the scribe mark should be as uniform as possible along its entire length. The coating should be cut smoothly along the direction of the scribe mark. The cross-sectional shape of the scribe may be either "V" or "U" shaped, depending upon the tool used, and should be such that for a "V"-shaped cut $a > b > c$ and for a "U"-shaped cut $a > b$, with the width (b) of both "V" and "U" shapes such that $b \geq 0,2 \text{ mm}$ (see Figure 2 for an explanation of the symbols). Certain scribing tools may also produce a rectangular cross-section, where a , b and c are approximately equal.

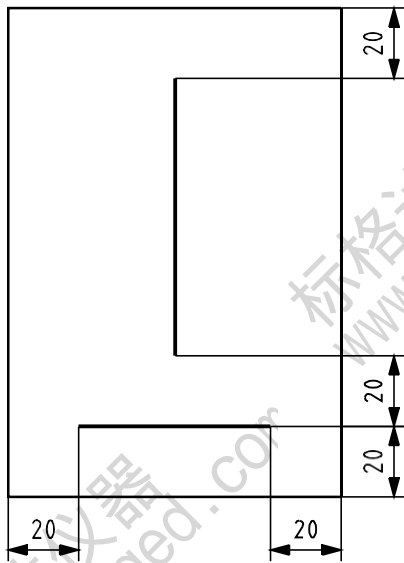
NOTE The shape, depth and uniformity of scribe marks resulting from the use of manual scribing tools will also depend on the operator carrying out the scribing procedure. To reduce this operator dependency, and hence variability in

subsequent corrosion test results, automatic scribing machines may also be used to introduce scribe marks, provided they produce a scribe mark which penetrates to the substrate. Such machines are able to introduce rectangular shaped scribe marks, where the dimensions a , b and c are approximately equal and each is greater than 0,5 mm.

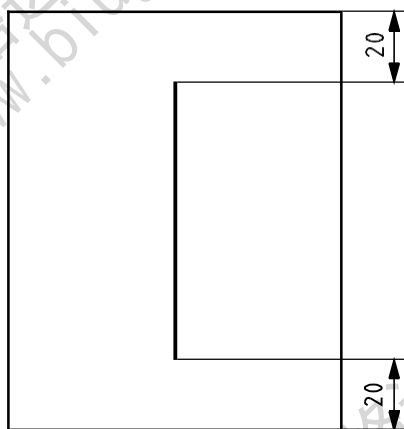
Dimensions in millimetres



a) X-shape

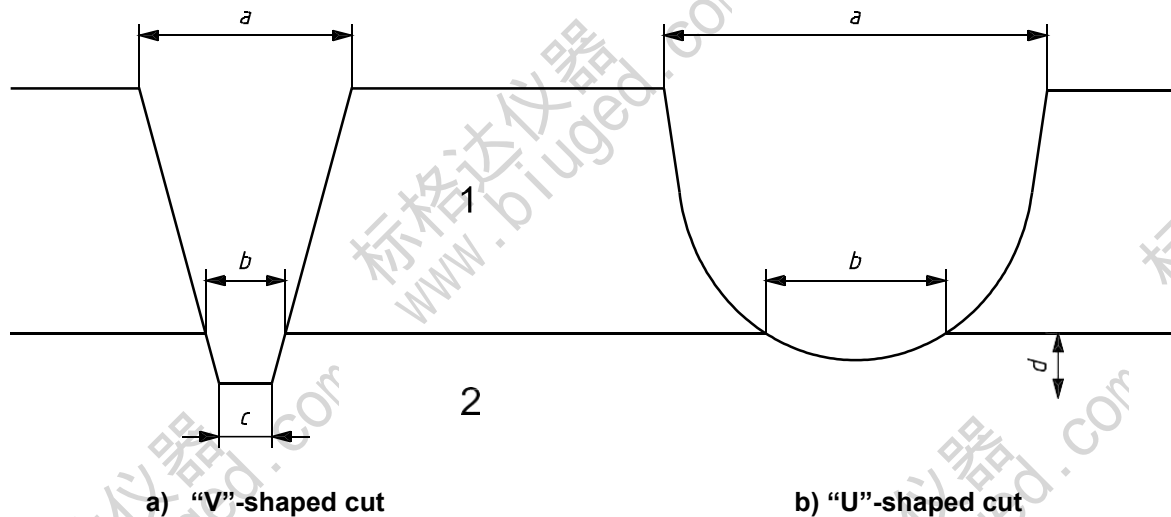


b) T-shape



c) Single line

Figure 1 — Surface shape of scribe marks on coated panels

**Key**

- 1 coating
2 substrate

- a* width of scribe mark at surface of coating
b width of scribe mark at coating/substrate boundary
c width of scribe mark at maximum penetration into substrate
d penetration of scribe mark into substrate

