International Standard 4536

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Metallic and non-organic coatings on metallic substrates — Saline droplets corrosion test (SD test)

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4536 was prepared by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Metallic and non-organic coatings on metallic substrates — Saline droplets corrosion test (SD test)

0 Introduction

0.1 This test differs significantly from that specified in ISO 3768, *Metallic coatings — Neutral salt spray test (NSS test),* although the fields of application of the two tests are similar and their results are often comparable. In the saline droplets corrosion test, a pattern of discrete droplets is produced by spraying the specified test solution on to the surfaces being tested.

0.2 The droplets test may therefore have advantages for testing some conversion coatings which may, in continuous leaching, undergo changes which do not occur in their usual conditions of service. For some applications, the droplets test may be more severe than the continuous spray test since the corrosion processes in static drops may cause more intense local action than that produced by a continuous moving moisture film.

The method has advantages in needing only simple, easily controlled apparatus and in being applicable to articles of complex shape.

0.3 The method of corrosion by a pattern of discrete droplets has been used with several solutions for tests intended to assess the resistance of a coating to particular environments.

Only one test solution is specified in this International Standard. It contains the major mineral constituents of sea-water and has advantages in that droplets of the solution do not easily dry out and that, for some purposes, simulation of the effects of sea-spray may be useful. However, other solutions may be given in specifications for materials and products.

0.4 In many instances, there is no direct relation between the results of an accelerated corrosion test and the resistance to corrosion in other media, because several factors which influence the progress of corrosion, such as the formation of protective films, vary greatly with the conditions encountered. The results obtained in the test should not, therefore, be regarded as a direct guide to the corrosion resistance of the tested materials in all environments where these materials may be used. Furthermore, performance of different materials in the test cannot always be taken as a direct guide to the relative corrosion resistance of these materials in service.

1 Scope and field of application

1.1 This International Standard specifies the test solution, the apparatus and the procedure for a saline droplets corrosion test for assessment of the quality of metallic and non-organic coatings, made in accordance with the requirements of coating or product specifications on metallic substrates.

1.2 The method of test specified is suitable for detecting defects and discontinuities in metal coatings cathodic to the underlying metal. It is also suitable for chemical or electrochemical conversion coatings such as those obtained by chromate and phosphate treatments. The method is not suitable for testing coatings intended for the more severe types of service.

1.3 The type and number of test specimens, the exposure periods to be used for a particular product and the interpretation of results are not specified in this International Standard. Such details should be given in the appropriate materials or coating specification.

2 References

ISO 483, *Plastics — Small enclosures for conditioning and testing at relative humidities maintained by aqueous solutions.*[1)]

ISO 1462, *Metallic coatings — Coatings other than those anodic to the basis metal — Accelerated corrosion tests — Method for the evaluation of the results.*

ISO 4540, *Metallic coatings — Coatings cathodic to the substrate — Rating of electroplated test specimens subjected to corrosion tests.*

3 Principle

Spraying of the test specimens with a neutral salt solution, storing in conditions of high humidity, respraying only when it is needed to maintain the pattern of droplets.

NOTE — The regular flow of new solution over the surfaces under test, such as occurs in the continuous salt spray test, does not take place.

1) At present at the stage of draft. (Revision of ISO/R 483-1966.)

4. Test solution (see the table)

Using only reagents of recognized analytical grade and only distilled or demineralized water of pH 6,5 to 7,2, prepare a solution, the composition of which is given in the table.

Table — Composition of test solution

Component		Concentration (g/l)
Sodium chloride	(NaCl)	26,5
Magnesium chloride	($MgCl_2$)	2,4
Magnesium sulfate	($MgSO_4$)	3,3
Calcium chloride	($CaCl_2$)	1,1
Potassium chloride	(KCl)	0,73
Sodium hydrogen carbonate	($NaHCO_3$)	0,20
Sodium bromide	(NaBr)	0,28

Filter the solution before use in order to remove any solid matter which might block the aperture of the spraying device.

5 Apparatus

5.1 Cabinet or other suitable container, in which the test specimens are exposed to air with relative humidity in the range 85 % to 95 % at 23 ± 3 °C. The cabinet may be of any suitable shape and dimensions. It shall be made of a corrosion-resistant material (for example glass or plastics) so as to prevent the formation of corrosion products which might contaminate the test specimens.

