

SSPC: The Society for Protective Coatings

GUIDE TO VISUAL STANDARD NO. 2

Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces

1. Scope

1.1 This standard provides a method to evaluate the degree of rusting on painted steel (or iron) surfaces. The reference color photographs and corresponding black and white images, which depict the percentage of rusting given in the written specification, form part of the standard. In the event of a dispute, the written definitions prevail.

1.2 This standard is particularly useful for evaluating rust on test panels or on localized areas of structures. (See Section 7.1.)

2. Description

2.1 This standard quantifies the degree of rusting on painted steel surfaces with a zero to ten scale based on the percentage of visible rust present on the surface. Visible rust includes rust blisters and undercutting of the coating. (See Section 7.3.)

2.2 The distribution of the rust is classified as spot rust, general rust, or pinpoint rust.

2.3 Standard reference photographs depict the appearance of painted steel surfaces with the appropriate percentage of rusting for various distributions of the rust. The rusting depicted in the photographs is not accompanied by blistering, but the photographs show staining associated with the rust. Black and white images highlight only those areas that are rusted. Both the color photographs and the black and white images enable the evaluator to assign an accurate rust grade.

3. Reference Standards

3.1 The standards listed here are referenced only in the Notes, which are not requirements of this specification.

3.2 The latest issue, revision, or amendment of the referenced standards in effect on the date of invitation to bid shall govern unless otherwise specified.

3.3 If there is a conflict between the requirements of any of the cited reference standards and this specification, the requirements of this specification shall prevail.

3.4 SSPC STANDARDS AND JOINT STANDARDS:

VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
VIS 3	Visual Standard For Power- and Hand-Tool Cleaned Steel
VIS 4/NACE No. 7	Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting

3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:

D 610	Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces
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3.6 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO):

4628-3	Paints and varnishes – Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect – Part 3: Designation of degree of rusting
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4. Rust Grade Scale

4.1 The painted steel surface to be evaluated for degree of rusting shall be assigned a rust grade based on the percentage of visible rust on the surface. The rust grade scale is defined in Table 1. The scale and description shown in Table 1 shall be used in conjunction with the photographic reference standards. (See Notes 9.1, 9.2 and 9.3.)

5. Rust Distribution

5.1 **SPOT RUSTING:** Spot rusting occurs when the bulk of the rusting is concentrated in a few localized areas of the painted surface. The reference photographs depicting this type of rusting are labeled 9-S through 1-S. (See Note 9.4.)

TABLE 1- SCALE AND DESCRIPTION OF RUST GRADES

Rust Grade	Percent of Surface Rusted	Photographic Standard		
		Spot	General	Pinpoint
10	Less than or equal to 0.01 percent	NONE		
9	Greater than 0.01 percent to 0.03 percent	9-S	9-G	9-P
8	Greater than 0.03 percent to 0.1 percent	8-S	8-G	8-P
7	Greater than 0.1 to 0.3 percent	7-S	7-G	7-P
6	Greater than 0.3 percent to 1 percent	6-S	6-G	6-P
5	Greater than 1 percent to 3 percent	5-S	5-G	5-P
4	Greater than 3 percent to 10 percent	4-S	4-G	4-P
3	Greater than 10 percent to 16 percent	3-S	3-G	3-P
2	Greater than 16 percent to 33 percent	2-S	2-G	2-P
1	Greater than 33 percent to 50 percent	1-S	1-G	1-P
0	Greater than 50 percent	NONE		

5.2 GENERAL RUSTING: General rusting occurs when various size rust spots are randomly distributed across the surface. The reference photographs depicting this type of rusting are labeled 9-G through 1-G. (See Note 9.4.)

5.3 PINPOINT RUSTING: Pinpoint rusting occurs when the rust is distributed across the surface as very small individual specks of rust. The reference photographs depicting this type of rusting are labeled 9-P through 1-P. (See Note 9.4.)

5.4 OTHER RUSTING: An actual rusting surface may be a hybrid combination of the types of rust distribution depicted in the reference photographs. In this case, combinations of the photographs and rust grades may be needed to classify the surface.

6. Conditions Depicted

6.1 The standard contains 27 color photographs of painted surfaces and the corresponding black and white rust images illustrating the maximum percentage of rusting allowed for each rust grade from rust grade 9 to rust grade 1

for three different rust distributions. Each color photograph and black and white image are labeled with the corresponding numerical rust grade followed by a letter indicating the type of rust distribution. The percentage of visible rust is also shown with each reference photograph. No photographs are used to depict rust grade 10 (less than 0.01 percent rust) or to depict rust grade 0 (over 50 percent rust). (See Note 9.5.)

