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ऑटोमोबाइल के लिए इनेमल,  
सिंथेटिक, स्टोविंग — विशिष्टि  
(पहला पुनरीक्षण)

**Enamel, Synthetic, Stoving, for  
Automobiles — Specification**  
( *First Revision* )

ICS 87.040

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## FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Paints, Varnishes and Related Products Sectional Committee had been approved by the Chemical Division Council.

This standard was first published in 1971. The material is intended to be used for finishing of automobiles to give high gloss finish. The finishing shall be compatible with the primer surfacer and shall be able to produce a satisfactory levelling and flow characteristics together with minimum of film shrinkage after stoving. The material is also expected not to exhibit excessive solvent attack on primer surfacer as to detract or mar the final appearance.

Revision of this standard has been taken up alongwith other related standards with a view to consider incorporation of the requirement of lead restriction in this standard. The Technical Committee responsible for the formulation of this standard observed that in practice most of the paints are used for household/decorative as well as in industrial/commercial applications. Taking cognizance of the fact that lead exposure of human being, particularly children, has adverse effect on human health and also adverse impact on environment and safety, the Technical Committee felt the need to introduce different levels of lead restriction in all paint standards likely to be used for household and decorative applications. It was also decided to introduce lead restriction in some of the industrial paints, as far as possible, keeping in view relevance of lead restriction with respect to application condition and service life of the paint and wherever the product corresponding to a particular specification is of such composition that it would be easy to incorporate lead restriction without creating any negative impact.

The Technical Committee observed that technologically it is feasible to manufacture this product with low limit of lead. The Committee also observed that the scope of this product allows this paint to be used for industrial applications and decided to prescribe maximum permissible limit of lead as 300 ppm to avoid hazardous impact of lead exposure on environment and human health.

Further, majority of consumers are not aware of the consequences of lead toxicity and its long-term implications to human health. Therefore, in this revision, alongwith lead restriction, a suitable cautionary notice has been included in the marking clause. In this revision use of carbon arc weatherometer is replaced by Xenon arc weatherometer in durability test and preparation of test sample/panels is described in details in particular for fastness to light test. Reference has been given to various parts/sections of IS 101 for the requirements given in the standard.

The ancillaries like the primer-surfacer, thinners, etc, preferably be obtained from the same manufacturer to ensure good results. For purposes of test, these should be from the same source.

Test the presence of water qualitatively by heating about 20 ml of the stirred and thoroughly mixed material in a metal dish. Presence of water, if any, is indicated by a cracking noise.

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 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*

**ENAMEL, SYNTHETIC, STOVING, FOR  
AUTOMOBILES — SPECIFICATION**

*( First Revision )*

**1 SCOPE**

**1.1** This standard prescribes the requirements and methods of sampling and test for enamel, synthetic, stoving, for automobiles. The material is intended for protection and decoration of metal and steel parts of automobiles and other vehicle bodies like autocycles and scooters.

**2 REFERENCES**

The standards listed in Annex A 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 agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

**3 TERMINOLOGY**

**3.1** For the purpose of this standard, the definitions given in IS 1303 shall apply.

**4 REQUIREMENTS****4.1 Composition**

The material shall be based on synthetic resins, pigments and suitable solvents as to satisfy the requirements of this standard. The composition of the vehicle and pigment of the bulk supply shall be similar to those of the registered sample.

**4.2 Toxicity**

The material shall be free from toxic solvents like benzene and chlorinated organic solvents when tested as prescribed in Annex B.

**4.3 DURABILITY****4.3.1 Registered Sample**

Sample supplied in advance by a prospective supplier and registered by the approved testing authorities after testing it to all the requirements of this standard. A complete record of its performance shall be kept in respect of all tests.

**4.3.1.1** When prepared and tested for normal outdoor exposure as prescribed under C-3, up to a period of 24 months, a film prepared from the registered sample of the material shall satisfy the requirements of the test.

**4.3.1.2** A film of the sample for registration shall be prepared and tested in accelerated weathering apparatus using Xenon arc as prescribed under C-4. It shall be examined every third day for a period of 1 000 h and a complete record of its performance maintained.

**4.3.4 Sample from Bulk Supply**

A film of the material prepared from a representative sample from bulk supply as described in Annex C and tested in the accelerated weathering apparatus (C-4) shall not be materially different in performance as compared with the record of the film of the registered sample. The film shall be examined daily for the period of 1 000 h.

**4.4 Fastness to Light Test****4.4.1 Panel**

Mild steel plate panel used for this test, unless otherwise mentioned, shall be prepared as prescribed in 2 of IS 101(Part 1/Sec 3). The painted panels shall be prepared as described in 6.2.2.

**4.4.2 Test Conditions**

The material shall be tested according to the method prescribed in IS 101(Part 4/Sec 3) in Xenon arc apparatus with the test conditions as prescribed below:

- a) black panel temperature  $63^{\circ} \pm 3^{\circ}\text{C}$ ,
- b) continuous exposure in light, and
- c) time of exposure to light for 300 h.

