RDSO SPECIFICATION NO. M&C/PCN/100/2006
SPECIFICATION FOR POLYURETHANE PAINTING SYSTEM (TWO PACK) FOR THE EXTERIOR PAINTING OF RAILWAY COACHES DIESEL AND ELECTRIC LOCOMOTIVES AND OTHER INDUSRIAL APPLICATIONS

P A I N T I N G S Y S T E M

SYSTEM –1
EPOXY Zinc Phosphate Primer
Unsaturated Polyester Putty
PU Surfacer
PU Full Gloss Enamel(2 coats)

Introduction :

Indian Railways have adopted Epoxy cum Polyurethane painting system for exterior painting of railway coaches, diesel electric locomotives etc. This specification consist technical and physical – chemical requirements of epoxy cum polyurethane system.

Structure :

This specification has been divided into 05 chapters designated as under :

1. General : Chapter – 1
2. Epoxy Zinc Phospate

II S U R F A C E P R E P A R A T I O N

A Substrate : i) Degreasing of appropriate chemicals
B Surface preparation : ii) By grit blasting to white metal Min A Sa 2 1/2 of ISO Spec No 8501-1

III SPECIFICATION DETAILS

Sl. No.	Painting operation	Description of Paint	Method of Application	Specification Number
1.	Primer	Epoxy Zn Phosphate	Airless spray	Chapter I M&C/PCN-102/2004
2.	Putty	Unsaturated Polyester Putty	By Knife/Spatula	Chapter II
3.	Surfacer	PU Surfacer	Airless spray	Chapter III
4.	Finishing enamel	PU Full Gloss	-do-	Chapter IV

Note :

(a) All paint materials for the above painting systems must be procured from the same source for ensuring compatibility.
(b) The paint suppliers shall indicate the viscosity figures at temps. Ranging from 10 to 45^0 C for all items except item no. 2.
(c) The paint suppliers shall indicate the presence of un reacted monomer in the system to ensure freedom from pollution hazards.
(d) For ensuring adherence to flash off time, after the painting operation, the coach shall be placed at the entrance of the curing oven and the coach shall be moved inside the oven slowly to cover the stipulated flash off time.
(e) For touch up painting, during POH, the paint supplier shall supply one litre packing. However, the supply of paint shall be in 20 litres packing.

(f) Use the percentage of thinner strictly as per manufacturer's recommendations.

(g) Manufacturers shall submit point wise technical data sheet of their product as per the requirement table with the tender enquiry.

(h) Manufacturers shall submit test certificates of the products with the supplies along with material safety data sheet.

(i) Manufacturers shall advise mixing ratio, application viscosity, atomization pressure, nozzle size, filter size etc. for different types of paints.

(j) Manufacturers shall certify that the paint material is free from health hazardous material like Cr, Pb, Hg, Asbestos etc. and also that the material is free from carcinogenic and estrogen minimic solvents.

CHAPTER-I

M&C /PCN/102/2004

SPECIFICATION FOR EPOXY BASED ZINC PHOSPHATE PRIMER (TWO PACK)

1. SCOPE

1.1 This standard specifies requirements and methods of testing of Epoxy based Zinc Phosphate Priming paint supplied in two packs, intended to be used, for coaches, bridges and special type of wagons. Two components epoxy zinc phosphate primer is intended to be used as an anti corrosive primer over bare steel surface garnet/ grit blasted to ASa2½ of ISO: 8501-I. The material shall have good adhesion on the substrate and shall have good compatibility with subsequent coats of two pack unsaturated polyester base two pack polyurethane based under coat paint and two pack polyurethane based top coat paint. The primer should be suitable for application by spray. It may also be suitable for application by brush for touching up smaller areas.

1.2 The paint obtained by mixing the material in two packs is used as a highly protective anti-corrosive primer on steel surfaces for providing a much higher degree of protection than conventional single pack primers.

2. TERMINOLOGY

2.1 For the purpose of this standard apart from the glossary of terms given in IS:1303-83, the following shall also apply.

2.1.1 Pack :The term used to describe each of the two packs of the paint which when mixed together, form an epoxy based zinc phosphate priming paint.

2.1.2 Paint :The mixture of the 2 packs, along with thinner, in the proportion recommended by the manufacturer. The mixing of the two packs shall be done with the heavy duty stirrer for 15 mts. max. (the rise in temp. shall not be more than $5^{o}C$).