Figure 2 — Cross-sectional shape of scribe mark through a coating

3 Apparatus

3.1 Scribing tool, see Annex A.

3.2 Metal rule, to aid the introduction of a straight scribe mark of the specified length.

3.3 Microscope, with $\times 25$ magnification lens (see Clause 6).

3.4 Magnification lens, $\times 5$ to $\times 10$ magnification, to visually ensure uniformity of the scribe and removal of debris (see Clause 5).

4 Test panels

Use a coated panel (or test piece) appropriate for carrying out the corrosion-resistance test.

5 Procedure

Ensure that the test panel is firmly secured while the scribe mark is being introduced to ensure uniform location and to prevent panel/tool slippage.

Use the scribing tool to introduce the scribe mark through the coating to the metallic substrate. When scribing, use the metal rule to guide the scribing tool and use a continuous scribing action with uniform speed. Take care not to damage the surrounding coating whilst introducing the scribe mark.

It is preferable that the scribe mark be introduced through the coating to the metal substrate in one smooth action. If this is not possible (see Annex B, Table B.2), it is recommended that actions should be repeated taking care to follow the cross-section of the previous actions. This should be recorded in the test report. An automated scribing machine may be used to achieve penetration to the metal substrate in a single action.

New scribing tools can be very sharp and it is recommended that they be conditioned prior to use on test-pieces by carrying out at least 10 scribes. The scribing tool can become blunt with use and therefore the blade/point should be regularly inspected and sharpened or replaced periodically.

The edges of the scribe mark should be uniform and should completely penetrate the coating. Remove debris from the scribed mark.

NOTE Ensuring uniformity of the scribe mark and complete removal of debris may be aided by viewing with a $\times 5$ to $\times 10$ magnification lens.

6 Shape verification of cross-section

If shape verification of the scribe mark is required, use a microscope with $\times 25$ magnification lens (see Annex B).

7 Report

A report of the procedure used for scribing should be prepared, including at least the following information:

- a) all information necessary for identification of the sample tested, including
 - details of substrate material, and surface preparation prior to coating, and
 - all details necessary to identify the coating system tested;
- b) a reference to this International Standard (ISO 17872:2007);
- c) a reference to the International Standard by which the scribed panels will be tested;
- d) details of coating thickness;
- e) the scribing tool used;
- f) the shape and dimensions of the scribe mark;
- g) the orientation of the scribe mark during the test;
- h) any deviations from the procedure specified;
- i) any unusual features (anomalies) observed during the test;
- j) the date the scribe was made.

Annex A
(informative)