**4.5 Lead Restriction**

**4.5.1** The material shall not contain lead or compounds of lead or mixtures of both, calculated as metallic lead more than 300 ppm, when tested for restriction from lead in accordance with IS 101(Part 8/Sec 5).

**4.6** The material shall also comply with the requirements given in Table 1.

**Table 1 Requirements for Enamel, Synthetic, Stoving, for Automobiles**  
(Clause 4.6)

SI No.	Characteristic	Requirement	Methods of Test, Annex of this standard	Ref to IS 101
(1)	(2)	(3)	(4)	(5)
i)	Drying time, hard dry, <i>Max</i>	30 min	—	(Part 3/Sec 1)
ii)	a) Consistency	Smooth, uniform and suitable for spraying after thinning	D	—
	b) Viscosity by Ford	Between 40- 55 cup No. 4 at 27° ± 2°C	—	(Part 1/Sec 5)
iii)	Finish	Smooth and glossy	—	(Part 3/Sec 4)
iv)	Colour	Approximate match to the colour specified in IS 5 or to the specified colour where IS colour is not specified	—	(Part 4/Sec 2)
v)	Gloss 60°, <i>Min</i>			
	a) Initial	90	—	(Part 4/Sec 4)
	b) Retention	90 percent	E	—
vi)	Fastness to light (300 h)	Passes the test if there shall be no appreciable colour change observed	—	(Part 4/Sec 3)
vii)	Wet opacity m <sup>2</sup> /10 litre	Between – 10 percent and + 20 percent of the approved sample, if any	—	(Part 4/Sec 1)
viii)	Flexibility and adhesion,			
	a) Bend test with Type 1 apparatus and 6.25 dia mandrel	No visible damage or detachment of film	—	2 of (Part 5/Sec 2)
	b) Scratch hardness at a load of (1 500 g)	No such scratch as to show the bare metal	—	3 of (Part 5/Sec 2)
ix)	Stripping test	Scratches free from jagged edges	F	—
x)	Impact resistance (by pendulum impact tester) (mass of steel tube approx 500 g)	Shall not show any signs of deterioration of the paint film	P	—
xi)	Resistance to humidity under conditions of condensation (expose for 250 h)	No blistering, rusting or loss of adhesion	—	2 of (Part 6/Sec 1)
xii)	Tape test	To pass the test	G	—
xiii)	Intercoat adhesion test	To pass the test	H	—
xiv)	Resistance to liquid		J	—
	a) Petrol	To pass the test		
	b) Lubricating oil	To pass the test		
xv)	Resistance to soap water and Spotting	To pass the test	K	—
xvi)	Resistance to heat (double bake schedule consists of bake-coolbake-cool)	To pass the test	L	—
xvii)	Resistance to bleeding	No bleeding	M	—
xviii)	Flash point	Not below 30°C	—	(Part 1/Sec 6)
xix)	Retouchability with Cellulose Nitrate Lacquers	To pass the test	N	—
xx)	Keeping properties	Not less than six months from date of manufacturing	—	(Part 6/Sec 2)

NOTE — Isolated minor blistering without corrosion shall not be the cause for rejection. These blisters should disappear when kept in oven at 110°C for 10 min

## 5 PACKING AND MARKING

### 5.1 Packing

Unless otherwise agreed to between the purchaser and the supplier, the paint shall be packed in metal containers conforming to IS 1407 and IS 2552. The packing is subject to the provisions of the law in force in the country at that time.

**5.1.1** Each container shall be marked with the following:

- a) Name of the material;
- b) Indication of the source of manufacturer;

- c) Volume of the material;
- d) Batch No. or Lot No. in code or otherwise;
- e) Colour of the material;
- f) Lead content, *Max*; and
- g) cautionary note as below:
  - 1) Keep out of reach of children.
  - 2) Dried film of this paint may be harmful if eaten or chewed.
  - 3) This product may be harmful if swallowed or inhaled.

### 5.1.2 BIS Certification Marking

The container may also be marked with the Standard Mark.

**5.1.2.1** The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers maybe obtained from the Bureau of Indian Standards

**5.2** Other details of packing and marking shall be in accordance with the instructions given by the purchaser.

## 6 SAMPLING

**6.1** Representative samples of the material shall be drawn as prescribed under **3** of IS 101(Part 1/Sec 1).

### 6.1 Preparation of Test Samples

#### 6.1.1 For Registration

The sample shall be submitted in three different containers each containing not less than 500 ml of the material.

**6.1.1.1** As the testing to the requirements of this standard covers a period of more than 24 months, the supplier is advised to submit samples for registration sufficiently in advance.

#### 6.1.2 Bulk Supply Sample

Representative samples of the material shall be drawn as prescribed under **3** of IS 101(Part 1/Sec 1).