3. REQUIREMENTS :

3.1 The mixing ratio of the pack A and pack B shall be simple ratio and same as supplied in dual containers.

3.2 Composition :The paint shall consist essentially of two packs, namely pack A and pack B.

3.2.1 Pack A : (normally referred to as base) shall consist of (a) Epoxy resin and (b) Pigment.

3.2.1.1 In the formulation of the paint, epoxy resin of the following grade shall be used.

TABLE I : REQUIREMENTS FOR EPOXY RESIN

S. No.	Characteristics	Requirement	Method of test
1.	Weight per epoxy equivalent on non-volatile vehicle content basis	400-600	CL. 4 of IS:9162-79

3.2.1.2 Pigment Content :

The paint shall contain 45 ± 5% by mass of pigment on the mass of paint and a minimum of 16% by mass of zinc phosphate pigment on the mass of total pigment apart from other pigment, such as extenders, as may be necessary conforming to IS : 10897-84, when both the components mixed in the ratio as given by manufacturer tested as per Cl.27.1.1 of IS: 101-90 by using the following extraction mixture.

i) Methyliso-butyl ketone or Methyl ehtyl ketone or a Mixture of both in the ratio — 25 parts) by volume) 1:1 by volume

ii) Xylene — 50 parts by volume

iii) Acetone — 25 parts by volume

b) The pigment shall conform to IS:10897-84 (Specification for zinc phosphate pigment.

3.2.2 Pack B : (Normally referred to as Hardener or catalyst solution)

This shall be liquid type, such as an aliphatic amine, an aliphatic or aromatic amine adducts, a polyamide or amidopolyamine or any other suitable hardeners. It shall react with epoxy resin at normal ambient temperature.

4. **Properties :**

4.1 General : The paint shall comply with the requirements specified in Table II of this specification.

4.2 Unless otherwise specified, the following testing conditions shall apply.

4.2.1. The preparation of metal panels shall be in accordance with CL.5.2.1.1 of IS:101-86.

4.2.2 All the tests shall be conducted at room temperature (27 ± 2°C) and a relative humidity at 65 ± 5% in a well-ventilated chamber free from draughts and dust.

4.2.3 The two packs i.e. base and hardener shall be mixed in the ratio as recommended by the manufacturer, before conducting the test or tests. Where the paint is required to be applied on panels, it shall be done so by suitable brush/spray. After mixing the two components thoroughly, an induction time of 10 to 15 minutes shall be allowed before use.

TABLE II - REQUIREMENTS FOR EPOXY BASED ZINC PHOSPHATE PRIMER (TWO PACK)

S.No.	Characteristics	Requirements	Test Method
1.	Drying time a) Surface Dry, max b) Hard Dry, max c) Hard Dry at 70°C, max	 3 hours 8 hours 30 minutes, with 15 minutes flash off time	 IS : 101-86 (Part 3, Sec. 1) -do- -do-
2.	Consistency	Smooth and uniform, suitable for brush/spray application	IS : 101-89 (Part 1, Sec.5)
3.	Finish	Smooth and matt to egg shell flat	IS : 101-87 (Part 3, Sec. 4)
4.	Colour	Self standard Red Oxide or Grey	IS: 101-89 (Part 4, Sec. 2)
5.	Dry film thickness/Per coat min.	60 microns	By Elcometer
6.	Volume solids, %, min	50.0 %	See Appendix-1
7.	Scratch hardness (1.5 Kg LOAD)	No such scratch so as to show base metal	IS: 101-88 (Part 5 Sec. 2)
8.	Flexibility & Adhesion (6.25mm mandrel)	No visible damage or detachment of film	IS: 101-88 (Part 5 Sec. 2)
9.	Flash Point (a) Component A (b) Component B	 Above 20°C Above 20°C	 IS: 101-87 (Part 1, Sec. 6) IS: 101-87 (Part 1, Sec. 6)
10.	Resistance to salt spray	No sign of corrosion & no sign of deterioration viz. bristling , detachment of film upto 500 hrs.	ASTM B – 117
11.	Protection against corrosion under condition of condensation	-do-	IS: 101-88 (Part 6 Sec. 1)
12.	Keeping Properties for both the packs	Min. 18 months	See Appendix-III
13.	Mass in Kg/10 litres,	12.5-14.5	IS : 101-87 (Part 1 Sec. 7)
14.	Pot life at 27 ± 2°C, min 40 ± 2°C, min	4 hours 2 hours	Appendix-II

15.	Theoretical Spreading Rate, min	8 Sq.M/ lt. mixture 60 microns DFT	As per Appendix-I(volume solid)
16.	Fineness of grind, max.	30 microns	IS : 101-87 (Part 1/Sec 7)

TABLE III : DETAILS OF PREPARING PAINTED PANELS FOR TESTING EPOXY BASED ZINC PHOSPHATE PRIMER (TWO PACK)

Sl. No.	Test	Type of Metal Panel	Size in m.m.	Painting Detail	DFT	Method of application	Duration of Air Drying Before Commencement of test	Special Instruc-tions
1.	Drying time	M.S.	150 X 100 X1.25	One coat of epoxy Zinc Phosphate Primer	60microns	Brush/ Spray	-	-
2.	Finish	-do-	-do-	-do-	-do-	-do-	48 hours	-
3.	Colour	-do-	-do-	-do-	-do-	-do-	24 hours	-
4.	Dry film thickness a)By brush b)By airless spray	 -do- -do-	 -do- -do-	 -do- -do-	 - -	 Brush Spray	 -do- -do-	 - -
5.	Flexibility & Adhesion	Tinned	150 X50 X.315	-do-	-do-	Brush/ Spray	7 days	-
6.	Scratch Hardness	-do-	-do-	-do-	-do-	-do-	-do-	Apply a load 1.5 Kgs instead of 1 Kg as speci-fied in Clause 15.1.2 of IS: 101-88
7.	Resistance to Salt Spray	M.S.	150 X 100 X 1.25	-do-	-do-	-do-	-do-	For 500 hours
8.	Protection against corrosion under conditions of condensation	-do-	-do-	-do-	-do-	-do-	-do-	-do-