Scribing tools

Table A.1 — Examples of commonly used scribing tools

Dimensions in millimetres

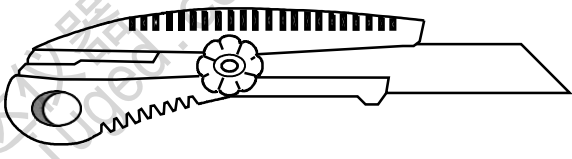
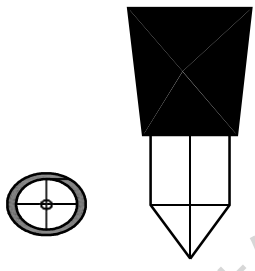
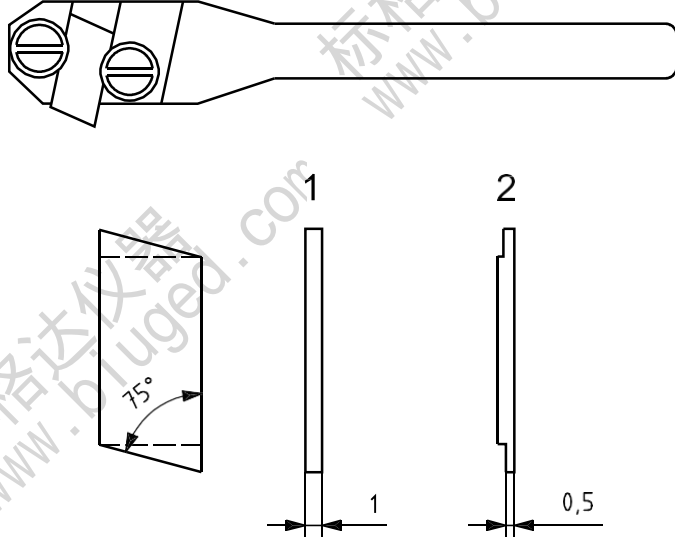
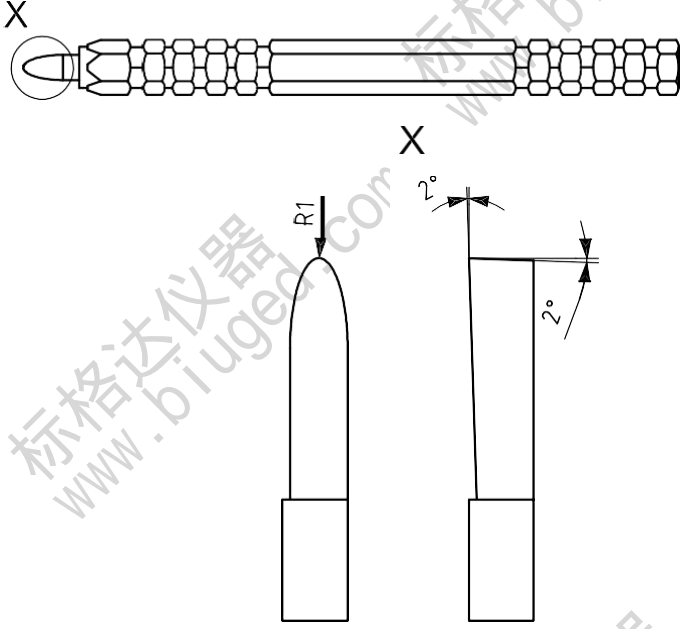
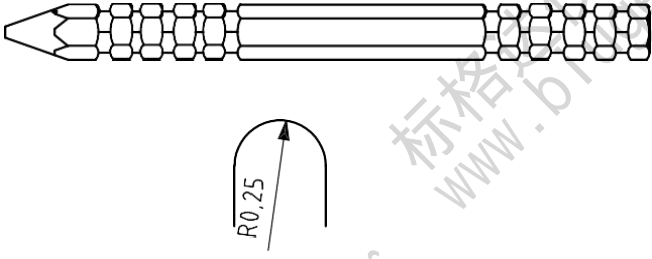

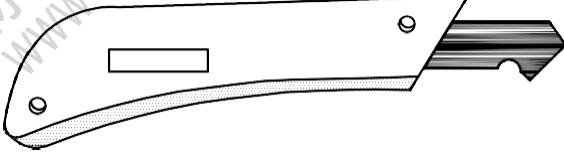
Tool ^a	Country	Material
 <p>a) Cutter 301 [®]</p>	Korea	Carbon steel
 <p>b) ECLIPSE E225 [®]</p>	UK	Tungsten carbide
 <p>Key</p> <p>1 original Sikkens version 2 Daimler Chrysler version</p> <p>NOTE The "original", 1 mm version was used in the collaborative trial.</p> <p>c) Sikkens [®]</p>	Germany	Tungsten carbide

Table A.1 (continued)

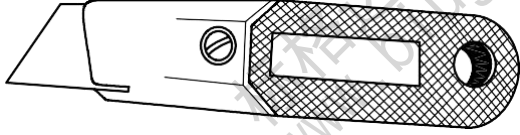

Dimensions in millimetres

Tool ^a	Country	Material
 <p data-bbox="454 1064 614 1097">d) Clemen[®]</p>	Germany	Tungsten carbide
 <p data-bbox="446 1400 614 1433">e) Van Laar[®]</p>	Germany	Tungsten carbide
 <p data-bbox="486 1579 582 1612">f) E-6[®]</p>	USA	Carbon steel
 <p data-bbox="470 1825 614 1859">g) P-800[®]</p>	Japan	Tungsten steel

