

भारतीय मानक ब्यूरो

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भारतीय मानक प्रारूप

पूर्व-रोगन की गई एल्यूमीनियम जिंक मिश्र धातु लेपित इस्पात पत्ती एवं चादरें

(IS 15965 का पहला पुनरीक्षण)

Draft Indian Standard

PRE-PAINTED ALUMINIUM ZINC ALLOY METALLIC COATED STEEL STRIP AND SHEET

(First revision of IS 15965)

ICS 77.140.50

Wrought Steel Products
Sectional Committee MTD 4

Last date for receipt of comments is
13Aug 2023

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 2012. This Indian standard has been developed to cover the various technical requirements. While reviewing this standard in the light of experience gained in its usage Committee felt that the standard should be reviewed to bring it in line with the present national and international practices in the field. In this revision, following significant changes have been made:

- a) Scope has been modified to do away with restriction on thickness and also to allow profiles
- b) Tables 1, 3, 4 & 5 have been modified.
- c) Clauses 1.1, 7.2, 7.4, 8.7 and 11.1 have been modified.
- d) Scope has been modified to do away with restriction on thickness and also to allow profiles
- e) Clause 4.2 has been added.

For all the tests specified in this standard (chemical/physical/others), the method as specified in relevant ISO standard may also be followed as an alternate method.

Annex E and Annex F for weathering performance of the pre-painted steel sheet and strip and summary of test for properties and expected results, respectively have been added for information.

The Committee responsible for the formulation of this standard has reviewed the provisions of following International Standards referred in this standard and has decided that they are acceptable for use in conjunction with this standard:

<i>International Standard</i>	<i>Title</i>
ISO 2808 : 2019	Paints and varnishes — Determination of film thickness
ISO 4628-2 : 2016	Paints and varnishes — Part 2: Assessment of degree of blistering

The composition of the Committee responsible for formulation of this standard is given in Annex G

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. *The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.*

**PRE-PAINTED ALUMINIUM ZINC ALLOY METALLIC COATED STEEL
STRIP AND SHEET
(First Revision)**

1 SCOPE

1.1 This standard covers the requirement of pre-painted aluminium-zinc alloy metallic coated steel strip and sheet for application as exposed / unexposed products.

1.2 Sheets and coils are produced by continuously coating and baking durable synthetic resin paint, for example, polyester, epoxy, acrylic, fluorocarbon etc, over both surfaces of aluminium- zinc alloy coated steel strip.

1.3 This standard covers requirements for different classes of durability of paint coatings in accordance with the severity of the application as building products.

2 REFERENCES

The standards listed below contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 101 (Part 4/Sec 4):2020 ISO 2813:2014	Methods of sampling and test for paints, varnishes and related products, Part 4 Optical Test Section 4 Gloss — Determination of gloss value at 20°, 60° and 85° (<i>fourth revision</i>)
IS 101 (Part 5/Sec 1):1988	Methods of sampling and test for paints, varnishes and related products: Part 5 mechanical test on paint films: Sec 1 hardness tests (<i>third revision</i>)
IS 101 (Part 5/Sec 2):1988	Methods of sampling and test for Paints, varnishes and related products. Mechanical Tests: Sec 2 flexibility and adhesion (<i>third revision</i>)
IS 101 (Part 6/Sec 1):1988	Methods of sampling and test for paints, varnishes and related products. Durability Tests : Sec 1 Resistance to humidity under conditions of condensation (<i>third revision</i>)
IS 1608(Part 1 :2022) ISO 6892-1 : 2019	Metallic materials — Tensile testing part 1 method of test at room temperature (<i>fifth revision</i>)
IS 1956 (Part 4:2013)	Glossary of terms relating to iron and steel: Part 4 flat products (<i>second revision</i>)

IS 8910:2022	Steel and Steel Products — General Technical Delivery Requirements (<i>second revision</i>)
ISO 404:2013	
IS 9844: 1981	Method of testing corrosion resistance of electroplated and anodized aluminium coating by neutral salt spray test
IS 14191:1996	Corrosion of metals and alloys — Classification of corrosivity of atmospheres
IS 15961:2012	Hot-dip aluminium — Zinc alloy coated steel strip & sheet (<i>first revision</i>)
IS/ISO 16162:2012	Cold-rolled steel sheet products — Dimensional and shape tolerances (<i>first revision</i>)
IS/ISO 16163:2012	Continuously hot-dipped coated steel sheet products — Dimensional and shape tolerances(<i>first revision</i>)
ISO 2808:2019	Paints and varnishes — Determination of film thickness
ISO 4628-2:2016	Paints and varnishes: Part 2 Assessment of degree of blistering

3 TERMINOLOGY

For the purpose of this standard the definition given in IS 1956 (Part 4) and the following shall apply.

3.1 Substrate — Hot dip aluminium- zinc alloy coated steel strip conforming to IS 15961.

3.2 Coil Coating — A continuous process by which paint and other coatings are applied and oven-baked onto moving aluminium- zinc alloy coated steel strip. The product of this process is referred to as pre-painted Al/Zn coated steel.

3.3 Organic Coating — The organic paint film of the pre-painted steel product.

3.4 Conversion Coating — A chemical treatment normally applied to a metal surface prior to final finishing, which is designed to react with and modify the metal to produce a surface suitable for painting.

3.5 Primer — The first complete layer of paint of a coating system applied to metallic surface. This serve as the bond between the substrate and topcoat/backer-coat and offers added corrosion prevention.

3.6 Finish-coat — A paint on the top side of the pre-painted steel. This is also known as top-coat.

3.7 Wash-coat — A thin paint on the bottom side of the pre-painted steel. This is also known as backer-coat.

3.8 Top-side — The side of the pre-painted sheet, which is exposed to external or internal weathering.

3.9 Bottom-side — The side of the pre-painted sheet, which is opposite to the exposed weathering side.

3.10 Coating Characteristics

3.10.1 Chalking — The formation on a pigmented coating of a friable powder evolved from the film itself at or just beneath the surface.

3.10.2 Fading — Loss in colour intensity experienced by paint over time, generally due the effect of ultra-violet radiation.

3.10.3 Gloss — The luster, shine or reflecting ability of a surface.

4 SUPPLY OF MATERIAL

4.1 The general requirements relating to supply of pre-painted aluminium-zinc alloy coated steel strip and sheet shall conform to IS 8910.

