International Standard

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Fourth edition
2024-11

Paints and varnishes — Evaluation of quantity and size of defects, and of intensity of uniform changes in appearance —

Part 3: Assessment of degree of rusting

Peintures et vernis — Évaluation de la quantité et de la dimension des défauts, et de l'intensité des changements uniformes d'aspect —

Partie 3: Évaluation du degré d'enrouillement

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword

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This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 139, *Paints and varnishes,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 4628-3:2016), which has been technically revised.

The main changes are as follows:

— the title has been shortened;

— the normative references have been updated;

— term 3.1, “degree of rusting” has been deleted;

— new terms 3.1 “red rust”, 3.2 “white rust” and 3.3 “rust traces” have been added;

— Clause 4 on symbols and abbreviations has been added;

— “rusted area” has been changed to “corroded area” in the entire text;

— a note on the original size of the figures has been added to the former Clause 4, which now is Clause 5;

— Table 1 for designating the size of rusting has been added;

— the percentage of the corroded area in Figure A.5 has been corrected;

— the assessment of white rust together with new pictorial standards has been added;

— the assessment of the degree of rusting by estimating the corroded area in per cent has been added;

— point “d) the method of assessment (method 1 or method 2) which was used;” has been added to the test report in Clause 8;

— a new Annex B has been added, showing an example for a test panel after the NSS salt spray test specified in ISO 9227 with a degree of rusting Ri 4;

— the former Annex B has become Annex C;

— in Annex C, the correlation with the ASTM rust scale has been adjusted to ASTM D610-08.

A list of all parts in the ISO 4628 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html

Introduction

ISO 4628-1 describes the system used for designating the quantity and size of defects and the intensity of changes in appearance of coatings, and it outlines the general principles of the system. This system is intended to be used, in particular, for defects caused by ageing and weathering, and for uniform changes such as colour changes, for example yellowing.

The pictorial standards for red rust have been selected from the “European rust scale” published by the European Confederation of Paint, Printing Ink and Artists' Colours Manufacturers' Associations (CEPE), Brussels. The correlation between the ISO scale and the “European rust scale” is given in Table C.1.

The correlation between the ISO scale and the rating system of ASTM D610-08 is given in Table C.2.

Paints and varnishes — Evaluation of quantity and size of defects, and of intensity of uniform changes in appearance —

Part 3: Assessment of degree of rusting

1 Scope

This document specifies methods for assessing the degree of rusting of surfaces coated with paints and varnishes (organic coatings), and metallic coating plus an organic coating (duplex system), by comparison with pictorial standards.

The pictorial standards provided in this document show surfaces which have deteriorated to different degrees by a combination of rust broken through the coating and visible under-rusting.

The assessment of the degree of rusting in this document is only an estimation of the affected area on specimen. Edges are not included.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4618, *Paints and varnishes — Vocabulary*

ISO 13076, *Paints and varnishes — Lighting and procedure for visual assessments of coatings*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 4618 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
red rust
corrosion products formed on ferrous substrates, such as iron or steel

Note 1 to entry: The red rust layer is generally porous, brittle and/or powdery.

3.2
white rust
corrosion products formed on non-ferrous substrates, such as zinc or aluminium

Note 1 to entry: White rust results from the formation of metal hydroxides and oxides when exposed to moist or humid conditions.

Note 2 to entry: The white/grey products are generally porous, brittle and/or powdery.

3.3
rust traces
contamination due to bleeding of the corrosion products formed

4 Symbols and abbreviations

NSS	neutral salt spray
R	red rust
Ri	degree of red rust by comparison with pictorial standards
R%	degree of red rust by estimating the corroded area in per cent
WR	white rust
WRi	degree of white rust by comparison with pictorial standards
WR%	degree of white rust by estimating the corroded area in per cent

5 Assessment of red rust

5.1 Method 1: Assessment of the degree of red rust by comparison with pictorial standards (Ri)

Assess the degree of red rust by means of the pictorial standards (Ri) given in Figures 1 to 5. The original pictures are only examples of organic coated steel surfaces after natural weathering and do not show the rust reactions of surfaces after short time corrosion tests. Annex B shows an example for a test panel after the NSS salt spray test specified in ISO 9227 with a degree of rusting Ri 4. Rust traces shall not be assessed.

NOTE 1 When viewed in A4 format, the photographs in this document are in the original size for comparison.