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Table A.1 (continued)

Dimensions in millimetres

Tool ^a	Country	Material
 <p data-bbox="544 533 703 566">h) Stanley [®]</p>	South Africa	Carbon steel
 <p data-bbox="448 712 794 745">i) S22B [®] (Mechanical tool)</p>	Japan	Diamond with tungsten steel
<p>^a These are examples of suitable products available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these products.</p>		

Annex B
(informative)

Determination of shape and dimensions of scribe marks made using common scribing tools

A study of the dimensions of scribe marks produced by some of the scribing tools described in Annex A was carried out. The countries listed in column 1 of Table B.1 participated in the study. Three different coating types of dry film thickness less than 150 µm were used in the first study. In the second study, one coating type applied as one and two coats to give a nominal film thickness of 250 µm and 500 µm, respectively, was used. The width of the scribe marks obtained was measured using a microscope with ×25 magnification. The results are given in Tables B.1 and B.2.

Table B.1 — Coating dry film thickness less than 150 µm

Country	Scribing tool ^a	Coating type ^b	Scribe width, <i>b</i> (µm)	Scribe depth, <i>d</i> (µm)	Scribe shape	Uniformity
Korea	Cutter 301 [®]	A	289	34	V	good
		B	283	45	V	fair
		C	289	22	V	good
UK	ECLIPSE [®]	A	272	11	U	good
		B	295	85	U	fair
		C	210	40	U	poor
Germany	Sikkens [®]	A	893	13	V	good
		B	899	13	V	good
		C	797	10	V	good
USA	E-6 [®]	A	249	17	V	good
		B	278	26	V	good
		C	255	6	V	fair
Japan	P-800 [®]	A	215	45	V	good
		B	200	40	V	good
		C	200	17	V	good
South Africa	Stanley [®]	A	262	233	U	good
		B	175	153	U	good
		C	102	51	U	good

b is the width of scribe mark at coating/substrate boundary (see Figure 2).

d is the penetration of scribe mark into substrate (see Figure 2).

^a These are examples of suitable products available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these products.

^b A: Air drying alkyd (applied at 30 µm to 40 µm dry film thickness).
 B: 2-Component urethane (applied at 30 µm to 40 µm dry film thickness).
 C: Polyester powder coating (applied at 100 µm to 110 µm dry film thickness).

Table B.2 — Thickness of dry film coating between 200 µm and 520 µm
(2-pack, high-build, polyamide cured epoxy)

Number of coats	Scribing tool	Total thickness of dry film coating	Width of scribe (depending on number of scribing actions)		
			1 action	3 actions	5 actions
1	Cutter 301	230 µm	NG	NG	366 µm
	P-800		NG	NG	420 µm
	S22B		567 µm		
	Cutter 301	275 µm	NG	NG	400 µm
	P-800		NG	NG	576 µm
	S22B		746 µm		
	Cutter 301	226 µm	NG	NG	425 µm
	P-800		NG	NG	395 µm
	S22B		672 µm		
	Cutter 301	237 µm	NG	NG	321 µm
	P-800		NG	NG	447 µm
	S22B		702 µm		
Cutter 301	215 µm	NG	NG	380 µm	
P-800		NG	NG	421 µm	
S22B		521 µm			
2	Cutter 301	473 µm	NG	NG	380 µm
	P-800		NG	NG	421 µm
	S22B		536 µm		
	Cutter 301	517 µm	NG	NG	462 µm
	P-800		NG	NG	395 µm
	S22B		650 µm		
	Cutter 301	457 µm	NG	310 µm	418 µm
	P-800		NG	NG	625 µm
	S22B		576 µm		
	Cutter 301	517 µm	NG	NG	380 µm
	P-800		NG	NG	354 µm
	S22B		572 µm		
Cutter 301	487 µm	NG	373 µm	417 µm	
P-800		NG	315 µm	422 µm	
S22B		615 µm			
NG: Scribe did not penetrate coating to substrate.					
NOTE Details of the methods used to determine scribe mark shape and dimensions, along with full results, are available from ISO/TC 35/SC 9.					

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