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RDSO SPECIFICATION No. M&C/ PCN/ 100/ 2018

Date of enforcement is 01.04.2018

SPECIFICATION FOR EPOXY CUM POLYURETHANE PAINTING SYSTEM (TWO PACK) FOR THE EXTERIOR PAINTING OF RAILWAY COACHES, DIESEL AND ELECTRIC LOCOMOTIVES AND OTHER INDUSTRIAL APPLICATIONS

PAINTING SYSTEM

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

RESEARCH DESIGNS & STANDARDS ORGANISATION
LUCKNOW-226 011

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1. INTRODUCTION: Indian Railways have adopted Epoxy cum Polyurethane painting system for exterior painting of railway coaches, diesel , electric locomotives etc. This specification consists of technical and physico-chemical requirements of epoxy cum Polyurethane system.

2. STRUCTURE: This specification has been divided into 05 chapters designated as under:
 - i) General : Chapter-I
 - ii) Epoxy Zinc Phosphate primer : Chapter –II
 - iii) Unsaturated Polyester Putty : Chapter-III
 - iv) PU Surfacer : Chapter-IV
 - v) PU Full Gloss Enamel (Two Pack) : Chapter-V

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CHAPTER-I

1. GENERAL: This Chapter provides information with regard to Surface preparation, details of various components of painting system, aspects to be adhered to by the manufacturers, procurement details to be followed by the users and other important aspects.

2. Surface Preparation: The substrate shall be degreased by using suitable petroleum hydrocarbon solvents to IS: 1745-78. After degreasing, the surface shall be prepared by grit blasting to white metal and the prepared surface shall match to minimum A Sa 2.5 of ISO Specn No. 8501-1.

3. Components of the Painting system: The painting system has the following components

Sl. No.	Painting operation	Description of paint	Method of Application	Chapter of Specification No. M&C/PCN/100/2018
1	Priming	Epoxy Zinc Phosphate primer	Airless spray	Chapter-II
2	Putty	Unsaturated Polyester Putty	By Knife/ Spatula	Chapter-III
3	Surfacer	PU Surfacer	Airless Spray	Chapter-IV
4	Finishing	PU Full Gloss enamel	-do-	Chapter-V

4. Important Instructions

A. For manufacturers:

- i) The paint Manufacturers shall indicate the presence of un-reacted monomer in the system to ensure freedom from pollution hazards.
- ii) For touch up painting, during POH, the paint supplier shall supply the material in one liter packing. However, bulk supply of paint shall be in 20 liters packing.
- iii) Manufacturers shall submit internal test certificate for each product for all the parameters specified, at the time of supplying the material.
- iv) Manufacturers shall submit material safety data sheet along with the supplies.
- v) (a) Paint system procured through Indian Railway store contract:

Indian Railways may use cleaning compound for cleaning of exterior of coaches to RDSO Specification No. M&C/ PCN / 101/ 2007, taking into this and other aspects such as prevailing operating / service conditions, the Manufacturers will take warranty of their material regarding gloss retention, colour retention and adherence property at the time of supplying the painting system, to be used for painting of railway assets. The minimum acceptable limits, for the above properties, after various duration, are as per the following Table:

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(b) Paint system procured through Supply-Apply and Maintenance contract:

The paint system procured by Indian Railway through Supply-Apply and maintenance contract, the contractor may use other cleaning /washing/polishing agent of their own choice and on their own expenses during the entire warrantee period for color and gloss retention as per the following Table. Mechanical damage and any other painting defect arise during service and warranty period shall be repaired by the contractor on their own cost. Production units and other consignee shall frame their own terms and conditions of supply-apply and maintenance contract for procurement of the paint system and the same shall be introduced in P.O.