4.2 The pre-painted aluminium-zinc alloy coated steel sheets of this standard may also be supplied in profiles based on mutual agreement between the purchaser and the supplier for structural applications subject to fulfillment of required condition for imposed load on roofs as per 4.2 of IS 875 (Part 2).

5 MANUFACTURE

5.1 The substrate for pre-painted aluminium- zinc alloy metallic coated steel strip and sheet shall conform to IS 15961.

5.2 Pre-painting will be done in a continuous painting line by applying a conversion coating, primer, back-coat and finish coat on substrate. Curing of paint coatings shall be at a temperature suitable to produce an aesthetic and durable painted surface.

6 PRODUCT DESIGNATION

6.1 The product designation shall follow the sequence below:

- a) Number of this Indian Standard (IS);
- b) Steel grade (*see* IS 15961) ;
- c) Coating class (*see* IS 15961);
- d) Class of durability of paint coating (*see* **8.5**)

6.2 The designation of steel grade shall include a set of characters as follows:

- a) First and second characters: to indicate yield strength ‘YS’; and
- b) Third, fourth and fifth characters: to represent the minimum yield strength in MPa, namely ‘250’, ‘300’, ‘350’, ‘450’, & ‘550’.

Example: ‘YS 550’

6.3 The designation of coating class shall include a set of characters as follows: aluminium-zinc alloy metallic coating shall be indicated by the prefix ‘AZ’, followed by a number representing the minimum coating mass, in ‘grams per square meter’ (GSM) of sheets or strips (total for both surfaces determined by triple spot test/on-line X-ray fluorescence method as defined in IS 15961).

Example: ‘AZ 150’

6.4 The designation of the paint durability class shall include a set of characters as described in 7.

Example : ‘ IS 15965:2012 / YS550 / AZ150 /Class 3’.

7 COATINGS

7.1 The minimum recommended class of the aluminium- zinc alloy metallic coated steel strip shall be as per following Table 1.

7.2 The paint coating thickness shall be measured in **micrometer**.

7.3 Standard top-coat (finish coat) coating for durability class 2, 3, 4 shall be minimum 15 **micrometer** , and backer-coat (wash coat) shall be 4 **micrometer** minimum.

NOTE — Other coating thicknesses, like in durability Class 1 can be supplied as per mutual agreement between the customer and the supplier depending on the end use application of the pre-painted product.

7.4 Primer coating shall be minimum 4 **micrometer** for all durability classes with the exception of Class 1 wherein the polyester or water-based paint system **of single coat quality**.

7.5 The recommended durability class for atmospheric classification of IS 14191 is specified in the following Table 1.

Table 1 Recommended Guide to the Selection of Pre-painted Coating Class
(Clauses 7.1 and 7.5)

Sl No	Durability Class	Atmospheric Classification (IS 14191)	Aluminium- Zinc Alloy metallic coating (see Note 2)	Typical Top coat paint System (see Note 1)
(1)	(2)	(3)	(4)	(5)
i)	Class 4	Category C4	AZ 200	Polyester/ Super Durable Polyester/ Polyvinylidene Fluoride (PVDF)/ Water-based- acrylic
ii)	Class 3	Category C3	AZ150/AZ165/AZ180	
iii)	Class 2	Category C2	AZ100/AZ120/AZ150	
iv)	Class 1	Category C1	AZ 70/ AZ100	

NOTES

1 Different top paint system gives different paint durability at given exposure. Paint systems with higher paint durability are for long term colour and gloss retention requirement. Class 3 denotes products with paint durability better than that of class 2

2 See IS 15961

8 TEST FOR PHYSICAL PROPERTIES OF PAINT COATING

8.1 Mandatory Testing

The following tests for physical properties and appearance are mandatory at the time of production:

- a) Adhesion ;
- b) Pencil hardness;
- c) Solvent Resistance;
- d) Color (*see 9.2*);
- e) Gloss (*see 9.3*); and
- f) Dry film thickness;

8.2 Sampling Frequency

One sample for the tests indicated in **9.1**, or as agreed between manufacturer and buyer, is taken for testing from every 25 *T* of sheets/coil or part thereof from a lot of the products of the same quality, dimensions, coating mass and colour.

8.3 Adhesion Test

8.3.1 *T-bend Adhesion Test*

For pre-painted sheet and strip when tested in accordance with Annex A, the adhesion of the paint shall be sufficient to prevent its removal from the metal when tape is pulled. All pre-painted sheet and strip shall comply with internal bend diameter of 5 *t* or less, unless agreed otherwise between the purchaser and the manufacturer.

8.3.2 *Reverse Impact Resistance Test*

When a pre-painted steel product test piece is subjected to reverse impact test in accordance with Annex B using the impact energy level of 10 J or 1020 Kg.mm, there shall be no loss of adhesion of the paint coating. On visual inspection there should not be any cracking, powdering or peeling of the paint film.

8.4 Pencil Hardness Test

Pencil hardness is one of the attributes, which depicts degree of cure and how easily it can be processed in the customers' factory. Standard pencil of known hardness should be used for the pencil hardness test [*see 4* of IS 101 (Part 5/Sec 1)]. On visual inspection there shall not be any scratch on the tested portion. The minimum acceptable hardness shall be HB hardness minimum.

8.5 Scratch Hardness

When measured in accordance with **3** of IS 101(Part 5/Sec 2), the scratch resistance of the coating shall not be less than 1.5 Kg or as agreed between the manufacturer and the purchaser.

NOTE — This test is not a part of the mandatory testing mentioned in **8.1**.

8.6 Solvent Resistance Test

Methyl Ethyl Ketone (MEK) double rub test shall be conducted on a test piece in accordance with Annex C. This is one of the measures for determination of oven paint curing process completion.

8.7 Dry Film Thickness

This refers to the paint film thickness of the finish coat or top coat. When measured by method as mentioned in **5B** of ISO 2808, the supplied dry film thickness of paint coating (Finish coat or top coat) shall comply with the requirements of the **7.3** of this specification or the agreement between the manufacturer and the purchaser.

NOTE — In order to determine the total thickness of coating for optimum corrosion protection the following details should be considered together:

- a) Coating class of the aluminium- zinc alloy metallic coating (for example AZ 150, AZ 200)
- b) Type and dry film thickness of the topcoat and the back coat paint.
- c) Type and dry film thickness of the primer.

9 APPEARANCE

9.1 General

Pre-painted metal products shall have uniform appearance, colour and texture. It will be essentially free of blemishes such as flow lines, streaks, blisters or other surface imperfections. It should be reasonably flat and free from physical imperfections like bare spots, holes, tears etc. Sheets and coils shall be free from defects detrimental to practical use with the exception of coils which may contain some irregular portions (like welds, colour shading etc.) since irregular portions in the coil cannot be removed as in the case with cut length.