7. Procedures

7.1 SELECT AREA: Select the area which is to be evaluated for degree of rusting. This area may be as small as a test panel or as large as the hull of a ship. For complex structures, each member may be evaluated as a whole, or different sections may be evaluated separately (e.g., top of flange, web of a beam, or edges).

7.2 DETERMINE RUST DISTRIBUTION: Determine the rust distribution (spot, general, or pinpoint) that most closely matches the selected area. Compare the selected area with the corresponding color photograph or black and white image. Determine the percentage of rust on the surface by visual comparison with the reference photographs, by electronic scanning techniques, or other methods agreed upon by the contracting parties.

7.3 DETERMINE RUST GRADE: The rust grade is determined by the percentage of visible rust on the surface as defined in Table 1. If rust buildup is evident under the coating, as in a rust blister or as rust undercutting, then that rusted area shall be included in the determination of the rust grade.

7.3.1 A rust blister is defined as a spot on a painted surface where the coating is intact but raised from the surface by the expansion of rust. The rust is not visible, but lies beneath the coating. A rust blister is not the same as a fluid-filled blister, which is typically caused by osmotic pressure or solvent entrapment. The volume of rust (if present) in a fluid-filled blister is a small percentage of the volume of the blister, whereas rust occupies most of the volume of a rust blister. A fluid-filled blister may collapse, but a rust blister will not collapse. (See Notes 9.6 and 9.7) Fluid-filled blisters should not be included in the determination of the rust grade.

7.3.2 If rust blisters are present, the rust grade shall be determined considering the rust blisters as visible rust. This rating must be recorded in such a manner that it is clear to the contracting parties that rust blisters were present and that they were considered as visible rust when assigning a rust grade.

7.3.3 Rust undercutting at a damaged area, at a broken blister, or at a place where the painted surface meets a

rusted area, shall be considered as visible rust in the determination of the rust grade. A dull putty knife may be used to remove loose coating, thereby exposing the rusted areas.

7.4 OTHER CONSIDERATIONS: Care must be exercised when determining the percentage of rust on the surface.

7.4.1 Some finishes are stained by rust. This staining shall not be considered as rust.

7.4.2 Accumulated dirt or other material may make accurate determination of the degree of rusting difficult. This dirt shall not be considered as rust.

7.4.3 Certain types of dirt that contain iron or iron compounds may cause surface discoloration that should not be mistaken for corrosion.

7.4.5 In evaluating surfaces, consideration shall be given to the color of the finish coating. A light surface that contrasts with the rust may appear to have a lower rust grade than a similarly rusted surface with a color that blends with the rust.

7.5 REPORTING: Report the area or item evaluated, the type or types of rust distribution, the presence of rust blisters (if applicable), and the rust grade.

8. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

9. Notes

Notes are not a requirement of this standard.

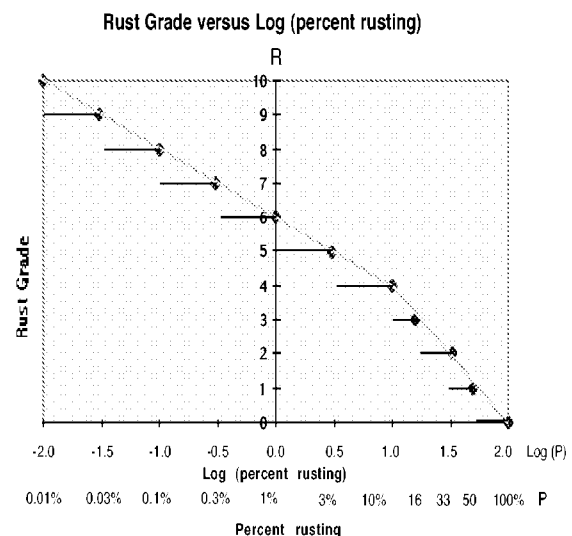
9.1 The rust grade scale is designed for use in distinguishing relatively large changes in the percentage of rust on the surface. For example, this standard is not intended to distinguish between 3.5 and 3.6% rust, even if electronic scanning equipment is used. For low rust levels, the amount of rust must triple before falling to the next rust grade. The standard photographs and the black and white images aid the inspector in distinguishing between adjacent rust grades.