CHAPTER – II

SPECIFICATION FOR TWO COMPONENT UNSATURATED POLYSTER BASE KNIFING PUTTY EXTERIOR – FOR RAILWAY COACHES, DIESEL AND ELECTIRC LOCOMOTIVES – AND OTHER INDUSTRIAL APPLICATIONS

SECTION I : SCOPE AND GENERAL

1.1 **SCOPE**

This standard specifies requirements and methods of testing a two-pack unsaturated Polyester base Knifing Putty intended to be used for the protection of the exteriors or Railway Coaches, Diesel and Electric Locomotives and other industrial applications, against atmospheric corrosion. It is suitable for application by knife of about 30 cm width or more.

1.2 **USES**

Material complying with this standard is intended to be used for levelling up effectively the surface imperfections viz., dents and depressions less than 10mm of the exterior of Railway Coaches, Diesel and Electric Locomotives and other industrial applications. The material shall have good compatibility with Epoxy Zinc Phosphate primer on which it is to be applied and with Polyurethane surfacer, which is to be used as a subsequent coat.

1.3 **DEFINITION**

For the purpose of this standard, the glossary of terms given in IS : 1303-83, shall apply.

SECTION II : MATERIAL REQUIREMENTS AND PROPERTIES

2.1.1 COMPOSITION

The knifing Putty shall consist essentially of two components, namely COMPONENT ‘A’ & COMPONENT ‘B’.

COMPONENT ‘A’ (normally referred to as knifing Putty) shall consist of:

(i) An appropriate unsaturated polyester resin,
(ii) Appropriate pigments, extenders, solvents and additives.

COMPONENT 'B' (normally referred to as HARDNER or catalyst solution) shall consist of:

(i) An organic peroxide,
(ii) Appropriate additives.

2.2.1.1

The material shall be of such a composition as to satisfy the requirements of this standard. In order to obtain satisfactory rubbing properties, use of slate powder (Conforming to IS: 61-50) along with suitable extenders and pigments, as may be necessary, is recommended.

2.1.1

MIXING RATIO : The mixing ratio shall be according to the recommendation of the supplier.

2.2 PROPERTIES

2.2.1 GENERAL

The paint shall comply with the requirements specified in TABLE-1 of the specification.

2.2.2

Unless otherwise specified, the following testing conditions shall apply :

2.2.2.1

The preparation of metal panels shall be in accordance with Clause 5.2 to 5.2.1.2 of IS : 101-1986.

2.2.2.2

All tests shall be conducted at room temperature (27 ± 2^0C) and a relative humidity of 65 ± 5% in a well-ventilated chamber free from draughts and dust.

2.2.2.3

The two-component knifing Putty (Component 'A' & 'B') shall be mixed in the ratio recommended by the manufacturer (before conducting the test/tests.

2.2.2. PREPARATION OF PANELS FOR TESTING

For the preparation of painted panels for conducting different tests mentioned in Table-1, the details given in Table-2 shall be followed.

2.2.3. CONDITION IN CONTAINER

Each component, as delivered, shall be free of gel, coarse particles, skins, foreign matter and sediments. Any sediment, that does form, must be easy to stir up again in order to give a homogeneous paste.

TABLE-1 REQUIREMENTS FOR AN UNSATURATED POLYESTER BASE KNIFING PUTTY (TWO PACK) FOR EXTERIOR SURFACES OF COACHES, DIESEL AND ELECTRIC LOCOMOTIVES

Sl. No.	Characteristics	Requirements	Test Method
1.	Drying time a) Surface dry, max. b) Hard dry, max. c) Hard dry time at 50^0C, max.	 2 hours 8 hours 2 hours, with 30 minutes flash off time	IS : 101-86
2.	Consistency	Smooth and uniform and suitable for knife application	IS : 101-87
3.	Stopping properties	Shall show no sagging, cracking or shrinkage	IS : 5083-88
4.	Rubbing properties	Shall dry rub with 180 grade paper and wet rub with 280 grade waterproof paper without clogging of the paper and shall not show defects like roughness, scratches, cracks and pinholes after rubbing.	IS : 5083-88
5.	Hold out Adhesion & Compatibility in Paint System	Finish with uniform gloss and colour with good adhesion and compatibility of the system	IS : 5083-88
6.	Pot life, min.	30 minutes	See Note
7.	Keeping properties	Not less than twelve months	See Appendix-III

Note :

1. Pot life is taken as the duration upto which the mixed material is still in a usable condition, starting from the time of mixing.