9.2 Colour

The colour batch to standard shall match the ‘colour specified’ (agreed between the pre-painted steel manufacturer and the purchaser). When tested in a light booth having a daylight simulator and incandescent light source, the visual color match shall achieve a rating of 2 or lower. The classification of degrees of colour match as determined by unaided visual inspection is described in Table 2. A more accurate instrumental measurement of color, with spectrophotometer adopting the Hunter Colour Measurement System, is also allowed for better batch-to-batch colour consistency.

9.3 Gloss

Gloss of pre-painted metal product shall comply with the requirement as agreed between the manufacturer and the customer, when tested using a 60° head (gloss geometry) [see IS 101 (Part4/Sec 4)].

Gloss level shall be agreed to between the pre-painted steel manufacturer and paint supplier as well.

NOTE — Specular gloss unit normally do not apply to textured finishes. Gloss is dependant on the paint system. However, 10 to 40 percent gloss with 60° head is a typical range for a standard paint system.

10 DURABILITY TEST FOR PAINT COATING

Sheets and coils will be subjected to the accelerated durability tests given in the Table 3 and described in **10.1** and **10.2**.

Table 2 Colour Match
(Clause 9.2)

SI No	Rating	Description	Explanatory Note
(1)	(2)	(3)	(4)
i)	0	Exact match	Colour of test sample indistinguishable from that of reference or standard sample.
ii)	1	Critical match	A small, just perceptible colour difference can be seen when the samples are held in contact but it cannot be detected when separated by 5 mm.
iii)	2	Close match	When separated by 5 mm a small color difference can be seen, but it is undetectable when increased to 25 mm.
iv)	3	Approximate match	When separated by 20 mm a small color difference can be seen, but it is undetectable when increased to 100 mm.
v)	4	Crude match (Poor match)	Difference is readily detectable even when separated by more than 100 mm

NOTE — A standard Light booth shall be used for the above qualitative measurement. These qualitative comparison measurements shall preferably be backed by color measurements with a standard spectrophotometer for high repeatability and reproducibility of colour.

TABLE 3 Test Duration for Salt Spray and Humidity Resistance
(Clauses 10, 10.1. and 10.2)

SI No	Durability Classes for Pre-painted Products	Corrosion Resistance (Salt Spray) [IS 9844] h	Humidity Resistance (IS 101 Part 6 Sec 1)
(1)	(2)	(3)	(4)
i)	Class 4	2000	1000
ii)	Class 3	1000	1000
iii)	Class 2	750	750
iv)	Class 1	500	500

NOTES

1 Requirements of Table 4 & Table 5 are required to be met with when tested for duration (hours) specified in Table 3.

2 Durability tests are for manufacturer's information only and are not necessarily mandatory at the time of production/coating.

10.1 Corrosion Resistance

When suitably prepared test specimens (scribed or un-scribed, as appropriate) are exposed to the salt spray test specified in IS 9844 and Table 3 and assessed in accordance with Annex D, the pre-finished product shall comply with the requirements of Table 4.

TABLE 4 Requirements for Salt Spray Resistance
(Clause 10.1)

Sl No.	Type of deterioration	Method of Test, Ref to	Requirement
(1)	(2)	(3)	(4)
i)	Undercut at scribed lines	D-1	Rating of 2 or less with no corrosion of base metal, no red rust formation
ii)	Corrosion of the base metal	D-2	Rating 1
iii)	Blistering	D-3	Not worse than rating 2(S3) ¹⁾

¹⁾Face of panel.

NOTE — Other requirement / acceptance level may be specified and agreed between the customer and the supplier.

10.2 Humidity Resistance

When suitably prepared test specimens (scribed or unscribed, as appropriate) are tested in accordance with IS 101 (Part 6/ Sec 1) & Table 3 and assessed in accordance with Annex D, the pre-finished product shall comply with the requirements of Table 5.

TABLE 5 Requirements for Humidity Resistance
(Clause 10.2)

Sl No	Type of deterioration	Method of Test, Ref to	Requirement
(1)	(2)	(3)	(4)
i)	Undercut at scribed lines	D-1	Rating of 2 or less with no corrosion of base metal, no red rust formation
ii)	Blistering	D-3	Not worse than rating 3 (S2) ¹⁾

¹⁾Face of panel.

NOTE -Other requirement / acceptance level may be specified and agreed between the customer and the supplier.

11 DIMENSIONS AND TOLERANCES

11.1 The typical base metal thickness is up to 1.50 mm .

11.2 In case of coils, the mass of the coils shall not exceed 10 mt (typical) and the internal diameter of the coils shall be 508 or 610 mm.

11.3 Sheets and coils of sizes other than those specified in **11.1** and **11.2** may be supplied, if agreed between the purchaser and the manufacturer.

11.4 Tolerances

11.4.1 Thickness

The tolerances on Base Metal Thickness (BMT) of sheets and coils shall be as given in **IS/ISO 16162**.

11.4.2 Width

No sheet or coil shall be smaller in width than that specified. The positive tolerance on width shall be 10 mm. In case of trimmed width it shall be + 3 mm maximum. **The total unilateral width tolerance range may be allowed bilaterally as agreed between purchaser and supplier on mutual agreement basis.**

11.4.3 Length

No sheet shall be smaller in length than that specified. Tolerance on length on plus side shall be 15 mm or 0.5 percent of length, whichever is greater.

12 SHAPE

12.1 Camber

Minimum camber values for coils and sheets shall be as given in IS/ISO 16163.

12.2 Deviation from Squareness (Out-of Square)

Deviation from Squareness of flat sheets shall be given in IS/ISO 16163.

12.3 Deviation from Flatness (Steepness)

This will be in accordance with Table 6

Table 6 Flatness Tolerance
(Clause 12.3)

Steepness Ratio, Percentage	
Class A	Class B
1.2	0.5

NOTES

1 Class A tolerance, where length between the points of contact, is less than 1000 mm, the steepness ratio percentage will be 1.