SN	Time Period	Gloss Retention (Initial gloss>85 units at 60° angle of incidence)	Colour Retention Rating on 0-10 scale (Initial rating of painted panels/coach or ISC/RAL Shade Card shall be taken as 10)	Adherence of Paints (with each other and with substrate) Cross-Cut Tape Adhesion test as per ASTM D:3359/97 (or latest)
1.	After 1 Year	80% of initial gloss	7	5B
2.	After 2 Year	70% of initial gloss	6	5B
3.	After 3 Year	60% of initial gloss	5	4B

- vii) *Manufacture 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 mimetic solvents.*
- viii) Unsaturated polyester putty shall be supplied in small containers and after mixing the contents of both the packs, the amount of putty should be 5 ± 0.5 Kg which can be easily consumed within its pot life i.e. 30 minutes.
- ix) Marking and Packing: Each container shall be marked with the following:-
 - a. Name of the material
 - b. Source of manufacture
 - c. Volume of the material
 - d. Batch No. or Lot No. in code or otherwise and
 - e. Month & year of manufacture
 - f. Shelf life of paint /material in container and temperature to be stored at.
- x) For touch up/patch painting, the material shall be supplied in one liter container

B. Procurement Authorities :

All paints including thinner for the above painting systems must be procured from the same source to ensure compatibility.

C. Testing Authorities :

- i) The paint shall be tested after mixing pack A & B in the stipulated ratio as mentioned in corresponding chapter of different components of paint system. No thinner shall be employed until recommended by the manufacturer.

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- ii) The following tests in this specification are defined as Type tests-

SN	Name of the paint component	Type Tests
1.	Epoxy Zinc phosphate primer (Two packs)	(a) Resistance to Salt Spray (b) Protection against corrosion under condition of condensation
2.	Full Gloss PU Enamel	(a) Accelerated weathering test (b) Humidity Test

- iii) All other tests as laid down in the specification are defined as Acceptance Tests
- iv) At the time of initial approval all characteristics of paints after mixing pack A and B in the stipulated ratio as mentioned in corresponding chapter of different components of paint system shall be tested as per the specification.
- v) When the total quantity of the paint purchased is up to 10 below-coach sets in single or multiple lots, the acceptance or rejection by the inspecting agency shall be of each multiple lot or the entire single lot based on test results of the acceptance tests.
- vi) When the total quantity of paint to be purchased is more than 10 coach sets, testing of each multiple lot (part quantity) shall be carried out for acceptance test and/or type tests as given below-

Lot quantity	Tests to be conducted
1 st lot up to 50 coach sets* of each lot	Acceptance Tests and Type Tests
2 nd , 3 rd & 4 th lots up to 50 coach sets* of each lot	Acceptance Tests
5 th lot up to 50 coach sets* each lot	Acceptance Tests and Type Tests
6 th ,7 th & 8 th lots up to 50 coach sets* of each lot	Acceptance Tests
9 th lot up to 50 coach sets* of each lot	Acceptance Tests and Type Tests
10 th ,11 th & 12 th lots up to 50 coach sets* of each lot	Acceptance Tests

*Quantity for each type of painting material in litres required per coach set for different types of coaches shall be as per Appendix XIII of the specification (for information only).

D. Coach Builders :

- i) Normally addition of thinner in prepared paint (obtained after mixing Pack A & Pack B in recommended mixing ratio) shall not be required. If environmental fluctuations (e.g. fall in temperature) take place, then small amount of thinner as recommended by the manufacturer, subject to a maximum of 10% (v/v), may be added to adjust the spray viscosity.
- ii) 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.
- iii) Due to short pot life, the unsaturated polyester putty may be prepared by mixing the contents of both the packs near the coach in small batches, as per the requirements, which can be consumed within its pot life i.e. 30 minutes

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CHAPTER-II

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 based putty, two pack polyurethane based under coat paint and two pack polyurethane based top coat paint, as the painting system may require the application of these materials. The primer should be suitable for spray application (as per Chapter I, Para 3) 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 and CI2 of IS: 9162-79, the following shall also apply. Rounding off, of observed values on different tests shall be in accordance with IS: 2-1960.

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 minutes max (the rise in temp. shall not be more than 5°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
(b) Pigment.

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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, g/mole	400-500	CL. 4 of IS:9162-79

3.2.1.2 Pigment Content:

The paint shall contain $45 \pm 5\%$ by mass of pigment on the mass of paint and a minimum of 16% by mass of zinc phosphate pigment, on the basis of, % by 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 of IS: 101-90, Part 8/ Section 2 by using the following extraction mixture.

