IS 13213 (1991): Polyurethane full gloss enamel (two pack)
[CHD 20: Paints, Varnishes and Related Products]

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IS 13213 : 1991
(Reaffirmed - 2012)

भारतीय मानक

पॉलियूरिथेन, पूर्ण चमक वाला इनैमल (दो पैक) – विशिष्टि

Indian Standard

POLYURETHANE FULL GLOSS ENAMEL (TWO PACK) - SPECIFICATION

UDC 666.293

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

October 1991 **Price Group 4**

Paints (Other than Industrial Paints) and Allied Products Sectional Committee, CHD 020

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Paints (Other than Industrial Paints) and Allied Products Sectional Committee had been approved by the Chemical Division Council.

High performance coatings based on synthetic polymers are a recent development. Polyurethane surface coatings being the most recent addition, are probably one of the best available system for corrosion protection of steel. It is also the economical among other anti-corrosion coatings. It not only wards off corrosion but also fortifies the steel against chemical attack and physical damage.

The use of polyurethane paints, presents a two-fold potential hazards such as toxic and fire hazards. The safety precautions should be taken in handling and painting of these materials (*see* Annex J).

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

AMENDMENT NO. 1 DECEMBER 1994
TO
IS 13213 : 1991 POLYURETHANE FULL GLOSS ENAMEL (TWO PACK) — SPECIFICATION

(*Page* 1, *clause* **1.1.1**, *line* 2) — Delete the words '(conventional air/airless)'.

(*Page* 1, *clause* **4.1.1**, *line* 2) — Delete the word 'extenders'.

(*Page* 1, *clause* **5.4**) — Add the following after the word 'apparatus':

'However during mixing of two components in large quantities, the mixing may be done using a high speed stirrer and the rise in temperature shall not be more than 5°C.'

(*Page* 2, *Table* 1) — Add the following after Sl No. (i)(b):

Sl No.	Characteristic	Requirement	Method of Test	
			Annex	Ref to IS No.
(1)	(2)	(3)	(4)	(5)
c)	Hard dry, 70°C, *Max*	30 min, with 15 min flash off time	—	101 (Part 3/Sec 1) : 1986 (*see* Note)

[*Page* 2, *Table* 1, *Sl No.* (i), *col* 5] — Substitute '101 (Part 3/Sec 1) : 1986' *for* '101 (Part 3/Sec 5) : 1987'.

[*Page* 2, *Table* 1, *Sl No.* (xiv)] — Substitute 'Gloss retention shall be minimum 50 percent of the original gloss value. There will be no appreciable change in colour' *for* 'Difference in gloss and colour between immersed and unimmersed area of paint film shall be minimum'.

(*Page* 2, *Table* 1) — Add at the end of the table:

'NOTE — Test Panels shall be kept at 70°C for hard drying.'

(*Page* 3, *clause* **6.1.1**) — Substitute 'Any sediment formed in the container shall be mixed thoroughly, preferably with power driven stirrer to form homogeneous paint' *for* 'Any sediment that does form must be easy to stir up again in order to give a homogeneous paint'.

(*Page* 3, *Annex* A, *line* 11) — Substitute 'Sec 1 : 1986' *for* 'Sec 1 : 1987'.

(CHD 031)

Reprography Unit, BIS, New Delhi, India

Indian Standard

POLYURETHANE FULL GLOSS ENAMEL (TWO PACK) – SPECIFICATION

1 SCOPE

1.1 This standard prescribes requirements and methods of sampling and test of a two-pack full gloss polyurethane enamel, intended to be used for the protection of exterior of railway coaches, diesel and electric locomotive against atmospheric corrosion.

1.1.1 It is primarily suitable for application by spraying (conventional air/airless). It may also be applied by brush for touching up small areas.

1.1.2 The material is intended to be used as a top coat in painting system for the protection of exterior of railway coaches, etc, involving wet and damp areas, high humidity, coastal, marine and industrial fall out. Polyurethane paints shall be suitable for use in those exterior applications where it is desirable to retain colour and gloss for long periods of time in addition to providing excellent chemical and corrosion resistance.