2 The steepness ratio expressed as a percentage is calculated by determining the maximum distance between the product surface and the straightedge and the length between two consecutive points of contact (shown in Fig 1), then applying the following equation:

$$\text{Steepness ratio} = (h / l) \times 100, \%$$

where

h = deviation from flatness (wave height), in mm

l = distance between two consecutive points of contact, in mm

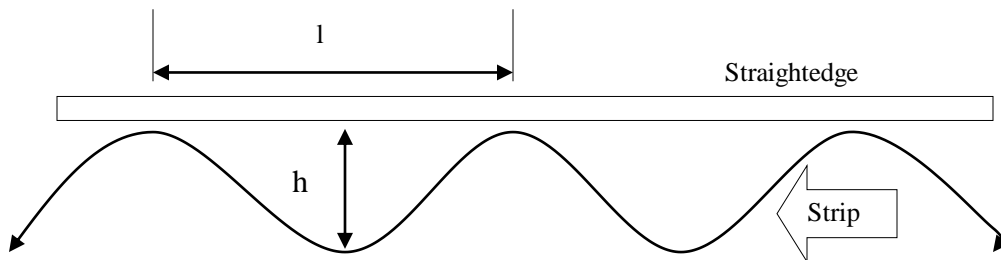


FIG. 1 DEVIATION FROM FLATNESS

13 MASS

13.1 The mass of the sheets or coils shall be given in 'kg' or 'mt' of actual.

13.2 The mass tolerance of ± 10 percent for individual sheet and ± 5 percent for sheet pack/coil shall apply.

14 RETEST

When a part of the test results for physical properties fails to comply with the requirement, a retest (two more sets of test samples shall be taken for specific test requirements from the

same lot) on the relevant items may be carried out to determine whether it is acceptable or not. If any of the retest samples fail to meet the test requirements of this standard, the entire batch of sheets represented by the sample shall be deemed as not conforming to this standard.

15 PACKING & TRANSPORTATION

15.1 Coils should be wrapped with polylaminated covering. Inner wrap surface (ID) should also be covered with poly laminated covering. The coil should then be wrapped with either steel sheet along with the side covers or with Hessian cloth covering both sides as agreed between the purchaser and the manufacturer. Circumferential ring and inner rings should be fitted along the edges. Finally it should be strapped with steel tape.

15.2 Sheets should be first wrapped with polylaminated covering and then with steel sheet or with Hessian cloth as agreed between the purchaser and the manufacturer. Finally it should be strapped with steel tape.

15.3 Every precaution should be taken against paint coating damage and contact with water during transit. Mixed loading with corrosive substances such as chemicals should be avoided.

16 MARKING

16.1 The following shall be legibly and indelibly marked on the top of each coil or package of sheets or shown on a tag attached to each coil:

- a) IS No. of this standard;
- b) Manufacturer's name or trade-mark;
- c) Material identification/ coil number/ packet number/ batch number, etc;
- d) Product dimension;
- e) Number of sheets or mass;
- f) Coating Class;
- g) Color Name of top-coat; and
- h) Date of packing.

16.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the Bureau of Indian Standards Act, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

17 STORAGE AND HANDLING OF PRODUCTS

It is essential that pre-painted products be kept dry in transit and stored under cover clear of the ground. Should packs or coils of the product become wet, layers should be separated,

wiped dry with a clean cloth and positioned so that air circulation will complete the drying process. The use of these procedures should prevent deterioration of the coating, which otherwise can lead to reduced life expectancy or poor appearance of the product.

Pre-painted products should be lifted directly and not dragged over rough surfaces or over each other. Care should also be taken to avoid dragging, cutting and forming tools over the surfaces of the pre-painted products.

Stocks of pre-painted products should be used in rotation as some mechanical properties of the coating may change slightly during prolonged storage, for example duration greater than six months. These changes are typically small and in most fabrication processes are not significant. However, it is possible that they could cause fabrication problems during severe forming operations.

ANNEX A
(Clause 8.3.1)

T-BEND ADHESION TEST

A-1 This Annex describes the method for assessing paint adhesion by the T-bend test. The method is suitable for testing pre-painted sheet and strip products up to 1.5 mm thickness.

A-2 PRINCIPLE

Pre-painted metallic product is bent flat. Adhesion of the paint on the outside of the bend is assessed by the application of adhesive tape and its subsequent rapid removal.

A-3 APPARATUS

The following test apparatus is required:

- a) A bench vice approximately 150 mm wide or alternative bending apparatus.
- b) Adhesive tape 20 mm to 25 mm wide which is semi-transparent, pressure-sensitive, and has an adhesion strength of 5 N to 15 N per 24 mm width.

Note — Scotch 600 tape fit the above specification

A-4 PREPARATION OF TEST PIECES

Test pieces shall be cut 50 mm wide at least (and shall have sufficient length - 200 mm long is normally sufficient) to suit the test requirement. Test piece shall be cut out parallel to the rolling direction of the base metal.

A-5 PROCEDURE

- a) Clamp approximately 25 mm of one end of the test piece in the vice.
- b) Bend the test piece through 90° with the coating to be assessed on the convex surface of the bend.
- c) Remove the bent test piece from the vice and bend it through to approximately 180°.
- d) Reinsert the test piece in the vice and compress flat. This represents a zero T-bend or starting point for subsequent folding.
- e) Fold once around this starting point to achieve 1 t and compress (the internal diameter of the bend is 1 t). Fold twice for 2 t and compress, and so on until the specified requirement as agreed between the manufacturer and the customer is completed.
- f) Apply adhesive tape along the entire length of the external bend and press down firmly.
- g) Remove tape with a rapid single pull at right angles to the bend.
- h) Examine the test piece for removal of paint.

Note — T = nominal thickness of sheet or strip

ANNEX B
(Clause 8.3.2)

REVERSE IMPACT TEST

B-1 This Annex describes a method to assess the impact resistance of pre-painted metal products and the adhesion of a coating to the base metal. This test applies to base metal thickness from 0.4 mm to 1.5 mm.

B-2 PRINCIPLE

The test piece is struck on the reverse side by a ball of specified diameter and with a specified force. Adhesion of the disturbed coating is assessed by examination after application and subsequent rapid removal of adhesive tape.

B-3 APPARATUS

The following apparatus is required:

- a) An impact tester fitted with a male and a female die of 19 mm diameter, or other diameter if specified in the product standard.

Note — Gardner Impact tester may be used for this test.

- b) Adhesive tape 20 mm to 25 mm wide, which is semi-transparent, pressure-sensitive, and has adhesion strength of 5 N to 15 N per 24 mm width.

Note — Scotch 600 tape fit the above specification

B-4 PREPARATION OF TEST PIECE

The test piece shall be cut 50 mm wide and 50 mm long approximately.