### 6.2 Preparation of Test Samples

**6.2.1** During preparation of samples for tests the following stoving/baking schedule shall be adhered to:

Not more than 30 min at 130°C

#### 6.2.2 For Drying Time and Other Tests

Prepare mild steel panel of sizes 150 mm × 100 mm × 1.25 mm as prescribed in **2** of IS 101 (Part 1/Sec 3). Apply the paint on each side of the panel uniformly by brushing to give a dry film mass commensurate with the mass per 10 litre as specified in Table 1 of IS 101(Part 3/Sec 4). The coated test panels shall be flash dried at room temperature and relative humidity of 65 ± 5 percent for approximately half an hour and then place the panels in a ventilated oven maintained for stoving at a schedule as prescribed in **6.2.1**. Prepared test panel then subjected to the drying time test as specified in IS 101(Part 3/Sec 1) as soon as possible. For other tests like finish, gloss, colour and fastness to light keep the stoved panels at room temperature for 24 h.

### 6.2.3 For Flexibility and Adhesion and Stripping Test

For all the tests prepare separate burnished tin plate panels, rectangular, of sizes 100 mm × 50 mm × 0.3 mm as prescribed in **3** of IS 101(Part 1/Sec 3). Apply one coat of material uniformly by brushing on each of the panels as to give a dry film mass commensurate with the mass per 10 litre as specified in Table 1 of IS 101(Part 3/Sec 4). The coated test panels shall be flash dried at room temperature and relative humidity of 65 ± 5 percent for approximately half an hour and then place the panels in a ventilated oven maintained for stoving at a schedule as prescribed in **6.2.1**. The stoved panels then be placed in a well ventilated chamber, free from draughts and dust for 24 h at room temperature. During this period the film shall be exposed to diffused daylight for at least 6 h and care should be taken to protect it from direct sunlight. The panels then shall be conditioned at a temperature of 27° ± 2°C and relative humidity of 65 ± 5 percent for a minimum time of 16 h. Prepared test panel then subjected to the test as prescribed in **2** and **3** of IS 101 (Part 5/Sec 2). Prepared test panel then subjected to the stripping test as prescribed in Annex F.

### 6.2.4 For Resistance to Humidity Under Conditions of Condensation Test

Prepare mild steel panel of sizes 150 mm × 100 mm × 1.25 mm as prescribed in **2** of IS 101 (Part 1/Sec 3). Apply the paint uniformly on each side of the panel by brushing to give a dry film mass commensurate with the mass per 10 litre as specified in Table 1 of IS 101(Part 3/Sec 4). Seal the edges of the panel with wax up to a depth of 6 mm by dipping in molten wax. The coated test panels shall be flash dried at room temperature and relative humidity of 65 ± 5 percent for approximately half an hour and then place the panels in a ventilated oven maintained for stoving at a schedule as prescribed in **6.2.1**. The stoved panels then be placed in a well ventilated chamber, free from draughts and dust for 24 h. During this period the film shall be exposed to diffused daylight for at least 6 h and care should be taken to protect it from direct sunlight. Prepared test panel then subjected to the test as prescribed in **2** of IS 101(Part 6/Sec 1).

### 6.2.5 For Resistance to Heat Test

Prepare mild steel panel of sizes 150 mm × 100 mm × 1.25 mm as prescribed in **2** of IS 101 (Part 1/Sec 3). Apply the paint uniformly on each side of the panel by brushing to give a dry film mass commensurate with the mass per 10 litre as specified in Table 1 of IS 101(Part 3/Sec 4). The coated test panels shall be flash dried at room temperature and relative humidity of 65 ± 5 percent for approximately half an hour and then place the panels in a ventilated oven maintained

for baking at a schedule as prescribed in 6.2.1. The panel then be cooled for minimum 30 min and then again place the panel in oven for baking further at the schedule as prescribed in 6.2.1. The double baked panel then be cooled for minimum 30 min. The panels then shall be conditioned at a temperature of  $27^{\circ} \pm 2^{\circ}\text{C}$  and relative humidity of  $65 \pm 5$  percent for a minimum time of 24 h.

### 6.3 Criteria for Conformity

A lot shall be declared as conforming to the requirements of this standard if the test results of the

composite sample satisfy the requirements prescribed under 4.

## 7 TEST METHODS

7.1 Tests shall be conducted as prescribed in 4.1 and 4.5 and in 4 and 5 of Table 1.

### 7.2 Quality of Reagents

Unless otherwise specified, pure chemicals and distilled water (*see* IS 1070) shall be employed in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

## ANNEX A

(Clause 2)

### LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title
101	Methods of sampling and test of paints, varnishes and related products:	Sec 2: 1990	Section 2 Resistance to liquids ( <i>third revision</i> )
Part 1	Test on liquid paints (general and physical),	Part 8/ Sec 5: 1993	Tests for pigments and other solids, Section 5 Lead restriction test ( <i>third revision</i> )
Sec 1: 1986	Sampling ( <i>third revision</i> )	264 : 2005	Nitric acid — Specification ( <i>third revision</i> )
Sec 3: 1986	Preparation of panels ( <i>third revision</i> )	266 : 1993	Sulphuric acid ( <i>third revision</i> )
Sec 5: 1986	Consistency ( <i>third revision</i> )	285 : 1992	Laundry soaps — Specification ( <i>third revision</i> )
Sec 6: 1987	Flash point ( <i>third revision</i> )	513 : 2008	Cold reduced low carbon steel sheets and strips ( <i>fifth revision</i> )
Part 3	Tests on paint film formation,	1017 : 1983	Chamois leather ( <i>second revision</i> )
Sec 1: 1986	Drying time ( <i>third revision</i> )	1070 : 1992	Reagent grade water ( <i>third revision</i> )
Sec 2: 1989	Film thickness ( <i>third revision</i> )	1303 : 1983	Glossary of terms relating to paints ( <i>second revision</i> )
Sec 4: 1987	Finish ( <i>third revision</i> )	1407 : 1977	Specification for round paint tins ( <i>second revision</i> )
Part 4	Optical test,	1604 : 1994	Aviation gasoline — Specification ( <i>third revision</i> )
Sec 1: 1988	Opacity ( <i>third revision</i> )	2552 : 1979	Specification for steel drums (galvanized and ungalvanized) ( <i>second revision</i> )
Sec 2: 1989	Colour ( <i>third revision</i> )	3618 : 1966	Specification for phosphate treatment of iron and steel for protection against corrosion
Sec 3: 1988	Light fastness test ( <i>third revision</i> )	5691 : 1970	Specification for lacquer, cellulose, nitrate, pigmented, finishing, glossy
Sec 4: 1988	Gloss ( <i>third revision</i> )	6126 : 1971	Nitrocellulose surfacer
Part 5	Mechanical test on paint films,		
Sec 1: 1988	Hardness Test ( <i>third revision</i> )		
Sec 2: 1988	Flexibility and adhesion ( <i>third revision</i> )		
Part 6	Durability tests on paint films,		
Sec 1: 1988	Resistance to humidity under conditions of condensation ( <i>third revision</i> )		
Sec 2: 1989	Keeping properties ( <i>third revision</i> )		
Part 7/	Environmental tests on paint films,		

**ANNEX B***(Clause 4.2)***TEST FOR TOXICITY****B-1 OUTLINE OF METHOD**

The material is steam distilled and solvents collected. It is subjected to test for benzene and chlorinated hydrocarbons qualitatively.

**B-2 APPARATUS**

**B-2.1 Steam Distillation Apparatus**

**B-2.2 Distilling Flask** — 100 ml capacity.

**B-3 REAGENTS**

**B-3.1 Nitric Acid** — conforming to IS 264.

**B-3.2 Sulphuric Acid** — conforming to IS 266.

**B-3.3 Copper Wire** — of 1 mm diameter.

**B-4 PROCEDURE**

**B-4.1** Steam distill 100 ml of the material using a receiver cooled in ice. Separate the solvent layer, wash with several times its volume of distilled water, discard the washings dry and redistill, collecting all solvents within the agreed specified boiling range. Subject this to the tests prescribed in **B-4.1.1** and **B-4.1.2**.

**B-4.1.1 Test for Benzene**

Mix equal volumes of nitric acid and sulphuric acid in a test tube and cool. To 2 ml of this solution add 10 drops of the solvent and shake. Warm, if necessary and

examine for the odour of nitrobenzene which is given by 5 percent benzene or larger amounts of toluene. Boil the contents for at least 30 s, allow to cool and add 10 ml of water. Mix the contents and examine for odour of nitrobenzene, which should be no longer present if the contents were boiled enough. Allow the tube to stand for some time. A yellow cloudy solution or flocculent precipitate changing to yellow needles is evidence or the presence of benzene. It may further be confirmed by separating the yellow needles and finding out its melting point which should be 89° to 90°C.

In case of dispute gas chromatography may be employed to detect the presence of benzene using analytical grade benzene as standard.

**B-4.1.2 Test for Chlorinated Hydrocarbons**

Form a small loop in the copper wire and heat in a small Bunsen flame until it no longer colours the flame. Allow the loop to cool and then dip it into the test solution. Immediately place in the outer part of the flame and when the first luminous flame disappears, examine for the green colouration due to chlorinated compounds.

**B-4.2** The material shall be deemed to have passed the test if the solution, when tested as prescribed in **B-4.1.1**, does not give off smell of nitrobenzene or forms yellow crystals and when tested as prescribed in **B-4.1.2** does not impart a green colouration to the Bunsen flame.

**ANNEX C***(Clauses 4.3.1.1, 4.3.1.2 and 4.3.4)***DETERMINATION OF DURABILITY****C-1 OUTLINE OF METHOD**

The durability of the material is determined by ascertaining actual behaviour of suitably prepared test panels in normal outdoor exposure test for a specified period and evaluating the results of this exposure by a suitable method of rating for various characteristics of

the enamel film. Apart from this, the material is also evaluated by an accelerated weathering test wherein a prepared panel is subjected to controlled exposure of heat, light and water in an artificial weathering apparatus.