The required relative humidity may be produced and maintained within the cabinet by placing on its base an open vessel containing water or a saturated solution of salts (for example potassium chloride or potassium nitrate) which will not influence the corrosion process, or by any other convenient means (see ISO 483).

Other conditions of temperature and humidity may be used by agreement between the parties concerned. In this case, the agreed test conditions shall be described in the test report.

5.2 Stand(s) or **support(s)**, to hold the test specimens, made from non-metallic materials resistant to corrosion by the test solution (for example glass or plastics).

5.3 Means of producing a spray of fine droplets, comprising a container for the test solution, fitted with a suitable atomizing nozzle and provided with means of generating sufficient pressure to deliver spray from the nozzle.

NOTES

1 A suitable design of hand-operated atomizer is shown in figure 1. Alternatively, a glass chromatographic spray-head is satisfactory for use in producing these fine droplets; suitable spray-heads of this type are available commercially.

2 The compressed air used for spraying shall be thoroughly filtered and free from traces of oil.

6 Test specimens

6.1 Select the number and type of test specimens, their shape and their dimensions according to the specification for the product or coating being tested.

NOTE — The simultaneous exposure of control specimens for which the correlation between the test and service life has been established is often useful.

6.2 Unless otherwise specified, clean the test specimens before testing. Choose the method of cleaning appropriate to the nature of the surface and of the contaminants. Do not use abrasives on conversion coatings; for metallic coatings, the only permitted abrasive is a paste of pure magnesium oxide. Do not use solvents that are corrosive or which may deposit either corrosion-promoting or protective films. Take care to ensure that the test specimens are not recontaminated after cleaning by careless handling or in any other way.

6.3 If the test specimens are cut from a larger coated article, carry out the cutting in such a way that the coating is not damaged, especially in the area adjacent to the cut. Unless otherwise specified, protect the cut edges adequately by coating them with a suitable medium that is stable under the conditions of the test, such as paint, wax or tape. Take care to avoid contamination by swarf during cutting.

7 Method of exposure of test specimens

7.1 Place the test specimens on the stand(s) or support(s) (5.2) so that contact does not occur between individual specimens and so that test solution (clause 4) cannot run off from one test specimen on to another.

7.2 The surfaces to be tested may be inclined at any angle to the horizontal, provided that a pattern of discrete droplets of solution, as described in 8.1, can be produced on them by spraying and retained on them for the necessary period. The limitation on the angle of inclination imposed by this requirement depends to some extent on the nature of the surface being tested but is often negligible.

7.3 When the stand(s) or support(s) are placed in the cabinet, the test specimens shall not come into contact with the walls of the cabinet or with any vessels placed therein to maintain the desired relative humidity.

8 Procedure

8.1 Lightly spray the test specimens with the test solution from the atomizer nozzle (see 5.3) so as to cover the entire surface to be tested with discrete droplets of solution. The spraying shall not be so heavy that the droplets coalesce to form a continuous film of solution on the surface. The size and distribution of droplets required are illustrated in figure 2. If the droplets coalesce at the first spraying, wash off and dry the test specimen before re-spraying.

When articles of complex shape are tested, it will usually be necessary to arrange for them to be supported in more than one position so that spray can be directed conveniently at all surfaces to be tested and so that the droplet pattern can be seen.

It may be difficult (see top row of figure 2) to see the droplet pattern on some surfaces because of their roughness or colour. In such instances, it is advantageous to make a trial spraying on a surface such as that of clean, smooth metal, glass or plastics material on which the droplets are easily seen and then to repeat with the surface to be tested the action seen to produce the required pattern.

8.2 Immediately after spraying, place the test specimens on the stand(s) (5.2) in the test cabinet (5.1) maintained at the specified relative humidity and temperature, taking precautions against sudden changes or local differences of temperature.

8.3 At least once during each working day, remove the test specimens from the cabinet and record the progress of any corrosion that has occurred. Minimize the time occupied by the inspection and do not allow the droplets to dry out. Do not disturb accumulations of salts and corrosion products. If at any inspection the droplets are seen to be diminishing in size or number, respray the test specimens to restore the droplet pattern specified in 8.1

9 Duration of tests

The period of test shall be as designated by the specification for the coating or product being tested. Recommended periods of exposure are 2; 6; 24; 48; 96; 240; 480 and 720 h.