B-5 PROCEDURE

Reverse impact resistance shall be determined using the following procedure:

- a) Load the test piece into the test machine with the coated side to be tested facing away from the impactor.
- b) Set the impactor to apply the specified impact force.
- c) Trigger the machine and impact the test piece.
- d) Remove the impacted test piece from the machine and apply adhesive tape to the deformed area of the coated test side. Press the tape down firmly to remove air bubbles.
- e) Remove the tape immediately with rapid pull at right angles to the un-deformed surface.
- f) Examine the test piece and the tape for removal of paint.

ANNEX C
(Clause 8.6)

SOLVENT RESISTANCE TEST

C-1 This procedure is to be used to determine the degree of cure of a baked film by the paint films resistance to a specified solvent. This procedure is applicable whenever the resistance to methyl ethyl ketone (MEK) or methyl *iso*-butyl ketone (MIBK) has to be determined.

C-2 PRINCIPLE

The determination of solvent resistance is carried out by using a double rub machine. This machine rubs the test piece/panel with cotton doused in MEK or MIBK.

C-3 APPARATUS

- a) Fume cupboard;
- b) Protective gloves;
- c) Cotton pad (~50 mm square);
- d) Solvent (MEK or MIBK); and
- e) Solvent double rub machine.

C-4 PREPARATION OF TEST PIECE

A panel of **minimum size 60 mm × 200 mm** is prepared from the production test sample to be tested face up in the solvent rub machine.

C-5 PROCEDURE

C-5.1 Clamp the panel of **minimum size 60 mm × 200 mm** in the solvent rub machine.

C-5.2 Place a 50 mm² cotton pad between the magnetic holders on the bottom of the solvent rub machine head.

C-5.3 Fill the reservoir with recommended solvent - MEK for top coats and bottom coats or MIBK for primer evaluations.

C-5.4 Start the machine **with minimum 1Kg load** and stop it based on observations mentioned in item 6.

C-6 EVALUATIONS

C-6.1 Observe the operation of the solvent rub machine and stop the machine when failure has occurred. Failure shall consist of removal of the film to expose the primer or substrate at any spot along the centre-line of the double-rub stroke. The first and the last 25 mm of the stroke shall not be considered.

C-6.2 The solvent resistance of the organic coating is classified as the number of strokes the machine has made prior to failure of the organic coating.

C-6.3 The number of rubs required is dependent on the paint system. However completion of 50 double rubs is sufficient for the test of standard paint system (for durability class 2, 3 & 4). Failure of the paint film at less than 50 double rubs is an indication of a “problem”.

ANNEX D
(Clauses 10.1 and 10.2 and Table 4 and Table 5)

METHODS OF ASSESSMENT OF SALT SPRAY AND HUMIDITY TEST RESULT

D-1 UNDERCUT AT SCRIBED LINES

D-1.1 This method describes the assessment of the degree of deterioration for a metal substrate that has been coated by a paint system.

D-1.2 Principle

Coated test panels are exposed to an accelerated corrosive (Salt Spray Test) or humid (Humidity Test) environment. The corrosion on the surface of the paint film and on the metal surface beneath the paint film is assessed by comparison with photographic reference standards and rating table.

D-1.3 Procedure

- a. Remove loose corrosion products and any coating that has lost adhesion from the vicinity of the scribed line by scraping with a metal spatula or dull knife.
- b. Rate the mean creepage of undercut corrosion or loss of paint extending from the scribed line, as prescribed in Table 7.

TABLE 7 Rating for Failure at Scribe and Panel Edge

Rating Scale	Representative Mean Creepage of Under Film Corrosion from Scribed Line
(1)	mm (2)
0	0
1	> 0 ≤ 1.0
2	> 1.0 ≤ 3.0
3	> 3.0 ≤ 7.0
4	> 7.0 ≤ 13.0
5	> 13

D-2 CORROSION OF THE BASE METAL

D-2.1 This method describes the assessment of the degree of deterioration for a metal substrate that has been coated by a paint system.

D-2.2 Principle

Coated test panels are exposed to an accelerated corrosive environment. The corrosion on the metal surface beneath the paint film is assessed by comparison with photographic reference standards.

D-2.3 Procedure

- Carefully remove a portion or whole of the paint film using a suitable solvent-based paint remover.
- Determine the severity of corrosion by referring to the pictorial standards in the following Fig 2.