2 REFERENCES

The Indian Standards listed in Annex A are the necessary adjuncts to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1303 : 1983 and the following shall apply.

3.1.1 *Component*

Each of the two parts of the paint which when mixed together, form a pigmented polyurethane paint.

3.1.2 *Paint*

The mixture of the two components in the proportion recommended by the manufacturer.

4 REQUIREMENTS

4.1 Composition

The paint shall consist essentially of two components, enamel and hardener or catalyst solution to be mixed in such simple proportion preferably by volume to satisfy all the requirements of this standard.

4.1.1 An enamel shall consist of (i) an appropriate polyol, and (ii) pigments, extenders, solvents and additives.

4.1.2 Hardener or catalyst solution shall consist of (i) an aliphatic polyisocyanate, and (ii) solvents and additives.

NOTE — To determine whether the polyisocyanate is aliphatic or aromatic in nature, the test shall be carried out as prescribed in Annex B.

4.1.3 The mixture of base and hardener shall be allowed to mature for 20 min at 27±2°C. The mixture must be consumed within 4 hours after mixing.

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

5 TESTS

5.1 Unless specified otherwise, tests shall be conducted as prescribed in IS 101. References to the relevent parts of that standard are given in col 5 of Table 1.

5.2 The preparation of metal panels shall be as per IS 101 (Part 1/Sec 3) : 1986.

5.3 Quality of Reagents

Unless specified otherwise, pure chemicals and distilled water (*see* 1070 : 1977) shall be employed.

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

5.4 The two component polyurethane finish enamel shall be mixed in the ratio recommended by the manufacturer of the paint before conducting the test or tests. Where the enamel is required to be applied on panels, it shall be done so by using suitable spraying apparatus.

5.5 The spray gun shall be thoroughly cleaned before use. Correct size of nozzle and air-cap shall be fitted to it. The air pressure shall be adjusted in accordance with the viscosity of the material to be sprayed. An even and uniform coat having a dry film thickness of minimum 35 microns has to be obtained. The film thickness shall be determined by the method prescribed in Annex C.

Table 1 Requirements for Full Gloss Polyurethane Enamel (Two-Pack)

(*Clause* 4.2)

Sl No.	Characteristic	Requirement	Methods of Test	
			Annex	Ref to IS No.
(1)	(2)	(3)	(4)	(5)
i)	Drying time			101 (Part 3/Sec 5) : 1987
	a) Surface dry, *Max*	3 Hours		
	b) Hard dry, *Max*	8 Hours		
ii)	Consistency	Smooth and uniform and suitable for spray application	—	101 (Part 1/Sec 5)*
iii)	Finish	Smooth and full glossy	—	101 (Part 3/Sec 4) : 1987
iv)	Colour	Close match to be specified IS colour or to an agreed colour	—	101 (Part 4/Sec 2) : 1989
v)	Dry film thickness, *Min*	35 microns	C	—
vi)	Volume solids, *Min*	40 percent	D	—
vii)	Scratch hardness	No such scratch as to show bare metal	—	101 (Part 5/Sec 1) : 1988
viii)	Flexibility and adhesion	No visible damage or detachment of film	—	101 (Part 5/Sec 2) : 1988
ix)	Flash point (for each component)	Not below 20°C	—	101 (Part 1/Sec 6) : 1987
x)	Fineness of grind, *Max*	10 microns	—	101 (Part 3/Sec5) : 1987
xi)	Pot life, 27±2°C, *Min*	4 Hours	E	—
xii)	Gloss at 45° angle of incidence, *Min*	52	—	101 (Part 4/Sec 4) : 1988
xiii)	Weight in kg/10 1, *Min*	9	—	101 (Part 1/Sec 7) : 1987
xiv)	Accelerated tests:			
	a) Resistance to sulphuric acid	Shall not show any signs of blistering, wrinkling and lifting. Difference in gloss and colour between immersed and unimmersed area of paint film shall be minimum	F	—
	b) Resistance to caustic potash	do		
	c) Resistance to oil	do		
	d) Resistance to solvents	do		
xv)	Durability test:	*Rating*		
	a) Out-door exposure	Chalking 10 Checking 10 Cracking 10 Flaking 10 Spotting 10 Blistering 10 Colour change 7-8 Gloss The film shall have a minimum gloss retention of 90 percent of its original value Corrosion No corrosion (*see* 3.4 of IS 8662 :1978)	G	—
	b) Accelerated weathering test			
XVI)	Keeping properties	Not less than one year	—	101 (Part6/Sec 1) : 1988