Figure 1 — Degree of rusting Ri 1

Figure 2 — Degree of rusting Ri 2

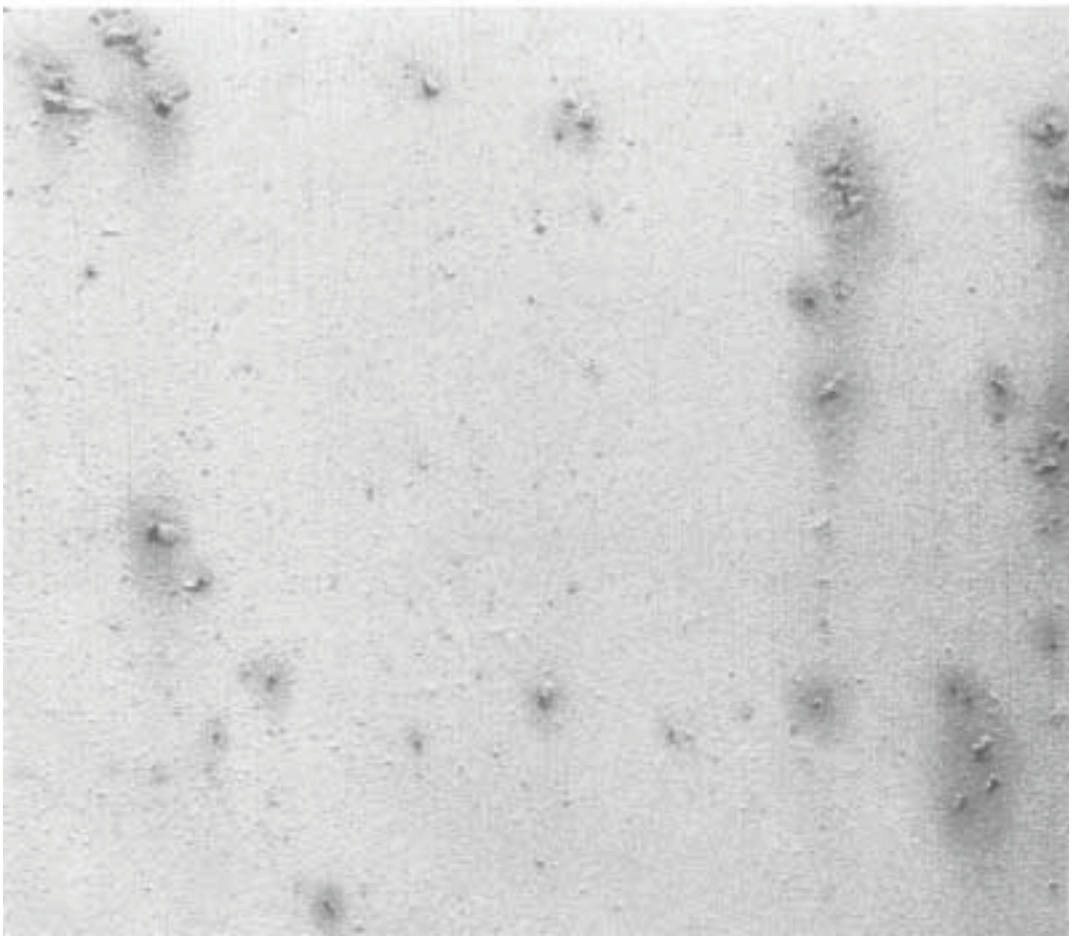


Figure 3 — Degree of rusting Ri 3

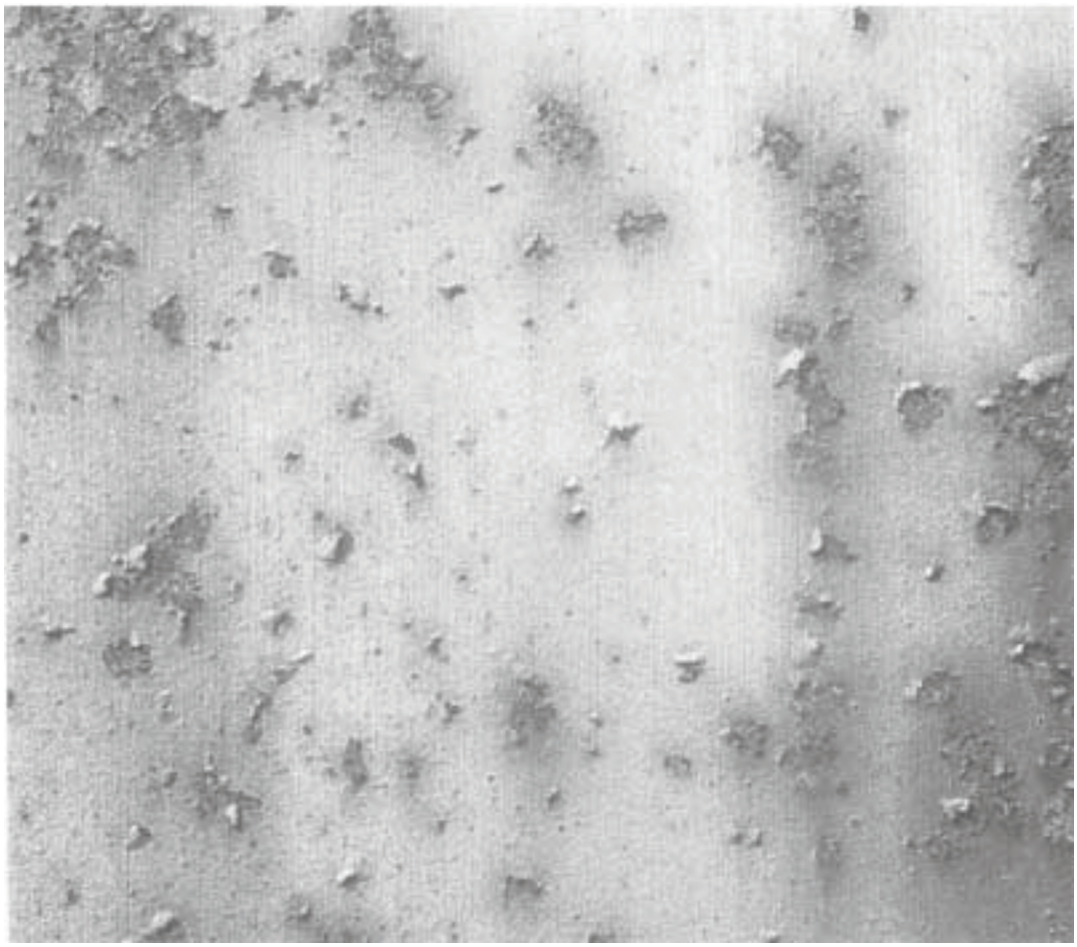


Figure 4 — Degree of rusting Ri 4

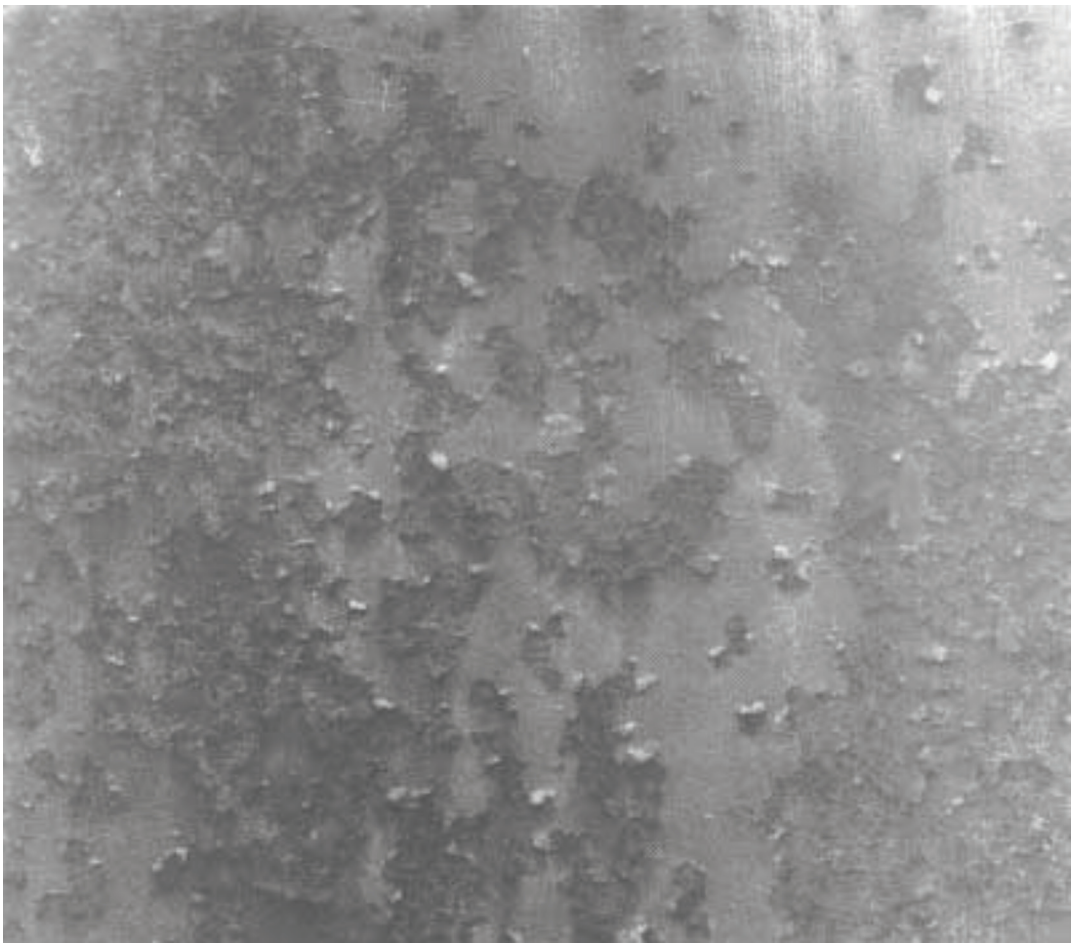


Figure 5 — Degree of rusting Ri 5

A better visibility is shown in the pictorial black-white calibration images in Figures A.1 to A.5. These figures shall be used to calibrate optical imaging systems.

Removing procedures to make possible under-rusting visible for assessing, if required, shall be agreed between the interested parties.

Where different degrees of rusting occur in different parts of the area being assessed, indicate these degrees of rusting together with the approximate dimensions of the area concerned, or its portion of the total area, expressed in per cent.

Carry out the assessment under good illumination, as specified in ISO 13076.

If the average size of the rust spots on the test area differs considerably from those shown in the pictorial standards, an indication of their size may be given as indicated in Table 1.