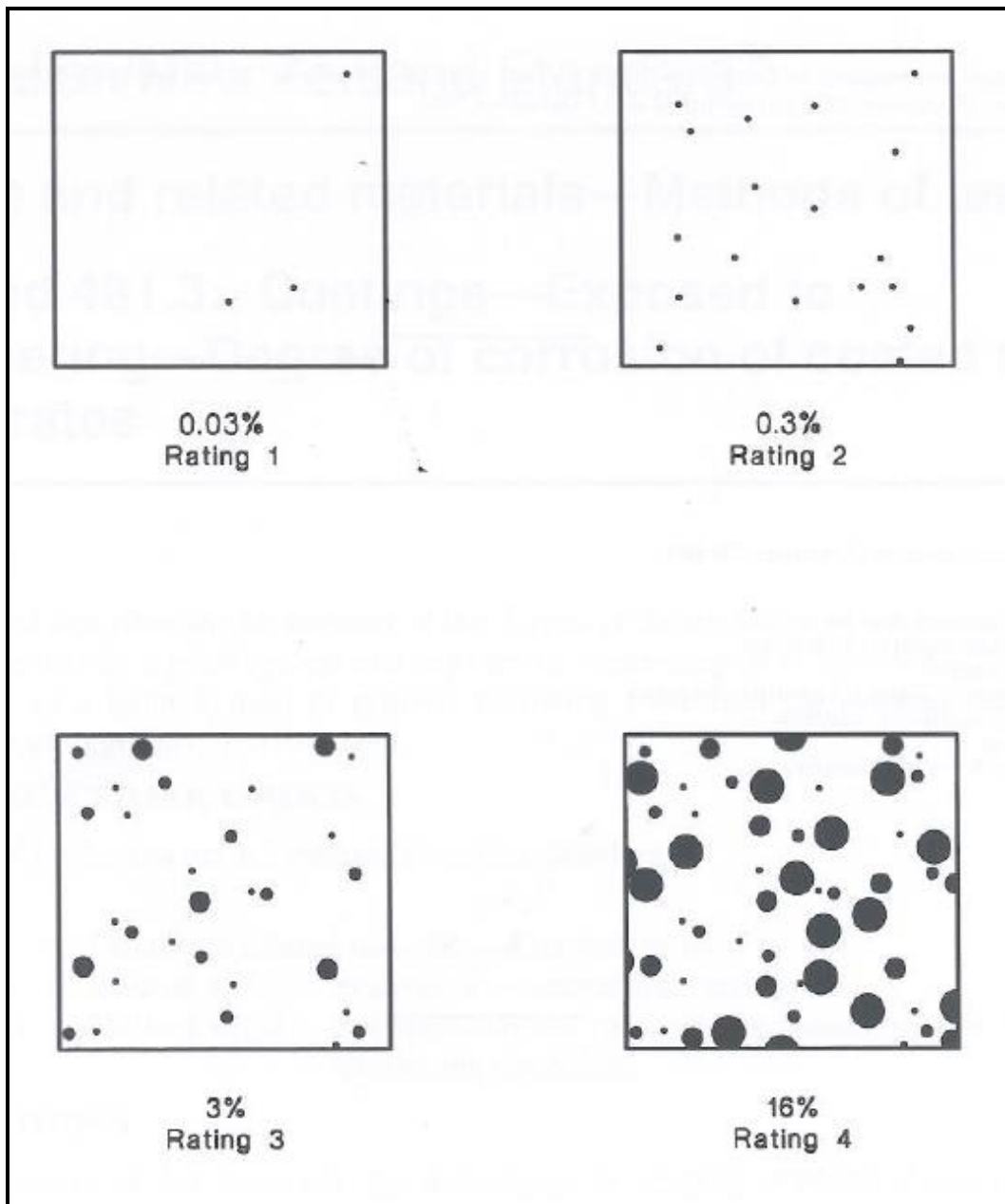


FIG. 2 TYPICAL CORROSION ON THE STRIPPED METAL SUBSTRATE

D-3 BLISTERING

D-3.1 This Annex sets out a method for determining the degree of blistering in a paint film exposed to accelerated weathering conditions.

D-3.2 Principle

The test is visually evaluated for the degree of blistering by comparing with diagram reference standards, which shows rated stages of blistering.

NOTE — The diagram reference standards have been adopted from ISO 4628-2.

D-3.3 Apparatus

Diagram standards (*see* Fig. 3, 4 & 5) - required for comparison with the test film.

D-3.4 Viewing Environment

Examination of the films should be carried out under lighting conditions of at least 500 lux or lumen/ m².

D-3.5 Procedure

- a) Visually examine the test film by comparing the surface finish with the reference diagram standards (*see* **D-3.2**) that shows a similar amount of blistering.
- b) Using Table 8 to determine the rating for density of blistering and Table 9 for the size of blistering.
- c) Record the rating as for example 2(S 3) where 2 stands for density and S 3 stands for size of blister.

TABLE 8 Rating for Density of Blistering
(Clause D-3.5)

Rating Scale ¹⁾	Density of blistering
0	None
1	Less than few
2	Few
3	Medium
4	Medium-dense
5	Dense

¹⁾ The rating scale conforms to current ISO practice.

TABLE 9 Rating for Size of Blisters
(Clause D-3.5)

Rating Scale ¹⁾	Size of blistering
1	Finer than in Fig. 3
2	See Fig. 3
3	See Fig. 4
4	See Fig. 5