ANNEX B

(*Clause* 4.1.2)

METHOD OF IDENTIFYING AROMATIC AND ALIPHATIC ISOCYANATES

B-0 GENERAL

B-0.1 Aliphatic polyisocyanates show no colouration while aromatic polyisocyanates show a light brown to a dark reddish brown colouration with hydrogen peroxide.

B-1 REAGENTS

B-1.1 Acetone

B-1.2 3 percent hydrogen peroxide solution in acetone.

B-2 PROCEDURE

B-2.1 Prepare an approximately 40-50 percent solution of the polyisocyanate in acetone. To 50 ml of this solution, stir 1 ml of 3 percent hydrogen peroxide solution. Allow it to stand for 5-I0 min.

B-2.2 The development of any light brown to a dark reddish brown colour indicates aromatic polyisocyanates. No colour indicates aliphatic polyisocyanates.

ANNEX C

[*Clause* 5.5, and *Table* 1, *Sl No.* (v)]

DETERMINATION OF PAINT FILM THICKNESS

C-0 GENERAL

C-0.1 This specifies non-destructive methods for determining the thickness of dry paint films on metallic substrates. It is, therefore, primarily intended for use in checking the thickness of paint films on painted articles.

C-1 APPARATUS

C-1.1 Electromagnet

This type of instrument, requires a supply of electrical power and incorporates means of stabilizing the supply to an electromagnetic head.

C-2 PROCEDURE

C-2.1 The head is placed on an unpainted metal surface similar in nature to that bearing the paint film under test. A reading is taken and the operation repeated on the painted surface. The scale on the instrument is calibrated to indicate the thickness of the paint film shown by the difference between two readings.

ANNEX D

[*Table* 1, *Sl No.* (vi)]

DETERMINATION OF VOLUME SOLIDS

D-0 GENERAL

D-0.1 This method is intended to provide a measure of the volume of dry coating obtainable from a given volume of liquid coating. This volume is considered to be the most equitable means of comparing the coverage and the wet film thickness of the given paint.

D-1 APPARATUS

D-1.1 Analytical Balance — Sensitive to 0.1 mg.

D-1.2 Stainless Steel Disc

60 mm diameter and 0.70 mm thickness with a small hole 2 to 3 mm from the edge. A fine wire such as chromel is attached through the hole for suspending the disc in a liquid.

D-1.3 Weight Box

D-1.4 Beaker — 1 litre.

D-1.5 Mass per Litre Cup

D-1.6 Hot Air Oven — Capable to maintain 90±2°C.

D-2 PROCEDURE

D-2.1 Dry the disc in an oven at 90°C for 10 minutes and cool Weigh the disc in air. Let it be W_1 grams.

D-2.2 Suspend the disc in water and weigh again. Let it be W_2 grams.

D-2.3 Calculate the volume of the disc V as follows:

$$V = \frac{W_1 - W_2}{d}$$

where

d is the density of the water at room temperature.

D-2.4 Determine the weight of non-volatile content of the liquid coating material by drying a known amount of paint at 90°C for 3 hours. Let it be W grams.

D-2.5 Determine the specific gravity of the paint to the nearest 0.001 g/ml by using mass per litre cup. Let it be P.

D-2.6 Dip the disc in the paint sample for 10 minutes and take out the disc. Allow the excess coating material to drain off. Blot the coating material off the bottom edge of the disc so that beads or drops do not dry on the bottom edge of the disc. Dry the disc at 90°C for 3 hours and cool. Weigh the coated disc in air. Let it be W_3 grams.