- | | | |
|------|--------------------------------------------------------------------------------------|------------------------------------|
| i) | Methyl iso-butyl ketone or
Methyl ethyl ketone or
Mixture of both in the ratio | 25% by volume

1:1 by volume |
| ii) | Xylene | 50 % by volume |
| iii) | Acetone | 25 % by volume |

3.2.1.3 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 ($27 \pm 2^\circ\text{C}$) and a relative humidity at $65 \pm 5\%$ in a well-ventilated chamber free from draughts and dust.

4.2.3 Condition in Containers: 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 high speed stirrer for 15 minutes maximum, in order to give a homogenous paint.

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4.2.4 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 spray (as per Chapter I, Para 3) . 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)
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	IS: 101-89 (Part 3/ Sec. 2) 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)
10.	Resistance to salt spray	No sign of corrosion & no sign of deterioration viz. blistering, detachment of film up to 500 hrs.	ASTM B – 117/90
11.	Protection against corrosion under condition of condensation	-do-	IS: 101-88 (Part 6 /Sec. 1)

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CHAPTER–III

SPECIFICATION FOR UNSATURATED POLYESTER BASE KNIFING PUTTY (TWO PACK)

1. SCOPE

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

1.1 USES

Material complying with this standard is intended to be used for levelling up effectively the surface imperfections viz., dents and depressions less than 2 mm of the exterior of Railway Coaches, Diesel and Electric Locomotives and other industrial applications. Dents more than 2 mm may be filled in, with the help of fillers based on unsaturated polyester resin filled with glass bubbles or any other suitable material. 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.

1.2 DEFINITION

For the purpose of this standard, the glossary of terms given in IS: 1303-83, shall apply. Rounding off, of observed values on different tests shall be in accordance with IS: 2-1960

2. MATERIAL REQUIREMENTS AND PROPERTIES

2.1 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 HARDENER or catalyst solution) shall consist of:

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

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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 along with suitable extenders and pigments, as may be necessary, is recommended.

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

1.1 PROPERTIES

2.2.1 GENERAL

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

Unless otherwise specified, the following testing conditions shall apply:

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

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

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

2.1.1 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.

2.1.2 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 with a high speed stirrer for 15 minutes maximum, in order to give a homogeneous paste.

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**TABLE-1 REQUIREMENTS FOR UNSATURATED POLYESTER BASE
KNIFING PUTTY (TWO PACK)**

Sl. No.	Characteristics	Requirements	Test Method
1.	Drying time a) Surface dry, max. b) Hard dry, max. c) Hard dry time at 70 ⁰ C, max.	2 hours 8 hours 2 hours, with 30 minutes flash off time	IS : 101-86 (Part 3/Sec.1)
2.	Consistency	Smooth and uniform and suitable for knife application	IS : 101-87 (Part 1/Sec.5)
3.	Stopping properties	Shall show no sagging, cracking or shrinkage	Appendix-IX
4.	Rubbing properties	Shall dry rub with 150 grade paper and wet rub with 280 grade water proof paper without clogging of the paper and shall not show defects like roughness, scratches, cracks and pinholes after rubbing.	Appendix-X
5.	Hold out Property	Finish with uniform gloss and colour	Appendix-XI
6.	Adhesion & Compatibility of Paint System	Good adhesion and compatibility of the paint system	Appendix-XII and ASTM D 3359-09
7.	Pot life, at 27 ± 2°C, min	30 minutes	See Note
8	% solids, , min	85	IS : 101-87 (Part 8/ Sec 2
9.	Keeping properties	Not less than twelve months	Appendix-III

Note: Pot life is taken as the duration up to which the mixed material is still in a usable condition, starting from the time of mixing.