**C-2 TEST PANELS**

**C-2.1** The panel shall be of mild steel plate of sizes 300

mm × 300 mm × 1.25 mm for the outdoor exposure test and 135 mm × 40 mm × 1.25 mm for the accelerated weathering test or any other sizes as suitable for the equipment but in any case the panel size shall not be less than 60 mm × 40 mm. The panels shall be free from surface defects (*see* IS 513).

**C-3 PREPARATION OF TEST PANELS**

**C-3.1** Prepare mild steel panels of sizes as mentioned in **C-2.1** by the method as prescribed in **2** of IS 101 (Part 1/Sec 3). The complete painting system on the panels shall consist of the following steps:

- a) The cleaned panel shall be rinsed in cold or hot water to remove such residues of cleaning materials as might affect the phosphating process. The phosphate treatment shall be of zinc-phosphate coating (*see* IS 3618) and with a minimum coating weight of 4.3 g/m<sup>2</sup>. After phosphate treatment, rinse the panel thoroughly to remove any residues of the phosphating solution first with water and then with a chromate solution at a temperature not below 60°C and having chromate (as CrO<sub>3</sub>) concentration of 0.125 to 0.50 kg/1 000 litres.

NOTE — The chromate rinse shall consist of a solution of chromic acid or alkali metal chromate or alkali metal dichromate or a mixture of equal parts of chromic and phosphoric acids.

After final rinsing, dry the panel thoroughly and use for painting without much delay.

- b) Apply two coats of primer surfacer suitably thinned to spraying consistency using appropriate thinner wet-onwet allowing a flash off time of 10 min between coats and bake for 30 min at 130°C to give a total dry film thickness of 50.0 to 62.5 microns.
- c) Rub down wet with emery paper No. 280, followed by No. 400 until the surface is sufficiently smooth and even to take a coat of the material. About 50 microns thickness of the film shall be left after flattening. Wash the surface with water to remove all loosely adhered dust and dry for 30 min.
- d) Wipe with petrol damped rag. Apply two coats of the material thinned suitably to spraying consistency with appropriate thinner wet-onwet with a flash of time of 10 min, between coats and bake for 30 min at 130°C to give a total dry film thickness of this finish to be 32.5 to 50 microns.

**C-4 NORMAL OUTDOOR EXPOSURE TEST**

Subject the sample for registration to normal outdoor

exposure test in the manner described under **C-4.1**.

**C-4.1** Expose in the open the test panels, prepared in the manner prescribed under **C-2** and **C-3**, in duplicate, in a position facing south at 45°.

**C-4.1.1** Examine the condition of the exposed films at monthly intervals for gloss retention, at the end of 24 months for corrosion of the substrate and at bi-monthly intervals for the other characteristics given below:

- a) Colour;
- b) Checking, cracking and blistering;
- c) Chalking; and
- d) Blooming and spotting.

**C-4.1.2** For the above examination, wash the right hand half of the surface of the two test panels by pouring water and then wiping with a soft cloth or chamois leather (*see* IS 1017). Adequate time for cooling of the panels to room temperature shall be allowed prior to washing. Polish half of the left half of the panel and assess gloss after polishing. Examine the same portions of the test panels at each examination. As an aid in the examination, a magnifying glass may be used, but the evaluation shall be based on an assessment with the unaided eye. At the end of the stipulated period for durability test, examine all the three portions of the test panels. The sample shall be considered satisfactory if the material surface underneath as well as condition of the film in all the parts, the one washed periodically, the one polished periodically and the one washed only for the final examination is satisfactory by the method of evaluation described hereunder (*see* **C-4.2**). Stray film failure due to extraneous causes other than climatic shall be ignored.

**C-4.2 Method of Rating**

The film of an unexposed test panel possessing high gloss shall be rated at 100, which figure shall be made up of basic values as follows:

a) Possessing high gloss after polishing	20
b) Possessing correct colour	20
c) Freedom from checking, cracking and blistering	20
d) Freedom from chalking	10
e) Freedom from blooming and spotting	10
f) Freedom from corrosion of metal substrate	<u>20</u> <u>100</u>

NOTE— The initial rating of film may be 100 or less according to the conditions of gloss and colour, the rating for freedom from checking, cracking, blistering, chalking, blooming and spotting being always maximum in the case of unexposed films.



### C-4.3 Evaluation of Exposed Film

In recording the condition of the exposed films at each examination, express the observed relative values of different characteristics in percentages of the basis value allotted to each characteristic under C-4.2. For arriving at an assessment, multiply the basic value for each assessment (*see* C-4.2) by the percentage awarded for the performance in the test and divide the product so obtained by 100 to obtain the percentage award for the observed value of each characteristic. Take the sum of these resulting values as the overall assessment.