D-2.7 Suspend the coated disc in water and weigh again. Let it be W_4 grams.

D-2.8 Calculate the volume of the coated disc V_1 as follows:

$$V_1 = \frac{W_3 - W_4}{d}$$

where

d is the density of water at room temperature.

D-2.9 Calculate the volume of the dried coating as follows:

Volume of dried coating = $V_1 - V$ (Vd)

D-2.10 Calculate the volume of wet coating as follows:

$$V_w = \frac{W_3 - W_1}{W \times P}$$

where

W = grams of non-volatile matter in 1 g of wet coating.

D-2.11 Calculate the percent volume solids of the paints as follows:

$$\frac{V_1 - V}{V_w} \times 100 \text{ OR } \frac{V_d}{V_w} \times 100$$

D-2.12 The percent volume solids of a paint is related to the covering capacity and film thickness in the following manner:

a) **Theoretical coverage (m^2/l) =**

$$\frac{\text{Percent volume solids}}{\text{Dry film thickness (microns)}} \times 10$$

b) **Wet film thickness (microns) =**

$$\frac{\text{Dry film thickness (microns)}}{\text{Percent volume solids}} \times 100$$

ANNEX E

[*Table* 1, *Sl No.* (xi)]

DETERMINATION OF POT LIFE

E-1 GENERAL

E-1.1 The time taken to reach to end of working life from the original viscosity shall be considered as the pot life of the material.

E-2 PROCEDURE

E-2.1 Condition the components of the coating for one hour at 27°C and mix immediately in the proper ratio to fill the can to be approximately 1 cm of the top. The lid should be loosely placed on the can.

E-2.2 Measure the viscosity initially and every hour thereafter, as prescribed in IS 101 (Part 1/Sec 5).

NOTE — The interval may be shortened, if desired.

E-2.3 Near the end of the coating's working life, the viscosity builds up rapidly. When it appears that the coating may be too viscous to spray, remove a small portion and add the appropriate thinner. If the paint can still be thinned, the end of the working life has not been reached.

E-2.4 The end of the working life is reached when the paint gels, becomes stringy or cannot be thinned for application.

E-3 Report the working life as pot life of the period.

ANNEX F

[*Table* 1, *Sl No.* (xiv)]

ACCELERATED TESTS

F-1 GENERAL

F-1.1 These tests of chemical resistance, are included to assure the customer that the coating contains a sufficiency of cured resin to exhibit the long term requirements.

F-2 PROCEDURE

F-2.0 Prepare the panels as per Annex H. For the immersion tests as in **F-2.1** to **F-2.3**, prepare and paint both sides of the panels and protect the edges of the panels by sealing with a chlorinated rubber paint.

F-2.1 Resistance to Sulphuric Acid

Immerse 3/4th of the panel in 30 percent sulphuric acid for 24 hours. Remove the panel, wash in running fresh water and allow it to dry for an hour. Record the observation.

F-2.2 Resistance to Caustic Potash

Immerse 3/4th of the panel in 20 percent solution of potassium hydroxide for 24 hours. Remove the panel, wash in running fresh water, allow it to dry for an hour. Record the observation.

F-2.3 Resistance to Oil

Immerse 3/4th of the panel in a mineral lubricating oil (*see* **19.1** of IS 101 : 1964) for 24 hours.

Remove the panel and wipe the excess oil with cotton, wash it with mineral turpentine and allow to dry for 30 minutes. Record the observation.

F-2.4 Resistance to Solvents

Test one panel each for resistance to xylene, ethanol and acetone respectively. Take a clean white sterilized cotton and soak it in the solvent and place it on the painted panel without squeezing the cotton. Immediately cover the soaked cotton with a suitable watch glass and leave it for 6 hours. Remove the watch glass and the soaked cotton, wipe the area with a clean dry cotton. Record the observation immediately.