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

Sl. No.	Test	Type of metal panel	Size in mm	Painting detail	D.F.T., minimum	Method of application	Duration of Air Drying before commencement of test (Applicable for panels either air dried or dried at elevated temperature)
1.	Drying time	M.S.	150 X 150 X 1.25	One coat of knifing putty	300 microns	By knife/spatula	-
2.	Stopping properties	-do-	300 X150 X 0.9	One coat of zinc phosphate primer (allow it to air dry for 8 hrs.) followed by three coats of U.S. polyester based knifing putty(giving interval of not less than 8hrs. and not more than 24 hrs. between successive applications)	60 microns Total DFT 1000 microns, .	By suitable Spray technique By knife/spatula	- 02 Hours after application of each coat .
3.	Rubbing properties	-do-	-do-	One Coat of zinc phosphate primer (allow it to air dry for 8 hrs.) followed by One coat of U.S. polyester based knifing putty.	60 microns 300 microns	By suitable Spray technique By knife/spatula	- 08 Hrs. after application of putty.
4.	Hold out property	-do-	300 X 150 X 0.9	One coat of zinc phosphate primer (allow it to air dry for 8 hrs.), followed by three coats of U.S. polyester based knifing putty (giving interval of not less than 8hrs. and not more than 24 hrs. between successive applications) Allow final coat of putty to air dry for 08 hrs., followed by One coat of P.U. surfacer (allow it to air dry for 08 hrs.) followed by Two coats of PU full Gloss Enamel(apply 2 nd coat after 8hrs of air drying of 1 st coat)	60 microns Total DFT 1000 microns 60 microns 40 + 40=80 microns	By suitable Spray technique Knife/Spatula By suitable Spray technique -do-	- - - 48 hours
5.	Adhesion and compatibility in Paint System	-do-	300x150 x 0.9	-do- (same as at S.No.4)	-do- (same as at S.No.4)	-do- (same as at S.No.4)	07days

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CHAPTER-IV

POLYURETHANE SURFACER (TWO PACK)

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, Diesel and Electric Locomotives and other industrial applications. 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 DEFINITION

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

1.3 COMPONENT

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

1.4 PAINT

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

1.5 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 may be polyacrylate polyol
- Appropriate pigments, extenders, solvents and additives

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

- an aliphatic poly isocyanate
- Appropriate solvents and additives

To determine whether the poly isocyanate is aliphatic or aromatic in nature, it shall be tested in accordance with the procedure in Appendix- VII

- 1.6 The two components Polyurethane surfacer (Component 'A' & 'B'), 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 spraying technique. After thorough mixing of the two components, an induction time of 10 to 15 minutes shall be allowed before use.

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- 1.7 The spray gun shall be thoroughly cleaned before use. It shall be fitted with the correct size of nozzle and air cap. In case of airless, **the pressure ratio of air cylinder to hydraulic cylinder 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.

1.8 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 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° 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 (as per Chapter I, Para 3)	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	50.0	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° C Above 20° C	IS : 101-87 (Part 1/ Sec. 6)
10.	Fineness of Grind	20-30 microns	IS : 101-87 (Part 3 /Sec. 5)
11.	Pot life (After induction time), min i) 27± 2 °C ii) 40± 2 °C	3 ½ hours 2 hrs.	Appendix -II
12.	Mass in Kg/10 litres, min	12.0	IS : 101-87 (Part 1/ Sec. 7)
13.	Keeping properties	Min 12 months	Appendix-III
14.	Theoretical spreading rate, min	8 Sq.m./lt. at 60 micron DFT	Appendix-I
15.	Viscosity (Efflux time by Ford cup No. 4) of paint i.e. mix of two components at 27± 2 °C in Supply condition	70 sec, max	IS : 101-89 (Part 1/ Sec. 5)

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TABLE 2
DETAILS OF PREPARING PAINTED PANELS FOR TESTING
POLYURETHANE SURFACER (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 (Applicable for panels either air dried or dried at elevated temperature)	Special instructions
1.	Drying time	M.S.	150X100X1.25	One coat of PU Surfacer (Two Pack)	60 microns	as per Chapter I, Para 3	-	-
2.	Finish	-do-	-do-	-do-	-do-	-do-	48 Hrs.	-
3.	Colour	-do-	-do-	-do-	-do-	-do-	24 Hrs.	-
4.	Dry film thickness	-do-	-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 1.0 Kg.
6.	Flexibility & Adhesion	-do-	-do-	-do-	-do-	-do-	-do-	-

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CHAPTER – V

SPECIFICATION FOR FULL GLOSS POLYURETHANE ENAMEL (TWO PACK)

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.