2. The material shall be tested for sandiability in which no clogging shall be observed while sanding with appropriate sand paper. The material must sand in powder which indicates the ease of sanding.

TABLE –2 DETAILS OF PREPARING PAINTED FOR UNSATURATED POLYESTER BASE OR POLYURETHANE BASE OR EPOXY BASE KNIFING PUTTY (TWO-PACK)

Sl. No.	Test	Type of metal panel	Size in mm	Painting detail	D.F.T.	Method of application	Duration of Air Drying before commencement of test
1.	Drying time	M.S.	150X150X1.25	One coat of knifing putty	300 microns	By knife/spatula	-
2.	Stopping properties	-do-	300X150X0.9	Two coats of knifing putty	1 mm min.	-do-	2, 6 and 18 hours
3.	Rubbing properties	-do-	150X150X1.25	One coat of primer zinc phosphate	300 microns	Air/Airless Spray	-
4.	Hold out adhesion and computability in Paint System	-do-	300X150X0.9	One coat of primer zinc phosphate Two coats of knifing putty + one coat of P.U. surfacer	60 microns min. 300 microns	Air/Airless Spray Knife/Spatula Air/Airless Spray	- 12 hours

CHAPTER-III

TWO COMPONENT POLYURETHANE SURFACER

1.1 SCOPE

Material is intended to be used as a surfacer over a primed/putty applied surface for protection of exterior of passenger coaches. The material is used with the object of getting a smooth, uniform and non absorbent base for PU top coat paint. The material shall have good compatibility with two pack PU top coat paint, polyester based Putty and epoxy zinc phosphate primer.

1.2 COMPOSITION

The paint shall consist essentially of two components namely COMPONENT 'A' and COMPONENT 'B'.

COMPONENT 'A' (normally referred to as Base) shall consist of :

- The polyol shall be polyacrylic Polyol.
- Appropriate pigments, extenders, solvents and additives.

COMPONENT 'B' (normally referred to as HARDENER or catalyst solution) shall consist of :

- an aromatic polyisocyanate.
- Appropriate solvents and additives.

To determine whether the polyisocyanate is aliphatic or aromatic in nature, it shall be tested in accordance with the procedure in Appendix VI.

1.3 The two components Polyurethane surfacer (Component 'A' & 'B') alongwith thinner shall be mixed in the ratio recommended by the manufacturer of the paint before conducting the test or tests. Where the priming paint is required to be applied on panels, it shall be done so by using suitable air/airless spraying apparatus. After thorough mixing of the two components, an induction time of 10 to 15 minutes shall be allowed before use.

1.4 The spray gun shall be thoroughly cleaned before use. It shall be fitted with the correct size of nozzle and air cap. The air pressure shall be adjusted in accordance with the viscosity of the material to be sprayed. The material shall be sprayed carefully so as to obtain an even and uniform coat having a dry film thickness of 60 microns minimum per coat. The mixed paint shall show good spraying properties on vertical panels. The film when dry shall be free from sags, runs, streaks and any other film defects.

1.5 CONDITION IN CONTAINER

Each component, as delivered, shall be free of gel, coarse particles, skins, foreign matter and sediments. Any sediment that does from, must be easy to stir up with a high speed stirrer for 15 minutes maximum in order to give a homogeneous paint.

TABLE-1

REQUIREMENT FOR POLYURETHANE SURFACER (TWO PACK)

S. No.	Characteristics	Requirements	Test Method
1.	Drying time a) Surface dry, max b) Hard dry, max c) Hard dry at 70^0 C max.	 4 hrs. 8 hrs. 30 minutes, with 15 minutes flash off time	IS : 101-86 (Part 3 Sec. 1)
2.	Consistency	Smooth and uniform, and suitable for spray application	IS : 101-89 (Part 1 Sec. 5)
3.	Finish	Smooth and Matt to egg shell flat	IS : 101-87 (Part 3 Sec. 4)
4.	Colour	Self standard grey	IS : 101-89 (Part 4 Sec. 2)
5.	Dry film thickness, min	60 microns	By Elcometer
6.	Volume solids, % min	50%	See Appendix-I
7.	Scratch hardness (1.5 Kg LOAD)	No such scratch so as to show base metal	IS : 101-88 (Part 5 Sec. 2)
8.	Flexibility & Adhesion (6.25 mm mandrel)	No visible damage or detachment of film	IS : 101-88 (Part 5 Sec. 2)
9.	Flash point a) Component 'A' b) Component 'B'	 Above 20^0 C Above 20^0 C	IS : 101-87 (Part 1 Sec. 6)
10.	Fineness of Grind, max	40 microns	IS : 101-87 (Part 3 Sec. 5)
11.	Pot life (After induction time), min	27± 2 3 ½ hours 40±2 2 hrs.	See Appendix -II
12.	Mass in Kg/10 litres, min	12.0	IS : 101-87 (Part 1 Sec. 7)
13.	Keeping properties	Min. 18 months	Appendix-III
14.	Theoretical spreading rate, min	8 Sq.m./lt. at 60 micron DFT	Appendix-I (volume solid)