NOTE 2 The pictorial standards are intended for assessing the degree of rusting of organic coated iron/steel substrates. They can be used for designating the degree of corrosion of coated non-ferrous metals if the form of breakdown is comparable with that shown in the standards. In most cases, non-ferrous metals or zinc coated steel substrates show different reactions.

Table 1 — Size of rusting and corroded area for red rust

Rating	Size of rusting
S 0	not visible under ×10 magnification
S 1	only visible under magnification up to ×10
S 2	just visible with normal corrected vision (up to 0,2 mm)[a]
S 3	clearly visible with normal corrected vision (larger than 0,2 mm up to 0,5 mm)
S 4	larger than 0,5 mm up to 5 mm
S 5	larger than 5 mm

NOTE Reproduced from ISO 4628-1:2016, Table 2.

[a] Typically, defects larger than 0,2 mm are visible with normal corrected vision.

5.2 Method 2: Assessment of the degree of red rust by estimating the corroded area in per cent (R%)

If method 1 is not applicable, use method 2. Table 2 shows an alternative ranking of the rust grade as percentage estimation (R%) with broader percentage ranges for uncoated and coated substrates.

Table 2 — Degree of rusting and corroded area for red rust

Degree of rusting in per cent	Corroded area[a] %
R% 0	0
R% 1	up to 5 %
R% 2	more than 5 % up to 10 %
R% 3	more than 10 % up to 25 %
R% 4	more than 25 % up to 50 %
R% 5	more than 50 %