ANNEX G

[*Table* 1, *Sl No.* (xv)]

DURABILITY TEST

G-1 GENERAL

G-1.1 Both sides of the panels must be prepared and painted as per Annex J for normal outdoor exposure test as well as accelerated weathering test.

G-2 NORMAL OUT-DOOR EXPOSURE TEST

G-2.1 Expose the test panels in the open in duplicate at an angle of 45° facing south. The duration of test shall be for a period of 12 months. The test shall be started from any month in a calendar year. Examine the condition of the exposed films at monthly intervals for the first quarter and thereafter quarterly for the rest of the period for the following characteristics:

a) Gloss
b) Colour
c) Checking; cracking and flaking
d) Chalking
e) Spotting
f) Blistering

G-2.2 Wash the right hand half of the surface of the two test panels with 5 percent caustic soda solution followed by 5 percent hydrochloric acid solution and subsequent thorough rinsing with water. Wipe the panel with a clean soft cloth. Examine the same half of the test panels at each examination. As an aid in the examination, a magnifying glass may be used, but the valuation shall be based on an assessment with the unaided eye. At the end of the stipulated period for durability test, examine the two halves of the test panels. The sample shall be considered satisfactory if the material surface underneath as well as condition of the film in both the halves, the one washed periodically as well as the one washed only

for the final examination is satisfactory. The requirements of this test shall be taken to have been satisfied if performance in respect of the characteristics as noted in **A-3.2** and **A-3.4** of IS 8662 : 1978 is within the limits specified in Table 1.

G-3 ACCELERATED WEATHERING TEST

G-3.1 Carry out the test for 1 000 hours in a xenon arc type weatherometer (with rotating day/night device) with a cycle of 3 minutes rainfall and 17 minutes dry period.

The requirements of this test shall be taken to have been satisfied if performance in respect of the characteristics as noted in **A-3.2** and **A-3.4** of IS 8662 : 1978 is within the limits specified in Table 1.

ANNEX H

(*Clause* F-2.0)

PREPARATION OF PAINTED PANELS FOR ACCELERATED TESTS

H-1 The preparation of panels shall generally be in accordance with IS 101 (Part 1/Sec 3): 1986.

H-2 Apply one coat of epoxy zinc phosphate primer (two-pack) at minimum 35 microns dry film thickness by spraying and allow to dry for at least 6 hours and not more than 24 hours. Dry rub with emery paper No. 400 and wipe clean with a dry soft cloth.

H-3 Apply one coat of epoxy surfacer (two-pack) at minimum 35 microns dry film thickness by spraying and allow to dry for at least 6 hours and not more than 24 hours. Wet rub with water-proof emery paper No. 400 and allow to dry.

H-4 Apply one coat of full gloss polyurethane enamel (two-pack) at minimum 35 microns dry film thickness by spraying and allow to air dry for 7 days.

ANNEX J

(*Foreword*)

HEALTH HAZARDS AND SAFETY MEASURES

Use of polyurethane paints generally presents a two-fold potential hazard, toxic hazards and fire hazards.

Toxic effects through the lungs and the skin occur frequently in the industrial usage of paints. The best guide of comparative values of ingestion toxicity is the LD 50 value. It refers to the lethal doses of toxic substance which can kill 50 percent of one class of animal in test. The LD 50 value for polyisocyanates is much lower when compared to the LD 50 value of cyanides. Another guide of comparative values of inhalation is the threshold limit value (TLV). The TLV for monomeric di-isocyanates has been fixed up at 0.02 ppm. Therefore, spraying of polyurethane paints calls for safety precautions in the form of proper ventilation, proper exhaust facilities and hand-gloves for the spray painters. However, it would be an ideal painting practice to go in for proper spray booth.

As far as fire hazards are concerned, all solvents based paints are known for their fire-risks. This can be eliminated by providing good ventilation so as to avoid vapour air mixture which are flammable and also by not exposing the paint vapours to sources of static electricity, sparks or flames.

The polyurethane coatings are as safe to handle as any other solvent based paints, provided general industrial hygiene principles are followed.

Standard Mark

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 Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

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