TABLE 2
DETAILS OF PREPARING PAINTED PANELS FOR TESTING
POLYURETHANE UNDER COAT PAINT (TWO PACK)

Sl. No	Test	Type of metal panel	Size in mm	Painting detail	D.F.T	Method of application	Duration of air drying before commencement of test	Special instructions
1.	Drying time	M.S.	150X150X1.25	One coat of PU undercoat paint(2 component)	60 microns	Air/Airless spray	-	-
2.	Finish	-do-	-do-	-do-	-do-	-do-	24 hrs.	-
3.	Colour	-do-	-do-	-do-	-do-	-do-	-do-	-
4.	Dry film thickness	-do-	-do-	-do-	-do-	-do-		-
5.	Scratch hardness	Tinned	150X50X.315	-do-	-do-	-do-	7 days	Apply a load 1.5 Kg. Instead of 1 Kg. as specified in Clause 15.1.2 of IS : 101-88
6.	Flexibility & Adhesion	-do-	-do-	-do-	-do-	-do-	-do-	-

CHAPTER – IV

SPECIFICATION FOR FULL GLOSS POLYURETHANE ENAMEL (TWO PACK) EXTERIOR FOR RAILWAY COACHES, DIESEL AND ELECTRIC LOCOMOTIVES AND OTHER INDUSTRIAL APPLICATIONS

1.1 SCOPE

This standard specifies requirements and methods of testing a two-pack full gloss Polyurethane Enamel, intended to be used for the protection and decoration of exteriors of Railway Coaches, Diesel and Electric Locomotives and other industrial applications, against atmospheric corrosion. It is primarily suitable for application by spraying. It may also be applied by brush for touching up small areas.

1.2 USES

Material complying with this standard is intended to be used as top coat in paint system for the protection of exteriors of Railway coaches, Diesel and Electric Locomotives and other industrial applications, against corrosion, involving wet and damp areas, high humidity, coastal/marine and industrial fallout. Polyurethane paints are 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, abrasion and corrosion resistance.

1.3 DEFINITION

For the purpose of this standard, the glossary of terms given in IS : 1303-83, shall apply.

1.3.1 COMPONENT

The term used to describe each of the two parts of the paint which, when mixed together, form a pigmented polyurethane paint.

1.3.2 PAINT

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

2.1.1 **COMPOSITION**

The paint shall be consist essentially of two components, namely COMPONENT 'A' and COMPONENT 'B'

COMPONENT 'A' (normally referred to as Enamel) shall consist of :

(i) an appropriate oil free polycrylate Polyol
(ii) Appropriate pigments, solvents and additives.

COMPONENT 'B' (normally referred to as HARDENER or catalyst solution) shall consist of :

(i) an aliphatic polyisocyanate.
(ii) Appropriate solvents and additives.

To determine whether the polyisocyanate is aliphatic or aromatic in nature, carry out tests in accordance with the procedure in Appendix VI.

2.1.2 **MIXING RATIO**

The mixing ratio of the Component 'A' and Component 'B' shall be a simple ratio, such as 1:1, 2:1, 3:1 (or) 4:1 by volume max.

2.2 PROPERTIES

2.2.1 **GENERAL**

The paint shall comply with the requirements specified in TABLE 1 of the specification.

2.2.2 Unless otherwise specified, the following testing conditions shall apply :

2.2.2.1 The preparation of metal panels shall be in accordance with Clause 5.2 to 5.2.1.2 of IS : 101-1986.

2.2.2.2 All tests shall be conducted at room temperature (27 ± 2^{0}C) and a relative humidity of 65 ± 5% in a well-ventilated chamber free from draughts and dust.

2.2.2.3 The two components P.U. Finish Enamel (component 'A' & 'B'), along with thinner, shall be mixed in the ratio recommended by the manufacturer of the paint before conducting the test or tests. However, during mixing of the two components in large quantities for painting coach/locos, the mixing may be done by using a high speed stirrer for 5 minutes max. (Rise in temp. shall not be more than 5^0C). After through mixing of the two components, an induction time of 10 to 15 minutes shall be allowed before use. Where the enamel is required to be applied on panels, it shall be done so by using suitable air/airless spraying apparatus.

2.2.2.4 The spray gun shall be thoroughly cleaned before use. It shall be fitted with the correct size of nozzle and air-cap. The air-pressure shall be adjusted in accordance with the viscosity of the material to be sprayed. The material shall be sprayed carefully so as to obtain an even and uniform coat having a dry film thickness of 40 microns minimum per coat. From the relationship (b) in Appendix-I, determine the approximate wet film thickness required to obtain the above specified dry film thickness.

2.2.2.5 The mixed paint shall show good spraying properties on vertical panels. The film, when dry, shall be free from sags, runs, streaks, and any other film defects.

2.2.2.6 The above condition holds good wherever the use of Epoxy Primer and P.U. surfacer has been recommended to be used along with the P.U. Enamel for testing.