10 Treatment of test specimens after test

At the end of the test period, remove the test specimens from the cabinet and clean and examine them in the manner specified for the coating or product tested. Usually, before the test specimens are examined, it will be necessary to remove residues of spray solution from their surfaces, taking care to avoid disturbance of corrosion products. A suitable method is to rinse or dip the test specimens gently in clean running water at a temperature not exceeding 40 °C and then to dry them immediately in a stream of compressed air at a pressure of 170 to 200 kPa.* It is advantageous to allow ferrous test specimens to dry for 0,5 to 1 h before rinsing, in order to reduce the risk of removing corrosion products.

If the method to be used for evaluation of the results of the test depends on the number, size or distribution of individual corroded areas, then corrosion products may be removed to the extent necessary to make possible the observations required.

11 Evaluation of results

Criteria for evaluation of the results of the test will usually be given in the specification for the coating or product tested. For most applications of the test, only the following need to be considered:

a) the appearance after test;

b) the appearance after removal of superficial corrosion products;

c) the number and distribution of corrosion defects, i.e. pits, cracks, blisters, etc. These may conveniently be assessed by methods such as that specified in ISO 1462 or in ISO 4540;

d) the time elapsing before the first signs of corrosion were observed.

12 Test report

12.1 The test report shall indicate the outcome of the test according to the criteria for evaluation of the results prescribed for the test. Report the result obtained for each test specimen and, when appropriate, the average result for a group of replicate test specimens. The test report may, if required, be accompanied by photographic records of the tested specimens.

12.2 The test report shall contain information about the conduct of the test. This information may vary according to the purposes of the test and to the directions prescribed for it, but a general list of the details likely to be required is as follows:

a) the specification of the basis material tested;

b) the type(s) of coating(s), with (an) indication(s) of its (their) surface finish(es);

c) the number of test specimens of each coating or product subjected to the test;

d) the dimensions and shape of the test specimens, and the nature and area of the surface tested;

e) the preparation of the test specimens, including any cleaning treatment applied and any protection given to edges or other special areas;

f) the method used to clean the test specimens after the test with, when appropriate, an indication of the loss of mass resulting from the cleaning operation;

g) the composition of the test solution and the frequency of spraying during the test;

h) the relative humidity in the test cabinet;

i) the test temperature;

j) the duration of the test;

k) the character of any test panels placed in the cabinet expressly to check the correctness of the operating conditions and the results obtained with them.

* 1 kPa = 10^3 N/m^2

Figure 1 — Hand-operated atomizer

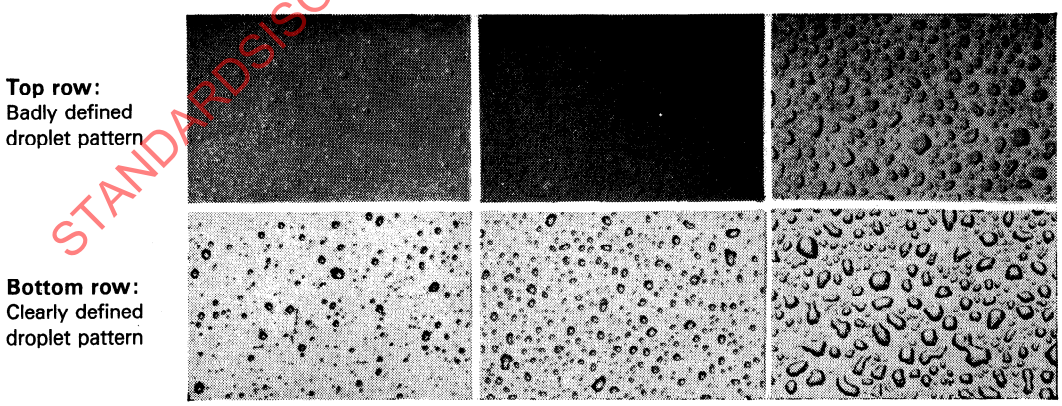

Figure 2 — Photographs illustrating the intensity of spraying required (actual size)