**C-4.3.1** The following table is intended to serve as an example for the assessment of enamel film after exposure.

<i>Sl no.</i>	<i>Characteristic</i>	<i>Basic value percent</i>	<i>Performance value percent</i>	<i>Assessment value percent</i>
(1)	(2)	(3)	(4)	(5)
i)	Possessing high gloss after polishing	20	80	16
ii)	Possessing correct colour	20	60	12
iii)	Freedom from checking, cracking and blistering	20	90	18
iv)	Freedom from chalking	10	40	4
v)	Freedom from blooming and spotting	10	80	8
vi)	Freedom from corrosion of metal substrate	20	90	<u>18</u>
				76

### C-4.4 Results of Exposure

Reckon the period for the general breakdown of the exposed film from the date of commencement of exposure to the time when the overall assessment falls below 70 percent or when the performance value of any one characteristic falls below 50 percent of the basic value adopted for that characteristic. In the example

given under C-4.3.1, although the overall assessment is 76 percent, yet the film is to be regarded as generally having broken down, because the performance value of chalking has fallen below 50 percent of its basic value.

### C-5 ACCELERATED WEATHERING TEST

Carry out the test by Xenon arc type accelerated weathering apparatus. The panel for the test shall be prepared as described under C-3.1. Samples for registration shall be tested in duplicate in Xenon arc type accelerated weathering apparatus (*see* C-5.1) and samples drawn from the bulk supply shall be tested in a similar manner.

#### C-5.1 Accelerated Weathering Apparatus (Xenon Arc)

An artificial weathering apparatus of the xenon arc type for uniform and controlled exposure to the effects of heat, light and water.

**C-5.1.1** Commonly used cycles and test conditions for Xenon arc apparatus are given below:

- Black panel temperature  $63^{\circ} \pm 3^{\circ}\text{C}$ .
- Continuous exposure in light for 17 min and intermittent exposure to water spray for 3 min light and spray.
- Irradiance  $0.55 \text{ W/m}^2/\text{nm}$ , and
- Total exposure time is 1 000 h.

However, any other cycle may be used if mutually agreed upon between the purchaser and the supplier.

**C-5.1.2** The requirement of this test on a sample from bulk supply shall be taken to have been satisfied if the gloss retention shall be minimum 40 percent of the original and the performance in respect of the other film characteristics is generally similar to that obtained with the registered sample.

#### NOTES

**1** As a precaution against inadvertent accidents, it is recommended that the normal outdoor exposure test (*see* C-3) and the accelerated weathering test (*see* C-4) are carried out in duplicate.

**2** For details of method of tests for Xenon arc apparatus follow 5 of IS 101(Part 6/Sec 5).

## ANNEX D

[Table 1, Sl No. (ii) (a)]

### CONSISTENCY

#### D-1 APPARATUS

##### D-1.1 Palette Knife or Metal Rod

##### D-1.2 Glass Panels

**D-1.2.1** Unless specified otherwise, glass panels of size 150 mm × 50 mm shall be prepared as prescribed in 5 of IS 101 (Part 1/Sec 3).

#### D-2 PROCEDURE

**D-2.1** Insert a clean metal rod or palette knife into the original container and examine the nature of settling.

##### D-2.2 Observations

The material shall not cake hard inside the container and shall be in such a condition that stirring easily produces a smooth uniform paint suitable for brushing/spraying on glass panels.

## ANNEX E

[Table 1, Sl No. (v) (b)]

### DETERMINATION OF GLOSS RETENTION

#### E-1 OUTLINE OF METHOD

The painted panels after specified period of ageing are examined for shrinkage and loss of gloss.

#### E-2 PROCEDURE

**E-2.1** The painted panel as prepared in 6.2.2 shall be put for ageing in a well ventilated chamber, free

from draughts and dust at room temperature for 10 days.

##### E-2.2 Observations

The paint shall be deemed to have passed the test if the painted panels shall not exhibit film shrinkage and the loss of gloss shall not be more than 10 percent of the original gloss.

## ANNEX F

[Table 1, Sl No.(ix) and Clause 6.2.3]

### STRIPPING TEST

#### F-1 OUTLINE OF THE METHOD

The minimum load required to produce a scratch showing the bare metal surface of the panel painted with the material is determined.

#### F-2 APPARATUS

The apparatus used for determining scratch hardness as prescribed in 3.2.2 of IS 101(Part 5/Sec 2) shall be used.

#### F-3 PROCEDURE

##### F-3.1 Preparation of Test Panels

Mild steel panels described under 6.2.3 shall be prepared.

**F-3.2** Test the dried film in the apparatus under such a load that a scratch is produced showing the bare metal surface.

##### F-4 OBSERVATIONS

**F-4.1** The paint shall be deemed to have passed the test if the scratch so produced shall be free from jagged edges.

**ANNEX G**

[Table 1, Sl No. (xii)]

**TAPE TEST****G-1 OUTLINE OF METHOD**

A tape is applied to the painted panel and stoved at a elevated temperature for a certain time. Afterwards the tape is removed and the film is examined for staining and permanent print.

**G-2 PROCEDURE****G-2.1 Preparation of Test Panels**

Prepare mild steel panel of sizes 150 mm × 100 mm × 1.25 mm as prescribed in 2 of IS 101 (Part 1/Sec 3). Apply the paint on each side of the panel uniformly by brushing to give a dry film mass commensurate with the mass per

10 litre as specified in Table 1 of IS 101(Part 3/Sec 4).