2.2.3. PREPARATION OF PAINTED PANELS FOR TESTING

2.2.3.1 For the preparation of painted panels for conducting different tests mentioned in Table-1 the details given in Table –2 shall be followed.

2.2.3.2 CONDITION IN CONTAINER

2.2.3.3 Each component, as delivered, shall be free of gel, coarse particles, skins, foreign matter and sediments. Any sediment, that does form, must be easy to stir up with a power driven stirrer again in order to give a homogeneous paint.

TABLE 1 REQUIREMENT FOR FULL GLOSS POLYURETHANE ENAMEL (TWO PACK) EXTERIOR FOR RAILWAY COACHES, DIESEL AND ELECTRIC LOCOMOTIVES AND OTHER INDUSTRIAL APPLICATIONS

S. No.	Characteristics	Requirements	Test Method
1.	Identification of polyisocyanate	Aliphatic polyisocyanate	See Appendix-VI
2.	Drying time a) Surface dry, max b) hard dry, max c) hard dry at 70^0 C	 4 hrs. 8 hrs. 30 minutes, with 15 minutes flash off time	 IS : 101-86 (Part 3 Sec. 1) -do- -do-
3.	Consistency	Smooth and uniform, and suitable for spray application	IS : 101-89 (Part 1 Sec. 5)
4.	Finish	Smooth and full glossy	IS : 101-87 (Part 3 Sec. 4)
5.	Colour	Close match to the specific IS/RAL colour or to an agreed colour where IS colour is not specified	IS : 101-89 (Part 4 Sec. 2)
6.	Dry film thickness, min	40 microns	By Elcometer
7.	Volume solids, % min	50%	See Appendix-I
8.	Scratch hardness (1.5 Kg LOAD)	No such scratch so as to show base metal	IS : 101-88 (Part 5 Sec. 2)
9.	Flexibility & Adhesion (6.25 mm mandrel).	No visible damage or detachment of film	IS : 101-88 (Part 5 Sec. 2)
10.	Flash point (a) Component 'A' (b) Component 'B'	 Above 20^0 C Above 20^0 C	IS : 101-87 (Part 1 Sec. 6)
11.	Fineness of Grind, max	15 microns	IS : 101-87 (Part 3 Sec. 5)
12.	Pot life (After induction time), min at a)27± 2^0C b)40‡ 2^oC	 3 ½ hrs. 2 Hrs.	See Appendix-II
13.	Gloss At 60^0 angle of incidence, min	>85^0 (for glossy finish)	By gloss meter. The gloss should be checked after applying two coats of PU

			enamel.
14.	Mass in Kg/10 litres, min	10.0	IS : 101-87 (Part 1 Sec. 7)
15.	Keeping properties	Min. 18 months	See Appendix-III
16.	Theoretical spreading rate, min	12.0 Sq. M./Kg. at 40 micron DFT	Appendix-I (Volume solid)
17.	% unreacted monomer	2% max.	Appendix-A

TABLE 1 REQUIREMENT FOR FULL GLOSS POLYURETHANE ENAMEL (TWO PACK) EXTERIOR FOR RAILWAY COACHES, DIESEL AND ELECTRIC LOCOMITIVES AND OTHER INDUSTRIAL APPLICATIONS.
(Continued from pre page)

Sl. No.	Characteristics	Requirements		Test Method
18.	Accelerated Tests (a) Resistance to 30% sulphuric acid (weight by volume) (b) Resistance to 20% caustic potash (c) Resistance to oil (d) Resistance to solvents	Shall not show any signs of blistering, wrinkling & lifting. Difference in gloss and colour between immersed and unimmersed area of paint shall be 7out of 10 max. -do- -do- -do-		See Appendix IV
19.	Durability Tests Accelerated weathering test	Rating Chalking Checking Cracking Flaking Spotting Blistering Corrosion Colour change	10 10 10 10 10 10 10 No corrosion 7	See Appendix-V

		Gloss	The film shall have a minimum gloss retention of 80% at 60^0 angle of incidence of its initial value.	

TABLE 2 DETAILS OF PREPARING PAINTED PANELS FOR FULL GLOSS PLOYURETHANE ENAMEL (TWO PACK)

Sl. No	Test	Type of metal panel	Size in mm	Painting detail	D.F.T	Method of application	Duration of air drying before commencement of test	Special instructions
1.	Drying time	M.S.	150X150 X1.25	One coat of PU enamel full gloss (2 component)	40 microns	Air/Airless spray	-	-
2.	Finish	-do-	-do-	-do-	-do-	-do-	24 hrs.	-
3.	Colour	-do-	-do-	-do-	-do-	-do-	-do-	-
4.	Dry film thickness	-do-	-do-	-do-	-do-	-do-		-
5.	Scratch hardness	Tinned	150X50 X.315	-do-	-do-	-do-	7 days	Apply a load 1.5 Kg. Instead of 1 Kg. as specified in Clause 15.1.2 of IS : 101-88
6.	Flexibility & Adhesion	-do-	-do-	-do-	-do-	-do-	-do-	-
7.	Gloss	M.S.	150X150 X1.25	-do-	-do-	-do-	24 hrs.	-
8.	Accelerated tests (a) & (b)	-do-	150X75 X1.25	See Appendix IV	Min. 200 microns	-do-	7 days	Prepare and paint both sides of the panels
	(a) Resistance to oil	Tinned	150X50 X.315	--do--	Min 200 microns	Air/Airless spraying	-do-	-do-