9.2 The numerical rust grade is a logarithmic function of the percent area of rust so that slight amounts of initial

rusting have the greatest effect on lowering the rust grade. The graph of rust grade versus log (percent rust) is a straight line from rust grade 10 to rust grade 4. The slope of the curve was changed between 10 percent of the area rusted to 100 percent rusted to permit inclusion of complete rusting on the 0 to 10 rust grade scale. The relationship between the rust grade, R, and the maximum percent of rusting, P, is approximated closely by the equations:

$$R = 6 - 2 \log(P) \quad \text{for rusting from 0.01\% to 10\% (rust grades 10 to 4), and}$$

$$R = 8 - 4 \log(P) \quad \text{for rusting from 10\% to 100\% (rust grades 4 to 0).}$$



9.3 Table 2 compares the rust grades defined by ISO 4628-3 with the European rust scale and with the rust grades defined by this standard.

Table 2
Approximate Correlation Among SSPC/ASTM, ISO, and European Rust Grade Scales

SSPC-VIS 2/ASTM D 610		ISO*		European Rust Grade**
Area Rusted, %	Rust Grade	Area Rusted, %	Rust Grade	
<0.01	10	0	Ri 0	Re 0
0.03 to 0.1	8	0.05	Ri 1	Re 1
0.3 to 1	6	0.5	Ri 2	Re 2
0.3 to 1	6	1	Ri 3	Re 3
3 to 10	4	8	Ri 4	Re 5
33 to 50	1	40/50	Ri 5	Re 7

* ISO 4628-3

** "European scale of degree of rusting for anticorrosive paints" published by the Comité Européen des associations de fabricants de peintures et d'encre d'imprimerie in 1964.

9.4 Spot rusting has been associated with barrier coatings such as epoxy or urethane coatings. General rusting has been associated with oil, alkyd, and latex paints. Pin-point rusting has been associated with untopcoated zinc-rich coatings, thin inadequately applied coatings, or as flash rusting on waterborne primers.

9.5 In addition to this standard, SSPC has visual standards for blast cleaned steel (SSPC-VIS 1), for hand and power tool cleaned steel (SSPC-VIS 3), and for steel cleaned by water jetting (SSPC-VIS 4).

9.6 The nature of a blister can usually be determined visually, by touching it, or by breaking it. If the blister has

collapsed, it was a fluid filled blister. If liquid flows out and the blister then collapses, it was a fluid filled blister. The hard build-up of rust beneath the paint can usually be felt by touching the blister, thereby identifying it as a rust blister. If these methods are inconclusive, cutting the blister with a knife or carefully scraping it off with a dull putty knife will make it easy to determine the nature of the blister.

9.7 Fluid filled blisters should not be considered in determining the rust grade. A fluid filled blister may form in a relatively short time and then remain intact for years, especially in immersion environments. A fluid filled blister may form between coats while the steel substrate is still protected.

Sample Black and White Images from SSPC-VIS 2

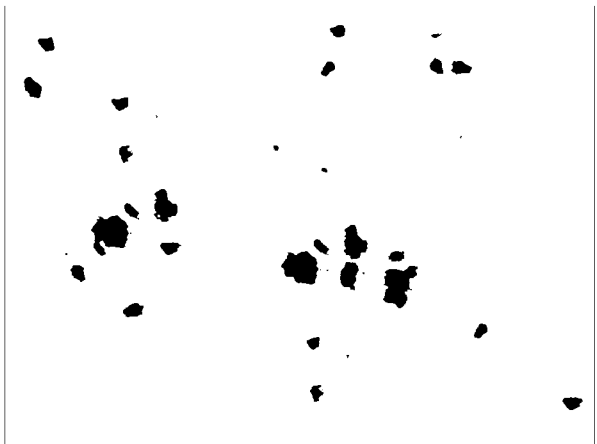
Rust Grade 8, 0.01% Rusted



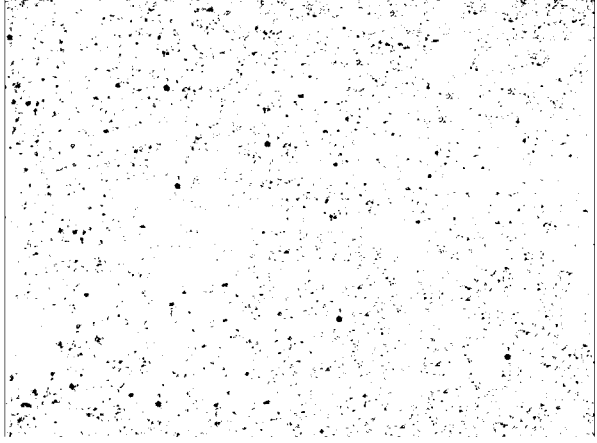
Rust Grade 5, 3% Rusted



Spot Distribution



General Distribution



Pinpoint Distribution