¹⁾ The rating scale conforms to current ISO

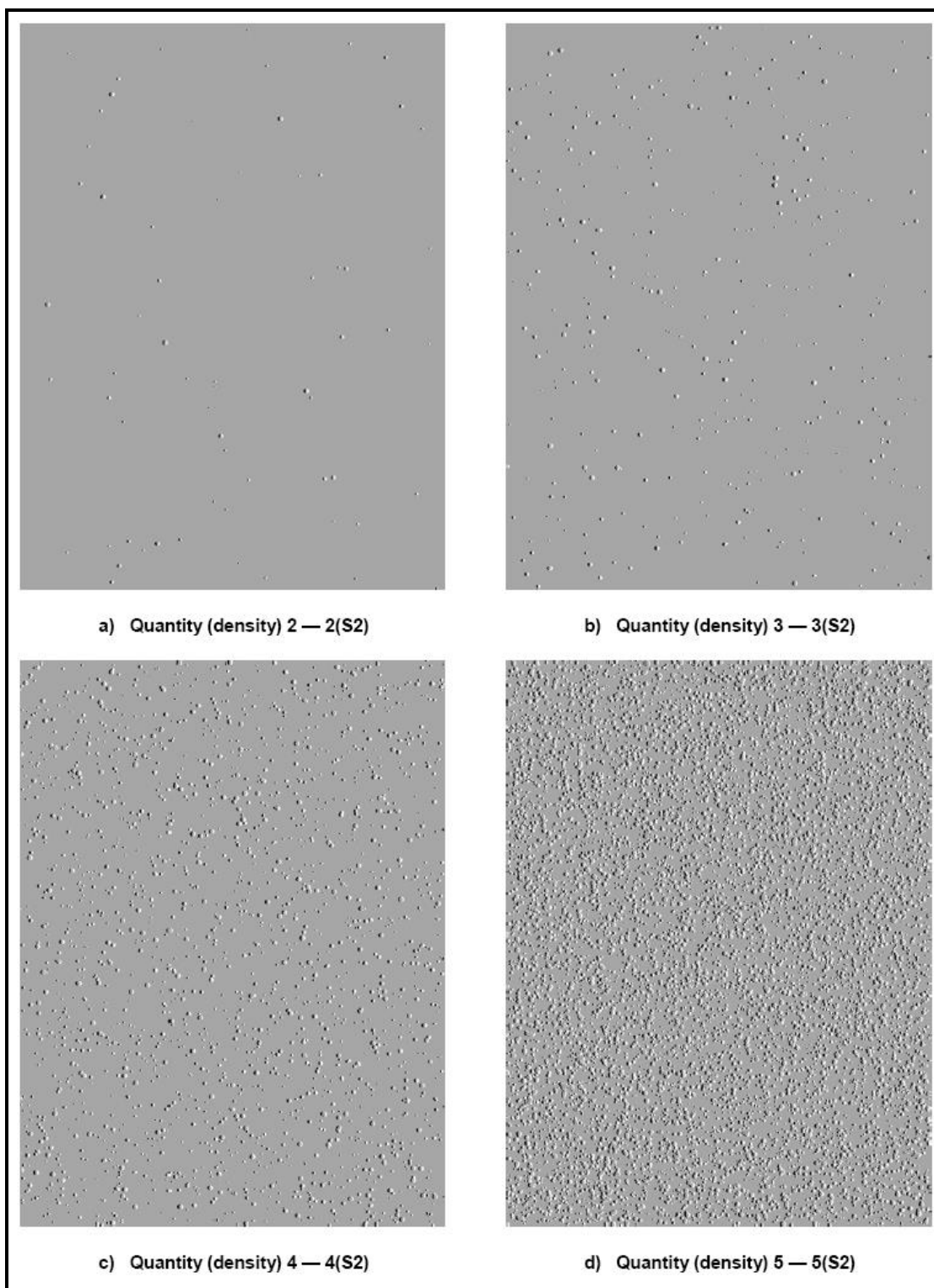


FIG. 3 BLISTERS OF SIZE 2

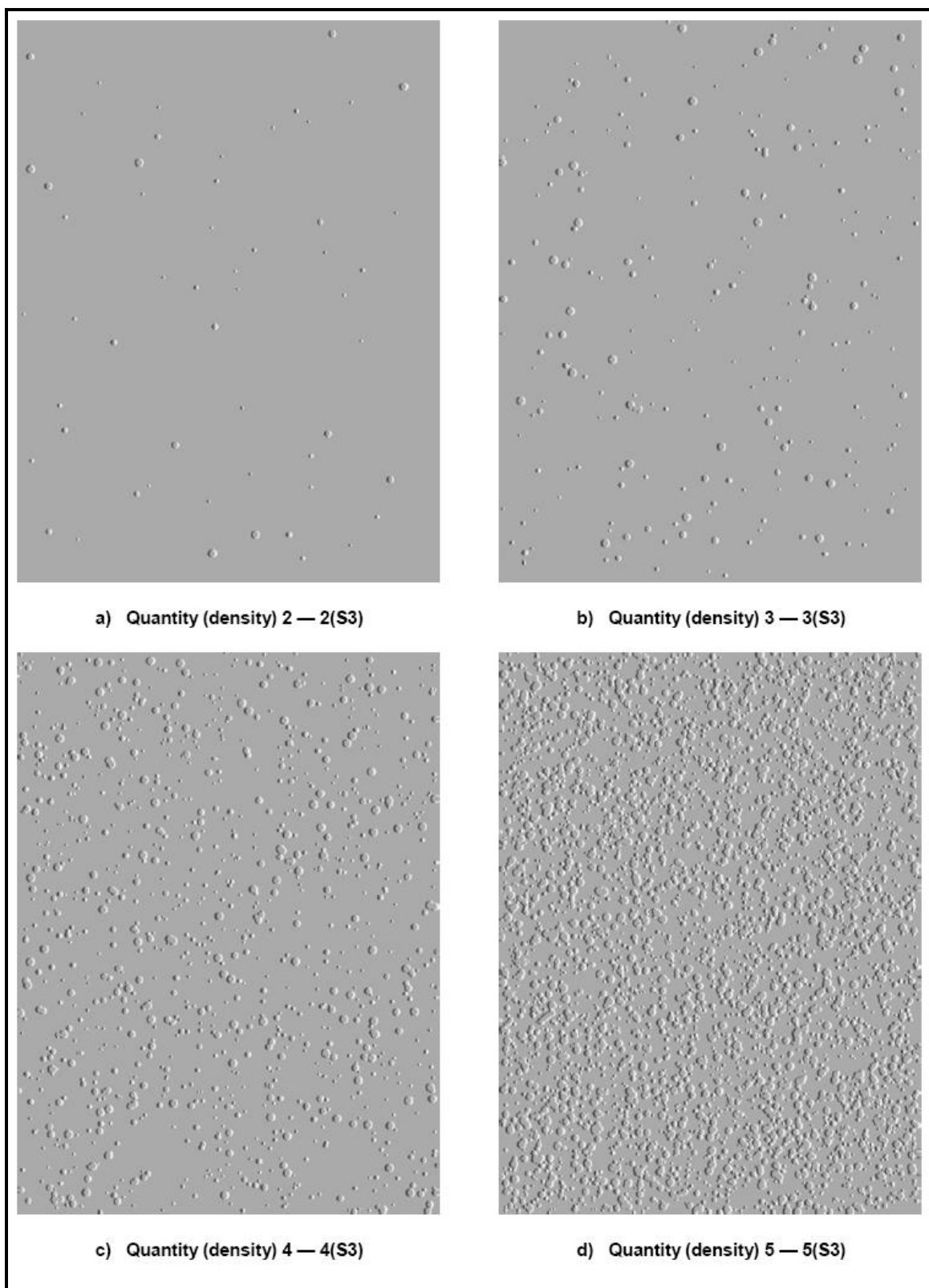


FIG. 4 BLISTERS OF SIZE 3

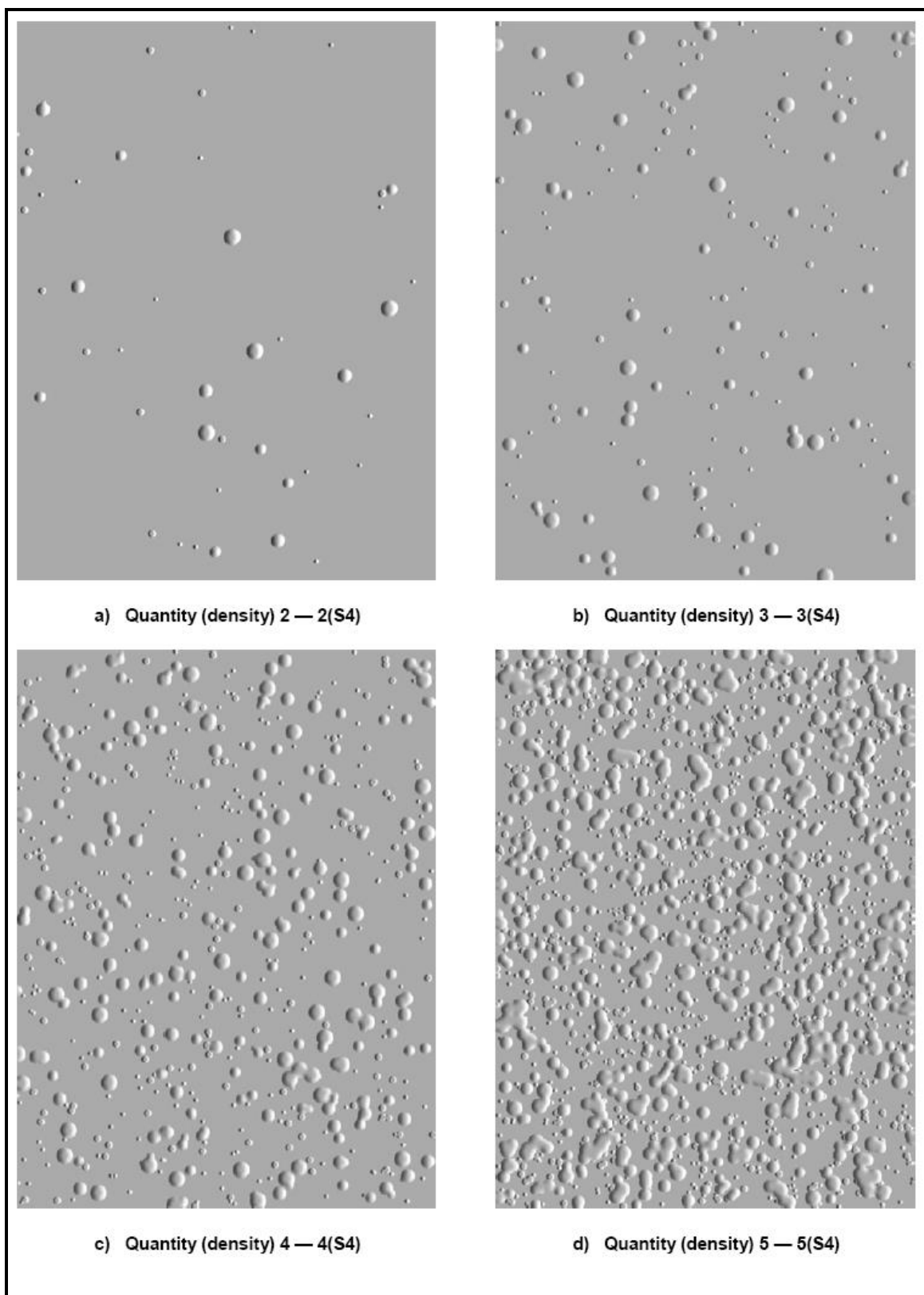


FIG. 5 BLISTERS OF SIZE 4

ANNEX E

(Foreword)

ADVICE ON THE WEATHERING PERFORMANCE OF THE PRE-PAINTED ALUMINIUM- ZINC ALLOY METALIC COATED STEEL STRIP AND SHEET

E-1 GENERAL

All organic coatings gradually change their appearance when exposed to the weather. The changes that take place occur at different rates depending on the aggressiveness of the environment and on the ability of the coatings to resist those changes.

Changes in the appearance of an organic coating do not necessarily imply that the coating has lost the ability to protect the base metal.

The changes that can occur and their likely effect on the performance of prepainted metal products are outlined in **E2** to **E6**.

E-2 LOSS OF GLOSS

Ageing on exposure to ultraviolet light causes initial loss of gloss. Contamination by atmospheric pollutants, e.g. sulfurous and ammoniacal fumes and by the collection of dirt can also cause deterioration of gloss.

The rate of impairment of gloss by the collection of dirt is less for vertically installed surfaces than for horizontal surfaces. Pre-painted products can be expected to retain their gloss better than products with conventional architectural paints used for the same application.

Loss of gloss usually precedes chalking.

E-3 CHALKING

Chalking involves the release of one or more of the constituents of the organic film in the form of loosely adherent fine powder. Chalking occurs slowly on pre-painted products and is not considered a serious defect unless it occurs early in the life of the product.

E-4 CHECKING

Checking is the formation of breaks in the surface of an organic coating, which do not render the underlying metal visible. Although checking can occur in a number of forms, it does not greatly detract from the appearance of a coating until the breaks become quite visible. Checking does not have a great effect on the durability of pre-painted metal products.

Slight checking, especially if it occurs during or after cold weather, is not detrimental to the product, and is considered to be a means whereby internal stresses that occur from time to time are relieved.

E-5 COLOUR FADING