1.4 COMPONENT

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

2.1 PAINT

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

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 polyacrylate Polyol
- (ii) Appropriate pigments, solvents and additives

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

- (i) an aliphatic poly isocyanate
- (ii) Appropriate solvents

To determine whether the poly isocyanate is aliphatic or aromatic in nature, carry out tests in accordance with the procedure in Appendix- VII.

2.1.2 MIXING RATIO

The mixing ratio of the Component 'A' and Component 'B' shall be in ratio of 4:1 by volume, max.

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3.1 PROPERTIES

3.2 GENERAL

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

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

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

3.2.3 All tests shall be conducted at room temperature ($27 \pm 2^{\circ}\text{C}$) and a relative humidity of $65 \pm 5\%$ in a well-ventilated chamber free from draughts and dust.

3.2.4 The two components P.U. Finish Enamel (component 'A' & 'B'), along with thinner, shall be mixed in the 4:1 ratio 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°C). After thorough 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 spraying apparatus (as per Chapter I, Para 3).

3.2.5 The spray gun shall be thoroughly cleaned before use. It shall be fitted with the correct size of nozzle and air-cap. In case of airless **spray**, the **pressure ratio of air cylinder to hydraulic cylinder shall be adjusted in accordance with the viscosity of the material to be sprayed.** The pressure ratio 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 35 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.

3.2.6 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.

3.2.7 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.

4.1 PREPARATION OF PAINTED PANELS FOR TESTING

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

5.1 CONDITION IN CONTAINER

5.1.1 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 high speed stirrer for 10 minutes maximum, in order to give a homogeneous paint.

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**TABLE 1: REQUIREMENT FOR FULL GLOSS POLYURETHANE ENAMEL
(TWO PACK)**

S. No.	Characteristics	Requirements	Test Method
1.	Identification of polyisocyanates	Aliphatic poly isocyanate	See Appendix-VII
2.	Drying time a) Surface dry, max b) Hard dry, max c) Hard dry at 70° C	4 hrs. 8 hrs. 30 minutes, with 15 minutes flash off time	IS : 101-86 (Part 3 Sec. 1)
3.	Consistency	Smooth and uniform, and suitable for spray application(as per Chapter I, Para 3)	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	35 microns	IS : 101-89 (Part 3/ Sec. 2)By Elcometer
7.	Volume solids, % min	45.0	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° C Above 20° 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° C b) 40 ± 2° C	3 ½ hrs 2 Hrs	See Appendix-II
13.	Gloss at 60° angle of incidence, min	85 (for glossy finish)	IS : 101-88 (Part 4/Sec. 4) 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. 12 months	Appendix-III
16.	Theoretical spreading rate, min	12.0 Sq. m./lt. at 35 micron DFT	Appendix-I
17.	Unreacted monomer, % by mass, max	2.0	By Gas Chromatograph method in reference to ASTM D 4827 – 03
18.	% poly isocyanate by mass, in hardener	16.min.	Appendix-VIII

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TABLE 1
(Continued from pre page)

Sl. No.	Characteristics	Requirements		Test Method
19.	Viscosity (Efflux time by Ford cup No.4) of paint i.e. mix. Of two components at $27 \pm 2^{\circ}\text{C}$ in Supply condition	60 Sec, max		IS:101-89 (Part 1 / Sec.5)
20	Accelerated Tests (a) Resistance to 30% Sulphuric acid (weight by volume) Resistance to 20% caustic potash (weight by volume) Resistance to oil Resistance to solvents Resistance to water	The film shall not show any signs of blistering, wrinkling & lifting. Difference in gloss and colour between immersed & unimmersed area of painted panel shall be 70%, minimum and 7 out of 10 max. respectively -do- -do- -do- -do-		Appendix-V
21-	Durability Tests Accelerated weathering test	Rating scale Chalking Checking Cracking Flaking Spotting Blistering Corrosion Colour change Gloss	0-10 10 10 10 10 10 10 No corrosion 7 The film shall have a minimum gloss retention of 80% of its initial value at 60° angle of incidence	Appendix-VI
22	Humidity test.	No sign of corrosion & no sign of deterioration viz. blistering, detachment of film up to 500 hrs		IS: 101-88 (Part 6 /Sec. 1)
23	Abrasion resistance-1000 Cycle-	125 mg loss, max		As per ASTM D-4060