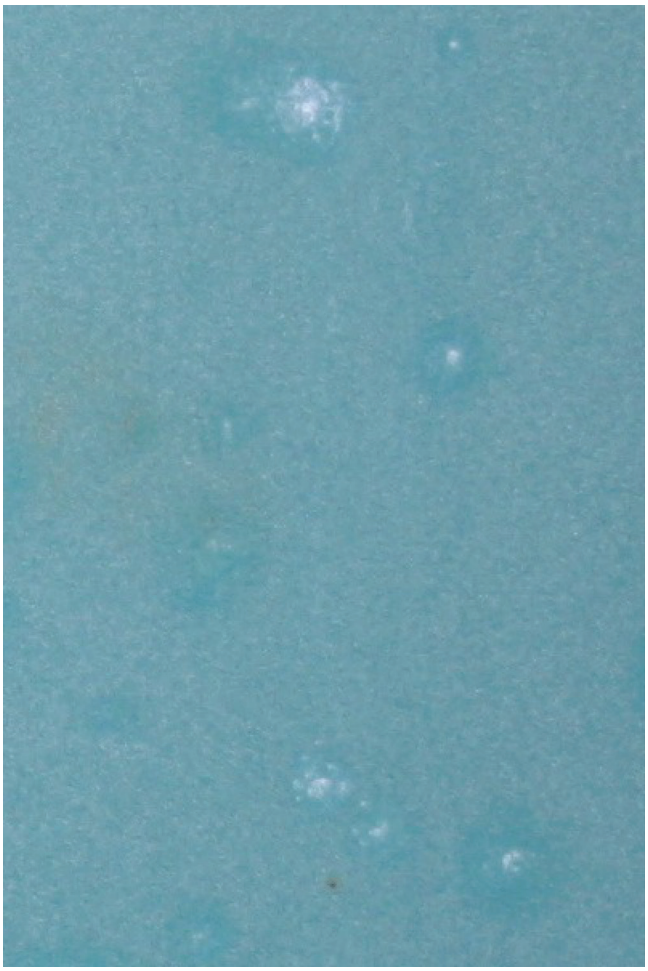
[a] This is a real estimation of the affected area in per cent.

6 Assessment of white rust

6.1 Method 1: Assessment of the degree of white rust by comparison with pictorial standards (WRi)

Assess the degree of white rust by means of the pictorial standards (WRi) based on NSS testing given in Figures 6 to 10.

The pictorial standards in Figures 6 to 10 show examples of a hot-dip galvanized coating plus an organic coating (duplex system) after a neutral salt spray test.



NOTE The original panel size is 150 mm × 100 mm. When viewed in A4 format, the photographs in this document are in the original size for comparison.

Figure 6 — Degree of rusting WRi 1

Figure 7 — Degree of rusting WRi 2

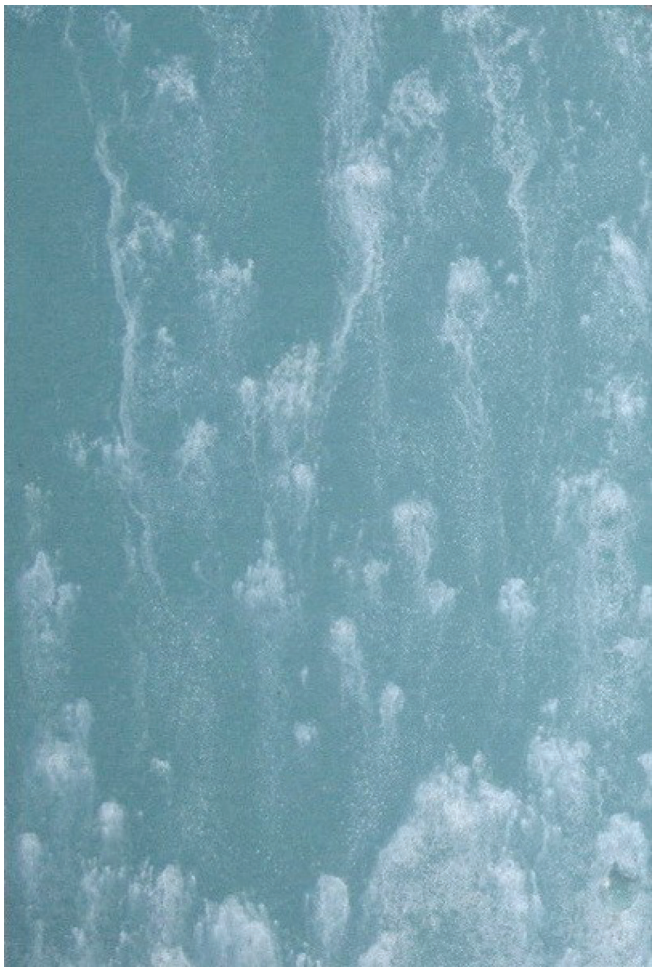


Figure 8 — Degree of rusting WRi 3

Figure 9 — Degree of rusting WRi 4

Figure 10 — Degree of rusting WRi 5

Rinse the test panel with fresh tap water immediately after exposure, i.e. before the surface dries out. Blow off residues of water from the surface using compressed air if necessary, and inspect for visible changes.

Carry out the assessment under good illumination, as specified in ISO 13076.

If the average size of the area of white rust on the test area differs considerably from those shown in the pictorial standards, an indication of their size may be given as indicated in Table 1.

6.2 Method 2: Assessment of the degree of white rust by estimating the corroded area in per cent (WR%)

If method 1 is not applicable, use method 2. Table 3 shows an alternative ranking of the rust grade as percentage estimation (WR%) with broader percentage ranges.

Table 3 — Degree of rusting and corroded area for white rust

Degree of rusting in per cent	Corroded area[a] %
WR% 0	0
WR% 1	up to 5 %
WR% 2	more than 5 % up to 10 %
WR% 3	more than 10 % up to 25 %
WR% 4	more than 25 % up to 50 %
WR% 5	more than 50 %

[a] This is a real estimation of the affected area in per cent.

7 Expression of results

Express the degree of rusting as Ri class or WRi class (method 1) or R% class or WR% class (method 2).

If applicable, indicate the different degrees of rusting obtained, together with the parts of the test area concerned.

If applicable, indicate the degree of rusting Ri or WRi, together with the numerical rating of the size of the rust spots (see Table 1).

EXAMPLE 1 Method 1, if the corroded area corresponds to Figure 3, Ri 3, and the sizes of the individual rust spots are between 0,5 mm and 5 mm (size 4), report the result as:

— rusting; degree of rusting Ri 3 (S 4).

EXAMPLE 2 Method 2, if the corroded area is about 20 %, R% 3, report the result as:

— rusting; degree of rusting R% 3.