	(d) Resistance to solvents	M.S.	150X150 X1.25	--do--	Min. 200 microns	-do-	-do-	Prepare and paint only one side of the panels
9.	Durability Test : (i) Out-door exposure test	M.S.	300X300 X1.25	Appendix-V	-do-	-do-	-do-	Prepare and paint both sides of the panels
	(ii) Accelerated weathering test	M.S.	150X75 X1.25	-do-	-do-	-do-	-do-	-do-

APPENDIX – I

PROCEDURE FOR DETEMINING VOLUME SOLIDS PERCENTAGE

1. SCOPE :

This method is applicable to the determination of the volume non volatile matter of paint coatings.

2. SIGNIFICANCE :

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 (sq.feet of surface covered at a specific film thickness per unit volume) and also for calculating the wet film thickness of the given paint.

3. APPARATUS :

i) Analytical Balance
ii) Steel Disc – Preferably stainless steel, 60 mm dia 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 and made of the appropriate length for suspending the disc in a liquid.
iii) Weight box
iv) Beaker 1 litre for weighing the disc in liquid.
v) Weight per litre cup for determining the specific gravity of the paint material and of the suspending liquid if not known.
vi) Oven.

4. PROCEDURE :

i) Dry the disc in an oven at 105^{o}C for 10 minutes and cool.
ii) Weight the disc in air. Let it be W1 grams.
iii) Suspend the disc in water and weigh again. Let it be W2 grams.

iv) Calculate the volume of the disc V as follows :

$$V = \frac{W1 - W2}{d}$$ where d is the density of the water at room temperature.

v) Determine the weight of non volatile content of the liquid coating material by drying a known amount of paint at 105^{o} C for 3 hours. Let it be W grams.

vi) Determine the specific gravity of the paint to the nearest 0.001 g/ml by using weight per gallon cup. Let it be P

vii) Dip the disc in the paint sample for 10 minutes and take out the disc and allow the excess coating material to drain off. Blot the coating material off the bottom edge of the disc so that heads or drops do not dry on the bottom edge of the disc.

viii) Dry the disc in an oven for 3 hours at 105^{o}C and cool.

ix) Weigh the coated disc in air. Let it be W3 grams.

x) Suspend the coated disc in water and weigh again. Let it be W4 grams.

xi) Calculate the volume of the coated disc as follows :

$$V1 = \frac{W3 - W4}{d}$$ where d is the density of the water at room temperature.

xii) Calculate the volume of the dried coating as follows :-

Volume of dried coating = V1 - V
(Vd)

xiii) Calculate the volume of wet coating as follows :

$$V_w = \frac{W3 - W1}{W \times P}$$ where W = grams of non volatile matter.
P = specific gravity of the paint.

xiv) Calculate the percentage volume solids of the paints as follows :

$$\frac{V1 - V}{Vw} \times 100 \quad (OR) \quad . \frac{Vd}{Vw} \times 100$$

The volume of non-volatile matter or the percentage volume solids of a paint is related to the covering capacity and thickness in the following manner :-

a) $$\frac{\% \text{ Volume solids}}{} \times 10 = \text{Covering Capacity}$$

Dry film thickness (microns)

b) Dry film thickness (microns) / % Volume solid X 100 = wet film thickness(microns)

APPENDIX – II

PROCEDURE FOR DETERMINING OF POT LIFE

Take the usable time as the pot life of paint and not the doubling in viscosity. A copy of Federal Test Method No. 2.7.1 for determining of POT Life is given below :

1. Condition the components of the coating for one hour at 25^0 C (77^0 F) and mix immediately in proper ratio to fill the quart cane to approx. ½ volume. The lid should be loosely placed on the can.

2. Measure the viscosity initially and every hour thereafter. However, the interval may be shortened, if desired.

3. Near the end of the coatings working life, the viscosity builds-up rapidly. During this period, when it appears 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. The end of the working life is reached when the paint gels, becomes stringy or cannot be thinned for application.

APPENDIX- III

KEEPING PROPERTIES

When stored under cover in a dry place in the original sealed containers under normal temperature conditions, the material shall detained the properties prescribed in the specification for the stipulated period from the date of manufacture which shall be subsequent to the date of placement of contract.

APPENDIX IV

ACCELERATED TESTS

The following short term tests of chemical resistance do not categorize the type of service for which polyurethane coating are intended but are included to assure the customer that the coating contains a sufficiency of cured resin to exhibit the long terms requirements.