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**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 (Applicable for panels either air dried or dried at elevated temperature)	Special instructions
1.	Drying time	M.S.	150 x 100 x 1.25	One coat of PU enamel full gloss (2 component)	35 microns	as per Chapter I, Para 3	-	-
2.	Finish	-do-	-do-	-do-	-do-	-do-	48 hrs.	-
3.	Colour	-do-	-do-	-do-	-do-	-do-	24 hrs.	-
4.	Dry film thickness	-do-	-do-	-do-	-do-	-do-	-do-	-
5.	Scratch hardness	Tinned	150 x 50 x 0.315	-do-	-do-	-do-	7 days	Apply a load 1.5 Kg. Instead of 1.0 Kg
6.	Flexibility & Adhesion	-do-	-do-	-do-	-do-	-do-	-do-	-
7.	Gloss	M.S.	150 x 100 x 1.25	Double coat of PU enamel full gloss (2 component)	70 microns	-do-	24 hrs	-
8.	Accelerated tests (a) & (b)	-do-	150 x 100 x 1.25	Prepare and paint both sides of the panels as per Appendix-IV	Min. 190 microns	-do-	7 days	See Appendix-V
	Resistance to oil	Tinned	150 x 50 x 0.315	--do--	Min 190 microns	-do-	-do-	-do-
	Resistance to water	M.S	M.S	--do--	--do--	--do--	--do--	--do--
	(d) Resistance to solvents	M.S.	150 x 100 x 1.25	Prepare and paint only one side of the panels	Min. 190 microns	-do-	--do--	-do-
9.	Durability Test : (ii) Accelerated weathering test	M.S.	150X75 X1.25	Prepare and paint both sides of the panels as per Appendix-IV	Min190 microns	-do-	-do-	Appendix-VI
10.	Humidity Test	M.S	150 x 75 x 1.25	Prepare and paint both sides of the panels as per Appendix-IV	Min190 microns	-do-	-do-	See Appendix IV
11.	Abrasion resistance test	M.S	100 x 100 x 1.25 Centrally located hole of size as per specific design of the testing machine	Double coat of PU enamel full gloss (2 component)	Min 70 microns	-do-	-do-	-

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APPENDIX-I

PROCEDURE FOR DETERMINING VOLUME SOLIDS PERCENTAGE

1. SCOPE :

This method is applicable for determination of the volume solids percentage 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 metre 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°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:

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

- (v) Determine the weight of non volatile content of the liquid coating material by drying a known amount of paint at 105° 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

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- iv) 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.
- v) Dry the disc in an oven for 3 hours at 105°C and cool.
- vi) Weigh the coated disc in air. Let it be W_3 grams.
- vii) Suspend the coated disc in water and weigh again. Let it be W_4 grams.
- viii) Calculate the volume of the coated disc as follows :

$$V_1 = \frac{W_3 - W_4}{d} \text{ where } d \text{ is the density of the water at room temperature}$$

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

$$\text{Volume of dried coating } (V_d) = V_1 - V$$

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

$$V_w = \frac{W_3 - W_1}{W \times P} \text{ where } W = \text{grams of non volatile matter of 1 g of wet coating}$$

$$P = \text{specific gravity of the paint}$$

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

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

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:-

$$(a) \quad \frac{\% \text{ Volume solids}}{\text{Dry film thickness (microns)}} \times 10 = \text{Covering Capacity}$$

$$(b) \quad \frac{\text{Dry film thickness (microns)}}{\% \text{ Volume solid}} \times 100 = \text{wet film thickness (microns)}$$

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APPENDIX – II

PROCEDURE FOR DETERMINING OF POT LIFE

(AS PER U.S. DEPTT. OF TRANSPORT/FED. RAIL, ROAD ADMN. OFFICE OF SAFETY TEST METHOD 2.7.1)

Take the usable time as the pot life of paint. Condition the components of the coating for one hour at $27 \pm 2^{\circ}\text{C}$ and mix immediately in proper ratio to get approx. 200 ml. of paint in 250 ml. of container. The lid should be loosely placed on the container.