8 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the coating examined;

b) a reference to this document, i.e. ISO 4628-3:2024;

c) the type of surface examined, its size and, if appropriate, its location;

d) the method of assessment (method 1 or method 2) which was used;

e) results of the assessment in accordance with Clause 7;

f) an indication of the illumination under which the assessment was carried out;

g) any deviations from the procedure;

g) any unusual features (anomalies) observed during the assessment;

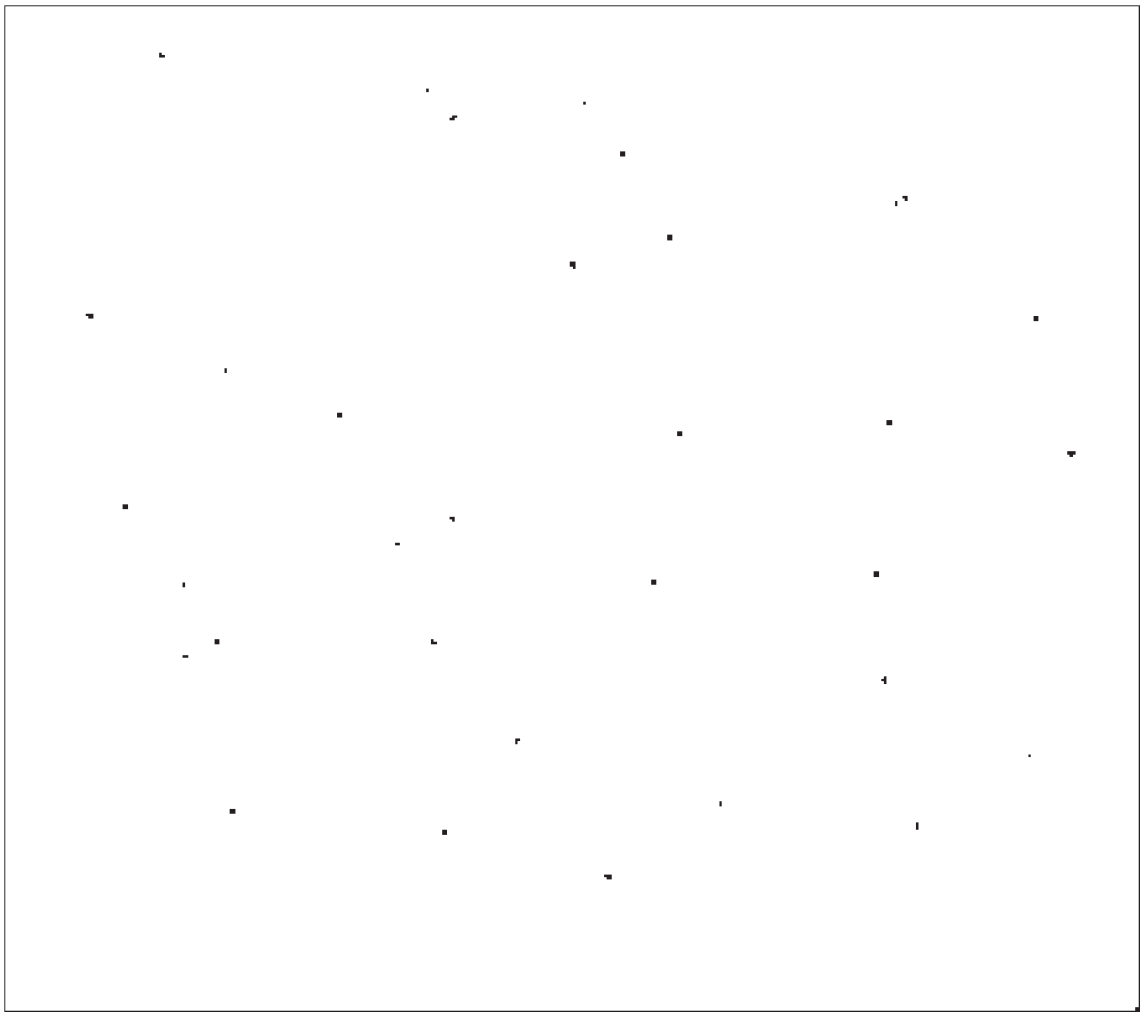
h) the date of the examination.

Annex A
(normative)