**G-2.2** Apply a 2.5 cm strip of masking tape over the length of the painted surface half an hour after the normal bake at a temperature of 105°C is performed. The taped panel shall then be further baked for 30 min at a temperature of 130°C. Upon cooling, the tape shall be removed and the panel inspected for staining and permanent printing.

**G-2.3 Observations**

The material shall be deemed to have passed the test if no stain and permanent print is left on the film after the tape is removed.

**ANNEX H**

[Table 1, Sl No. (xiii)]

**TEST FOR INTERCOAT ADHESION****H-1 OUTLINE OF METHOD**

Two diagonally intersecting lines were cut through the painted panel and a tape is applied to cover the cuts. These tapes are pulled sharply and any lifting of the top coat is examined.

**H-2 PROCEDURE****H-2.1 Preparation of Test Panels**

Prepare panel as prescribed in C-3.1.

**H-2.2** Cool the stoved panels for 30 min. Cut through the metal two lines, diagonally intersecting, at least 20 cm in length. Apply masking tape, of 2.5 cm width to cover the cut through lines completely. Pull the tapes sharply upwards and check for any lifting of the top coat from the primer.

**H-2.3 Observations**

The material shall be deemed to have passed the test if tape could be pulled off sharply.

**ANNEX J**

[Table 1, Sl No. (xiv)]

**TEST FOR RESISTANCE TO PETROL AND LUBRICATING OIL****J-1 OUTLINE OF THE METHOD**

The painted panels, after specified drying period, is dipped in petrol and lubricated oil separately and at specified temperature and time. On completion of the specified time periods, the panels are subjected for visual examination.

**J-2 PREPARATION OF TEST PANELS**

**J-2.1** Prepare mild steel plate panel as prescribed in C-3.1. The back and edges of the panels shall be protected with two coats of a suitable paint. The coated test pieces shall be air dried in a horizontal position for 7 days and shall be conditioned as described in 3.3 of IS 101(Part 7/Sec 2).

### J-3 REAGENTS

**J-3.1 100 Octane Aviation Gasoline** — (see IS 1604)

#### J-3.2 Lubricating Oil

Mineral lubricating oil having a viscosity of 18.0 cSt or having a time of flow of approximately 80 s for 50 ml in a No. 1 Redwood Viscometer.

### J-4 PROCEDURE

**J-4.1** Follow the procedure as prescribed in 4 of IS 101 (Part 7/Sec 2). Immerse one prepared panel in gasoline (see J-3.1) at room temperature for 15 min.

**J-4.1.1** Take out the panel from gasoline and allow the panel to stand in a vertical position for 5 min at room temperature and then swab it vigorously for about 5 s with a pad of cotton wool. Observe the paint films after cooling for 30 min at room temperature.

**J-4.2** Follow the procedure as prescribed in 4 of IS 101 (Part 7/Sec 2). Immerse one prepared panel in lubricating oil (see J-3.2) at 50°C for 2 h.

**J-4.2.1** Take out the panel from the oil and remove any residual lubricating oil from the surface by dabbing with a suitable absorbent paper or cloth or a pad of cotton wool and examine the test piece after a recovery period of 30 min at room temperature.

### J-5 OBSERVATIONS

The sample shall be treated as passing if there is no blistering, flaking and corrosion. The material shall be deemed to have passed the test if the film shall not show signs of disintegration, permanent injury or change of colour to a greater extent. The loss of gloss shall not be more than 50 percent of the original gloss.

## ANNEX K

[Table 1, Sl No. (xv)]

### DETERMINATION OF RESISTANCE TO WATER AND SOAP SPOTTING

#### K-1 OUTLINE OF METHOD

The painted panel is subjected to normal outdoor exposure for a specified period and then subjected to water and soap solution spotting. After keeping the panel in sunlight for a specified period the paint film is examined.

#### K-2 TEST PANELS

**K-2.1** At least two panels of mild steel plate of sizes 300 mm × 300 mm × 1.25 mm shall be prepared as prescribed in C-3.1.

#### K-3 PROCEDURE

**K-3.1** Ensure to carry out this test at laboratory temperature.

**K-3.2** The panels so prepared (see K-2.1) shall be cured for 24 h and then expose for 168 h to outdoor exposure facing south at an angle of 45°. On each panel place two cotton pads of 4 cm diameter, one soaked with water and other soaked with one percent soaps solution (conforming to IS 285) to be referred a spotted zone. Cover the pads with watch glass and keep it exposed in sunlight for 4 h.

**K-3.3** Remove the pads, wash with running water and remove any residual liquid from the surface by a clean cloth. Allow to dry for 1 h.

#### K-3.4 Observations

Examine visually any change in colour in spotted zones. The material shall be deemed to have passed the test if the film does not show any change in colour in spotted zones.

## ANNEX L

[Table 1, Sl No. (xvi)]

## DETERMINATION OF RESISTANCE TO HEAT

## L-1 OUTLINE OF THE METHOD

**L-1.1** An air-dried panel is heated to a maximum temperature under stipulated conditions. After this, it is cooled and dipped in water. The extent of deterioration of the film is examined and may also be compared with that of an approved sample (if any) tested at the same time.