Although fading involves loss of colour, the term is used to cover any colour change, including darkening. The degree and rate of loss of colour increase with increase in exposure to ultraviolet light (sunlight). Loss of colour is also associated with the inherent characteristics of pigments and the exposure environment.

Discolouration by dirt collection, chalking and subsequent absorption of foreign matter can often be misleading and give a false impression of a colour change. On removal of such contaminants the original colour is often restored. However, when chalking occurs at the same time as fading, cleaning can seldom restore the original surface colour.

E-6 EROSION OF ORGANIC COATINGS

Attrition of the organic coating by natural weathering depends very much on exposure conditions. Little or no erosion will occur when products are used indoors in domestic dwellings.

Products installed at an angle can be expected to deteriorate at up to twice the rate that would occur for products installed vertically or otherwise sheltered from the elements.

In general, products installed at an angle will erode more rapidly than those installed vertically.

The effects of dirt or industrial fallout can be greatly reduced by natural rain washing or by general washing with water. It is recommended that sheltered areas, such as under eaves and those that receive little natural rain-washing, are periodically washed with clean water.

ANNEX F

(Foreword)

SUMMARY OF TESTS FOR PROPERTIES AND EXPECTED RESULTS

<i>Sl. No.</i>	<i>Tests</i>	<i>Results</i>	<i>Comments</i>
i)	T-bend Adhesion Test	5t, <i>Max</i>	See Annex A
ii)	Reverse Impact Test	10 J or 1020 Kg.mm, <i>Min</i>	See Annex B
iii)	Pencil Hardness Test	HB hardness, <i>Min</i>	See 8.4
iv)	Scratch resistance test	1.5 Kg, <i>Min</i>	Or as agreed between the manufacturer and the customer. Not a part of the mandatory testing as mentioned in 8.5 .
v)	Solvent resistance test	50 Double rubs, <i>Min</i>	The number of rubs required is dependent on the paint system of the top-coat. However the result is an indication of standard topcoat paint system (<i>see</i> Annex C).
vi)	Dry film thickness test	15 μ , <i>Min</i>	Or as per agreement between the manufacturer and the customer. This refers to the paint film thickness of the finish coat or top-coat.
vii)	Colour	Rating of 2, <i>Max</i>	Rating classification for degree of color match (<i>see</i> Table 2).
viii)	Gloss	10- 40 percent with 60° head (gloss geometry)	Gloss is dependant on the paint system. However the result is a typical range for a standard paint system. Or acceptable limit is as agreed to between the customer and the supplier.