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

Near the end of the paint's working life, the viscosity builds-up rapidly. During this period, when it appears the paint 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 retained 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

PREPARATION OF TEST PANELS

1. In the painting procedure mentioned below, the air drying of the films shall be done at temperature of $27 \pm 2^{\circ}\text{C}$ and a relative humidity of $65 \pm 5^{\circ}\text{C}$
2. The surface of the test panels to be exposed shall be prepared as follows, taking care that total dry film thickness of the complete system shall be minimum 190 microns.
3. Apply one coat of Epoxy Zinc Phosphate primer by suitable spraying as per Chapter I, Para 3 conforming to this specification, and allow it to air dry for 24 Hrs.
4. Rub down lightly with waterproof emery paper No.280/320, wipe off the surface using a piece of clean and dry soft cloth and then apply one coat of P.U. surfacer by suitable spraying as per Chapter I, Para 3 conforming to this specification, and allow it to air dry for 24 hrs.

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5. Rub down, wet with waterproof emery paper No.280/320, wipe off the surface using a piece of clean and dry soft cloth and then apply one coat of P.U. Full Gloss Enamel by suitable spraying as per Chapter I, Para 3, conforming to this specification, and allow it to air dry for 24 hrs.
6. Rub down, wet with waterproof emery paper No.220, wash and wipe off water and when the surface is dry, apply a second coat of P.U. Full Gloss Enamel by suitable spraying, as per Chapter I, Para 3 conforming to this specification, and allow it to air dry for 07 days before subjecting to exposure test.

Note: The primer, surfacer and full gloss enamel shall be from the same supplier.

APPENDIX-V

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-IV 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 $\frac{3}{4}$ th of the panel in 30% Sulphuric Acid (W/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 Potash**
Immerse $\frac{3}{4}$ th of the panel in 20% Potassium Hydroxide (W/V) 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 $\frac{3}{4}$ th 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 oil (MTO) and allow to dry for 30 minutes and record the observation.
- d) **Resistance to Solvents**
Test on panel each for resistance to commercial grade xylene, ethanol and acetone respectively. Take 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 clean dry cotton and immediately record the observation.
- e) **Resistance to Water**
Immerse $\frac{3}{4}$ th of the panel in water for 240 hours. Remove the panel, wash in running fresh water and allow it to dry for an hour and record the observation.

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APPENDIX – VI

ACCELERATED TEST FOR DURABILITY

Both sides of the panels must be prepared and painted as per Appendix -IV and S.No.9 of Table 2: Details of preparing Painted Panels for Full Gloss P.U. Enamel (Two Pack).

a) ACCELERATED WEATHERING TEST

The test is performed according to DIN53387

Test Period : 1000 hours
 Apparatus : Weather-o-meter, Xenon Arc Lamp with rotating day/night device type
 Cycle : 3 Min. rainfall, 17 Min. dry period alternatively
 Light exposure : UVB 313 light exposure
 Temperature : 50°C

The requirements of this test shall be taken to have been satisfied if performance in respect of the characteristics as noted in Clause D-3.2 of IS : 8662-1993 (or corresponding clause of latest version) is within the limits.

ALTERNATE METHOD

The test may also be carried out as per ASTM-G-53

Test Period : 750 hours
 Apparatus : Operating Light and Water-Exposure Apparatus (Fluorescent UV-Condensation Type)
 Cycle : 4 Hrs. U.V. Light from UV-B lamps with a peak emission @ 313 n.m. and 4 hrs. condensation alternatively.
 Temperature : 50°C

The requirements of this test shall be taken to have been satisfied if performance in respect of the characteristics as noted in Clause D-3.2 of IS : 8662-1993(or corresponding clause of latest version) is within the limits.

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APPENDIX –VII

METHOD OF IDENTIFYING AROMATIC AND ALIPHATIC 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 is 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 show more or less marked yellowing from exposure to light and poor retention of gloss in outdoor 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% H₂O₂ solution in it.

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 colored liquids thus identifiable even without conducting the above tests. Whereas all the aliphatic isocyanates and some of the aromatic isocyanates are commercially marketed as clear water white liquids thus necessitating the above identification method to be conducted.

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APPENDIX – VIII

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:- If the polymer is insoluble, add 10 ml of dry, analytical grade acetone to the toluene.