Calibration images

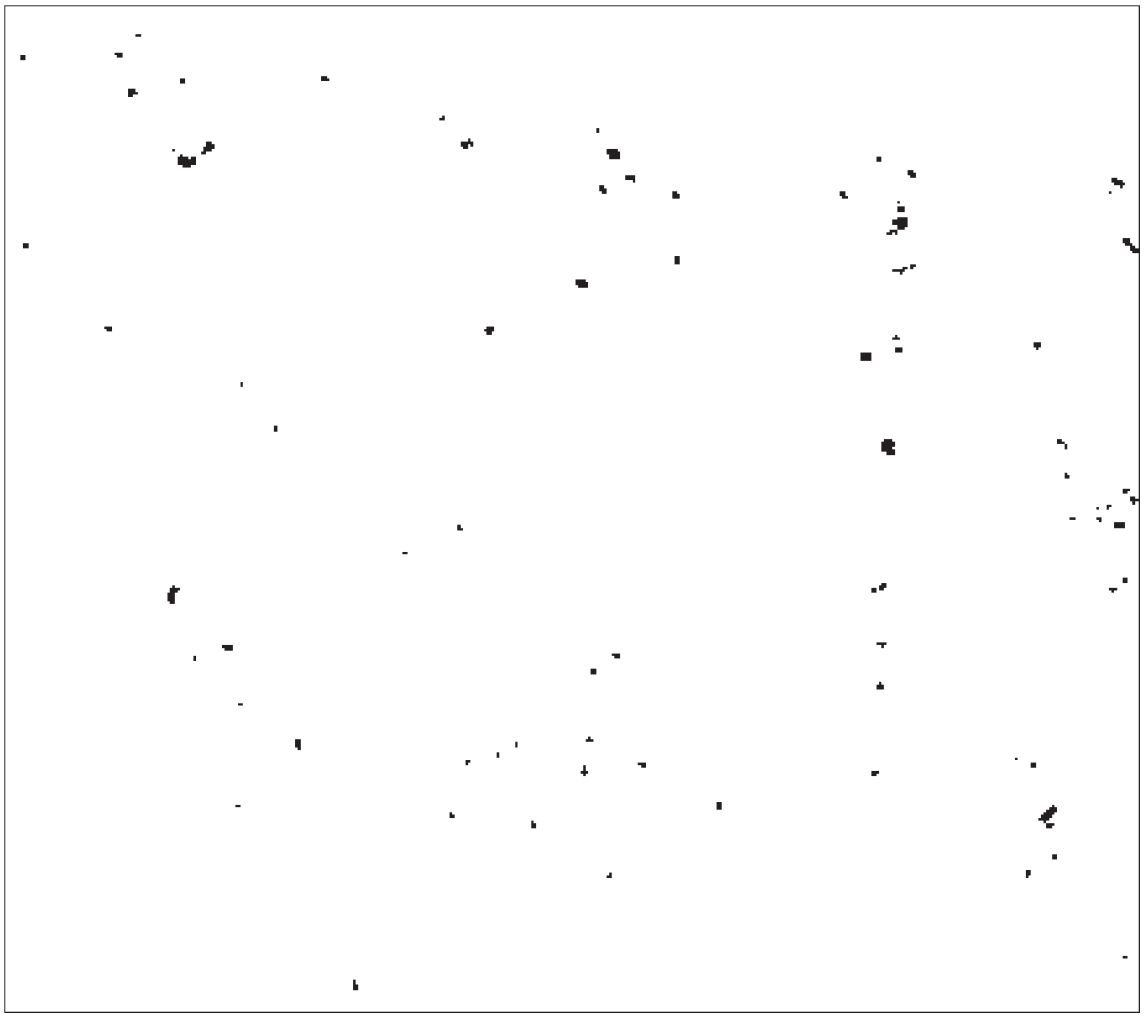
If the assessment is done using an optical imaging system, use the images given in Figure A.1 to Figure A.5 to calibrate the imaging system.

NOTE If viewed in A4 format, the photographs in this document are in the original size for comparison.



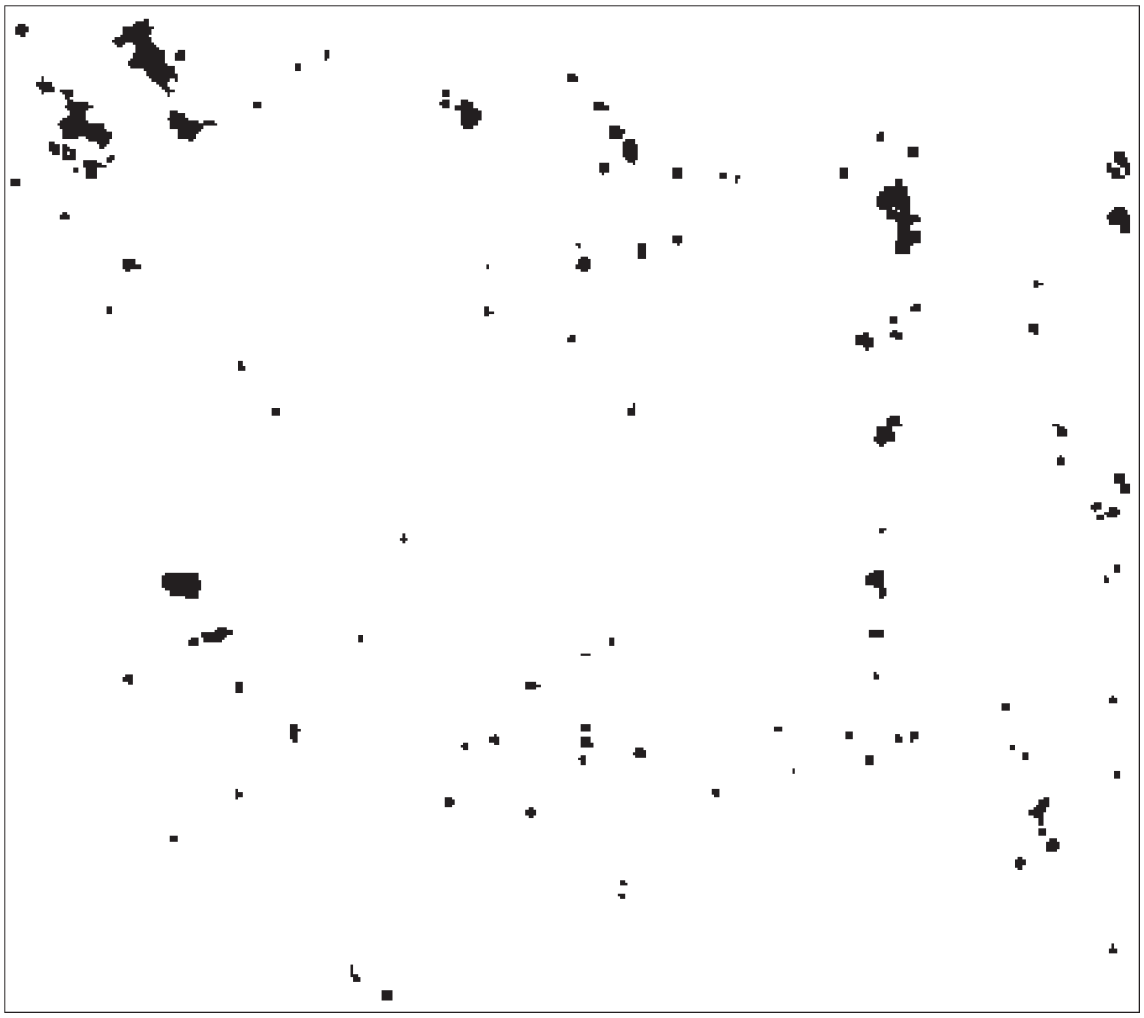
NOTE Corroded area, detected by optical imaging: 0,05 %.