Prepare the panels as per Appendix B allow the panels to air dry for seven days. For the immersion test as in (a), (b) and (c). Prepare and paint both sides of the panels and protect the edges of the panels by sealing with a suitable wax.

a. Resistance to Sulphuric Acid

Immerse ¾th of the panel in 30% Sulphuric Acid (u/v) for 24 hours. Remove the panel, wash in running fresh water and allow it to dry for an hour and record the observation.

b. Resistance to Caustic Acid

Immerse ¾th of the panel in 20% Potassium Hydroxide for 24 hours. Remove the panel, wash in running fresh water and allow it to dry for an hour and record the observation.

c. Resistance to Oil

Prepare the panel as per Table 2. Immerse ¾th of the panel in a mineral lubricating oil (As mentioned in Clause 19.1 of IS : 101-1964) for 2 hours.

Remove the panel and wipe the excess oil with a pad of cotton and wash it with mineral turpentine and allow to dry for 30 minutes and record the observation.

d. Resistance to Solvents

Test on panel each for resistance to xylene, cthanol and acetone respectively. Take a white sterilized cotton and soak it in the solvent and place it on the painted panel without squeezing the cotton. Immediately cover the soaks cotton with a suitable watch glass and leave it for 3 hours. Remove the watch glass and then the soaked cotton and wipe the area with a clean dry cotton and immediately record the observation after 2 hours.

APPENDIX – V

ACCELERATED TESTS AND TEST FOR DURABILITY

Both sides of the panels must be prepared and painted as per Appendix B for accelerated weathering test.

ACCELERATED WEATHERING TEST
The test is performed according to DIN53387

Test Period	:	1000 hours
Apparatus	:	Xeno test 1700 with rotating day/night device
Cycle	:	3 Min. rainfall, 17 Min. dry period
Light exposure	:	UVB 313 light exposure

The requirements of this test shall be taken to have been satisfied if performance in respect of the characteristics as noted in Clause A.3.2 and A.3.4 of IS : 8662-1993 is within the limits.

APPENDIX –VI

METHOD OF IDENTIFYING AROMATIC AND ALIPHATIC ISOCYANATE

INTRODUCTION

ISOCYANATE

Chemistry differentiates between aromatic and aliphatic isocyanates. This differentiation is justified by the difference in properties between these compounds and between their reaction products.

The difference in properties between aliphatic and aromatic isocyanates in found both with the mono and polyisocyanates and in the polyurethane paint film. Polyurethane films cured with aliphatic polyisocyanates show excellent resistance to yellowing on exposure to light and excellent retention of gloss in outdoor exposure unlike polyurethane film cured with aromatic polyisocyanates which how more or less marked yellowing from exposure to light and poor retention of gloss in out door exposure. This difference between aromatic and aliphatic polyisocyanates cured films makes uncomplicated identification method desirable.

PROCEDURE

For identifying aromatic and aliphatic isocyanate solutions (also frequently called “HARDENER” or “CATALYST SOLUTION”) prepare an approx. 40-50% solution with acetone into 30 – 50 ml of this solution stir approx. 1 ml of 3% HO solution in acetone.

RESULTS

Aliphatic polyisocyanates show no discoloration at all. Aromatic polyisocyanates show a light brown to a dark reddish – brown coloration after 5-10 minutes which deepens further in the course of several hours. Some aromatic isocyanates are commercially available as brown coloured liquids thus identifiable even without conducting the above tests. Whereas all the aliphatic isocyanates and some of the aromatic ioscyanates are commercially marketed as clear water white liquids thus necessitating the above identification method to be conducted.

APPENDIX – A

Standard Test Method for Isocyanate Groups in Urethane Materials or Prepolymers

1. Procedure

1.1 Weigh to 0.1 g a specimen containing approximately 1.1 milliequivalents of NCO (for example 1.0 g of prepolymer containing approximately 5% NCO) in a 250 mL Erlenmeyer flask.

1.2 Add 25 mL of dry toluene (Note 2), place a stopper in the flask, and swirl by hand or on a mechanical agitator to dissolve the prepolymer. Solution may be aided by warming in a hot plate.

Note 2 – If the polymer is insoluble, add 10 mL of dry, analytical made acetone to the toluene.

1.3 Using a pipet, add 25.00 mL of 0.1 N di-n-butylamine solution and continue swirling for 15 min. with stopper in place.

1.4 Add 100 mL of isopropyl alcohol and 4 to 6 drops of bromphenol blue indicator solution. Titrate with 0.1 N hydrochloric acid to a yellow end point.

1.5 Run a blank titration including all reagents above but omitting the specimen.

2. Calculations

2.1 Calculate the NCO content as follows :

$$\text{NCO, \%} = \frac{(B - V) \times N \times 0.0420]}{W} \times 100$$

Where :

B = Volume of HCl for titration of the blank, mL,
V = Volume of HCl for titration of the specimen, mL,
N = normality of HCl
0.420 = milliequivalent weight of the NCO group, and
W = grams of specimen weight, g.