## L-2 APPARATUS

## L-2.1 Electric Furnace

With a maximum attainable temperature of 900°C. The minimum dimensions of the heating chamber shall be 380 mm × 150 mm × 80 mm.

## L-3 PROCEDURE

**L-3.1** Prepare steel panel as described in 6.2.5. Heat

the panel in a vertical position in an electrical furnace, the temperature of which is gradually raised from room temperature up to a temperature of 300°C in 30 min time. Maintain the panel at the maximum temperature of 300°C for 2 h. Remove the panel from the furnace, cool to room temperature for 1 h. Test the approved sample (if any) in the same manner and at the same time.

## L-3.2 Observations

The material shall be deemed to have passed the test if the paint film remains firmly adherent and shows no sign of cracking, blistering or flaking. Formation of hair-lines shall not be a cause for rejection. For bulk supplies, the deterioration, if any, shall not be greater than that shown by the registered sample, if any.

## ANNEX M

[Table 1, Sl No. (xvii)]

## RESISTANCE TO BLEEDING

## M-1 OUTLINE OF METHOD

The painted panel is coated with a white finishing enamel and examined for bleeding.

## M-2 PROCEDURE

## M-2.1 Preparation of Panels

Prepare mild steel panel of sizes 300 mm × 100 mm × 1.25 mm as prescribed in 2 of IS 101 (Part 1/Sec 3). Apply the paint (except white colour) on one side of the panel (except for 25 mm lengthwise) uniformly by brushing/spraying to give a dry film mass commensurate with the mass per 10 litre as specified in Table 1 of IS 101(Part 3/Sec 4). Tape off 40 mm lengthwise, which will include the un — painted section and enamel in the remainder of the panel.

**M-2.2** The panel then shall be baked at 130°C and then cooled to room temperature. After that the bottom half of the enamelled area is lightly abraded with silicon carbide paper, grade 400 until the surface is completely free from gloss. Remove all of the dust with a cloth

dampened with petroleum hydrocarbon solvents. Remove the mask of tape and overcoat the entire panel uniformly by spraying/brushing with another coat of white enamel synthetic, stoving, conforming to this standard. Bake for 30 min at a temperature of 130°C. Cool the panel at room temperature.

## M-2.3 Examinations

Immediately after the film is dry, compare, in diffuse daylight, the degree of bleeding, as shown by the difference in colour between the areas of the panels coated with one coat paint only and overcoated with the paint sample. If daylight is not available, make the comparison in artificial daylight. The comparison shall be repeated after 24 h.

NOTE — If required and agreed, the degree of bleeding may be assessed by using a suitable colorimeter.

## M-2.4 OBSERVATIONS

The material shall be deemed to have passed the test if there is no bleeding.

## ANNEX N

[Table 1, Sl No.(xix)]

### TEST FOR RETOUCHABILITY WITH CELLULOSE NITRATE LACQUERS

#### N-1 OUTLINE OF METHOD

The panels prepared as prescribed in C-3.1 are coated with nitrocellulose surfacer and cellulose nitrate lacquer and film examined for compatibility.

water and dry for 30 min. Then, apply a coat of surfacer, nitrocellulose (conforming to IS 6126), dry for 30 min and apply a coat of lacquer, cellulose, pigmented, glossy (conforming to IS 5691). Dry for 15 to 30 min at room temperature and examine the film.

#### N-2 PROCEDURE

##### N-2.1 Preparation of Panels

Prepare the painted panels as described in C-3.1.

N-2.2 Slightly wet with silicon carbide paper, grade 400 to give a smooth surface. Wash thoroughly with

#### N-2.3 OBSERVATIONS

The material shall be deemed to have passed the test if the film when examined should be smooth, with a glossy finish, free from sagging and wringing and also firmly adhered to the enamel film.

## ANNEX P

[Table 1, Sl No. (x)]

### IMPACT TEST

#### P-1 OUTLINE OF METHOD

The painted panel is subjected to pendulum impact test and the test piece is examined for deterioration of paint coating.

#### P-2 APPARATUS

##### P-2.1 Pendulum impact tester

As described in 2.2.1 of IS 101 (Part 5/Sec 1).

#### P-3 PREPARATION OF TEST PIECE

Take test pieces as described in 2.2.2 of IS 101 (Part 5/Sec 1). Prepare the test piece as prescribed in C-2.

#### P-4 PROCEDURE

P-4.1 Prepared test piece then subjected to the test as specified in 2.3 of IS 101 (Part 5/Sec 1) as soon as possible. Ensure that the test piece is subjected to an impact of 0.92 kgfm directed on to the painted side (impact-in). Examine the points of impact for any deterioration of the paint film utilizing the same piece, age in an oven at a temperature of 60°C for 10 days and repeat the impact test.

#### P-4.2 Observations

Remove the test pieces and examine the points of impact for the loss of adhesion or removal of the coating or any deterioration of the paint film.

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This Indian Standard has been developed from Doc No.: CHD 20 (2095).

### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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