Figure A.1 — Degree of rusting Ri 1



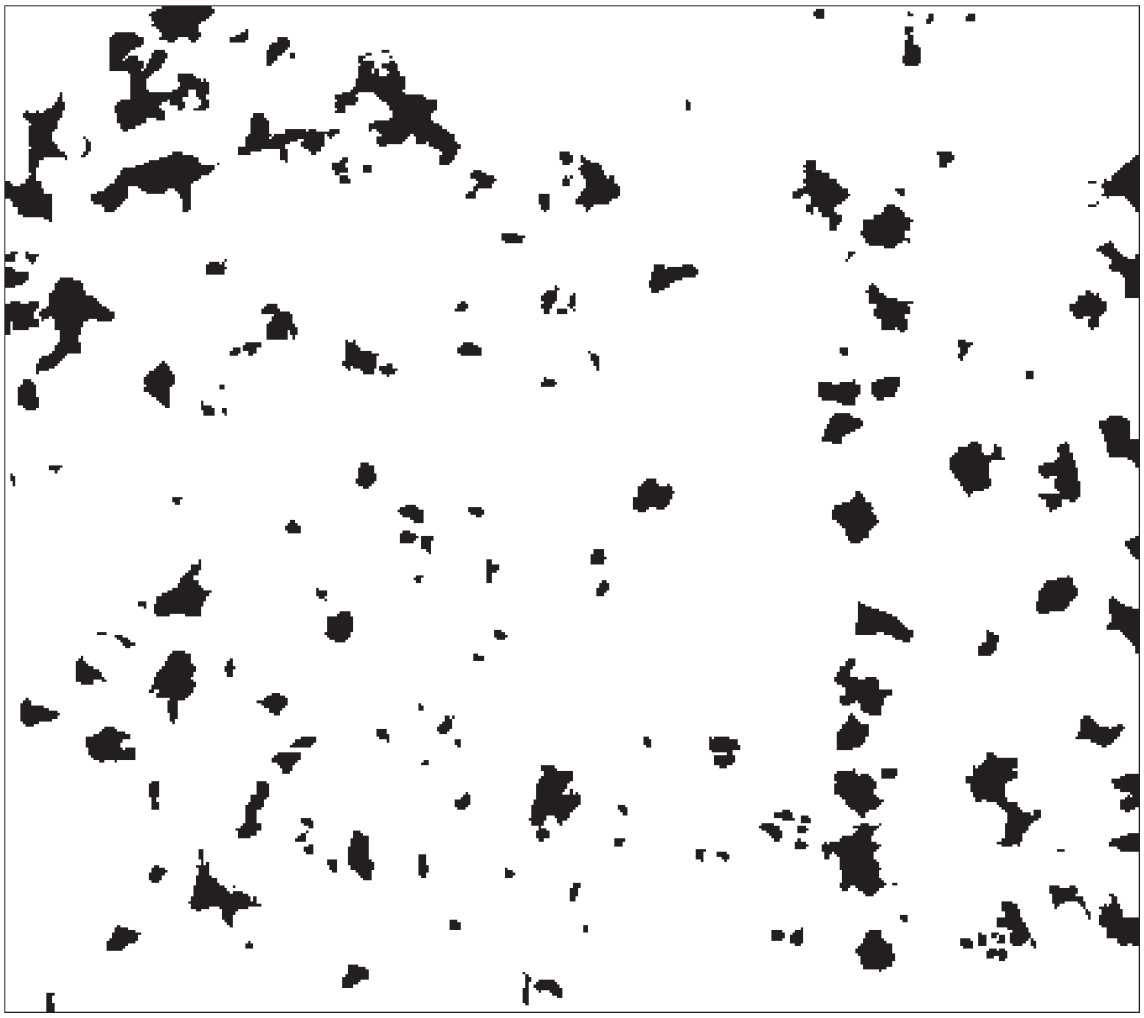
NOTE Corroded area, detected by optical imaging: 0,5 %.

Figure A.2 — Degree of rusting Ri 2



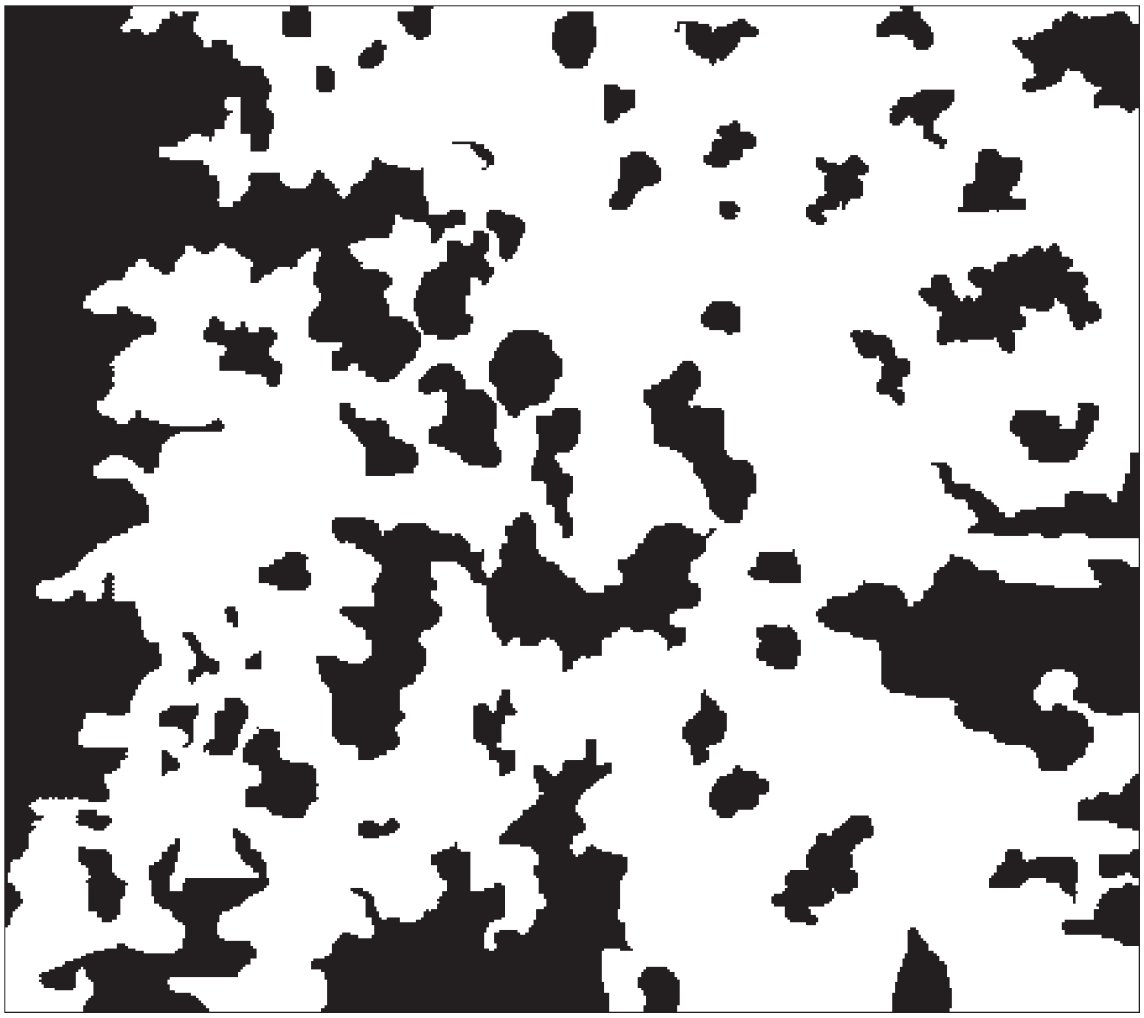
NOTE Corroded area, detected by optical imaging: 1 %.

Figure A.3 — Degree of rusting Ri 3



NOTE Corroded area, detected by optical imaging: 8 %.

Figure A.4 — Degree of rusting Ri 4



NOTE 1 Corroded area, detected by optical imaging: 35 %.

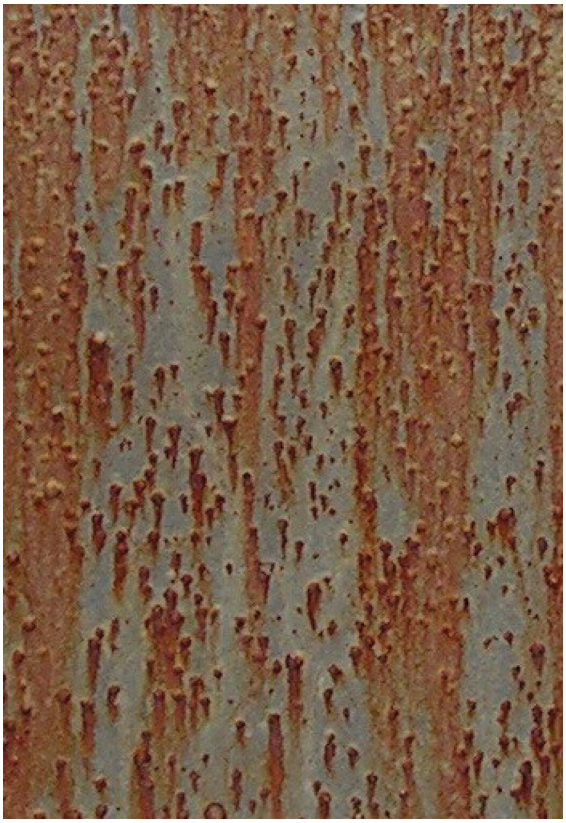
NOTE 2 When measuring the corroded area in Figure A.5, it is only about 35 %. If rust is assessed visually using the original photograph in Figure 5, the impression of corroded area is 40 % to 50 %. One reason can be that partly delaminated rust flakes are not distinguished from other corroded areas.

Figure A.5 — Degree of rusting Ri 5

Annex B
(informative)

Example for degree of rusting after performing the NSS salt spray test

Figure B.1 shows an example for a test panel after performing the NSS salt spray test specified in ISO 9227 with a degree of rusting Ri 4.



NOTE Original panel size: 150 mm × 100 mm.

Figure B.1 — Degree of rusting Ri 4

Annex C
(informative)

Correlation between the ISO rating system specified in this document and other systems

Table C.1 — Correlation between the ISO rating system and the "European rust scale"

ISO degree of rusting scale (this document)	**"European rust scale"**
Ri 0	Re 0
Ri 1	Re 1
Ri 2	Re 2
Ri 3	Re 3
Ri 4	Re 5
Ri 5	Re 7

Table C.2 — Approximate correlation between the ISO rating system and the ASTM rust scale

ISO degree of rusting scale (this document)		**ASTM rust scale** (ASTM D610-08)	
Rating	**Corroded area, shown in Figures A.1 to A.5**	**Rating**	**Corroded area**
Ri 0	0 %	10	Less than or equal to 0,01 %
Ri 1	0,05 %	9	Greater than 0,01 % and up to 0,03 %
Ri 2	0,5 %	7	Greater than 0,1 % and up to 0,3 %
Ri 3	1 %	6	Greater than 0,3 % and up to 1,0 %
Ri 4	8 %	4	Greater than 3,0 % and up to 10,0 %
Ri 5	35 %	2	Greater than 16,0 % and up to 33,0 %
		1	Greater than 33,0 % and up to 50,0 %

Bibliography

[1] ISO 4628-1:2016, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 1: General introduction and designation system*

[2] ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

[3] ASTM D610-08, *Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces*

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