- 1.3- Using a pipette, 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 bromophenol 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

0.0420 = mille equivalent weight of the NCO group, and

W = grams of specimen weight, g

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APPENDIX-IX

DETERMINATION OF STOPPING PROPERTIES

Outline of the method:

A mild steel panel is dented with a specified numbers of dents and then coated with epoxy based zinc phosphate primer followed by polyester based putty. It is then suitably examined at the dents for satisfactory Stopping properties.

Procedure:

Dent a 300 x 150 x0.9 mm mild steel plate with the help of blunt iron ball hammer and make 10 dents of about 3 mm diameter and 1 mm deep. The dents shall be so made that they are 50 mm away from the side of the panels and 50 mm apart from one another. Roughen the panel with emery paper no. 180. Wipe this with petroleum hydrocarbon solvent, 145/205 (low aromatic) (see IS: 1745- 1978) and allow to dry. Apply one coat of epoxy based zinc phosphate primer to produce minimum 60 microns DFT and air dry for 8 hrs, minimum. Make 3 applications of polyester based putty giving an interval of not less than 8hrs. and not more than 24 hrs. between successive applications, each having dry film thickness of 350 microns, minimum. Keep the panel vertically.

The material shall be deemed to have passed the test if there is no sagging after 2 hours, after every application at the dents, it works hard in 8 hours and shows no sign of crack or shrinkage after 18 hours.

APPENDIX-X

DETERMINATION OF RUBBING PROPERTIES

Outline of the Method:

The material in a specified film thickness is applied on a mild steel panel. The film when dry is tested for its rubbing properties by rubbing with abrasive paper.

PROCEDURE:

Take 300 x 150 x0.9 mm mild steel plate. Roughen the panel with emery paper no. 180. Wipe this with petroleum hydrocarbon solvent, 145/205 (low aromatic) (see IS: 1745- 1978) and allow to dry. Apply one coat of epoxy based zinc phosphate primer to produce minimum 60 microns DFT, air dry for 8 hrs, followed by one coat of polyester based putty having dry film thickness of 300 microns ,minimum.

The film prepared as above shall be suitable for dry rubbing with 150 grade paper and wet rubbing with 280 grade water proof abrasive paper without any clogging of the paper. After rubbing down, the surface shall not show defects like roughness, scratches, cracks, pin holes etc.. Minor pin holes or scratches which will duly be filled by subsequent coat of PU under coat paint shall not be the cause for rejection.

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APPENDIX-XI

DETERMINATION OF HOLD- OUT PROPERTY IN PAINT SYSTEM

1. Outline of method:

The material is tested in a painting system and schedule simulating actual use. Finish with uniformity of colour and gloss is taken as criteria for having passed the test.

2. Procedure:

A panel of 300 x 150 x 0.9 mm, mild steel with full paint system shall be prepared as described below:

a) Clean the surface either by shot or grit blast/ Phosphating / any appropriate chemical treatment/roughen the panel with emery paper no. 180 and wipe this with petroleum hydrocarbon solvent, 145/205 (low aromatic) (see IS: 1745- 1978) and allow to dry.

b) apply one coat of epoxy based zinc phosphate primer (two pack) , 60 microns, minimum DFT as per the specification and allow to air dry for 8 hours, minimum . Dry rub with emery paper no. 400 and wipe clean with a dry soft cloth.

c) Make 3 applications of polyester based putty with a suitable knife, each application having a dry film thickness of 350 microns, minimum , at an interval of not less than 8hrs. and not more than 24 hrs between successive applications. The overall dry film thickness of 3 applications shall be minimum 1000 microns. Allow the final coat to air dry for at least 8 hours and not more than 24 hours. Wet rub with 280 grade water proof abrasive paper and allow to dry.

d) apply one coat of polyurethane surfacer (two- pack) , 60 microns, minimum DFT , as per the specification. Allow to air dry for 8 hours, minimum. Dry rub with emery paper no. 400 and clean the surface .

e) apply two coats of full gloss polyurethane enamel (two-pack)of 35microns ,minimum DFT per coat, as per the specification at an interval of 8 hours, minimum between 1st and 2nd coat.. Allow to air dry for at least 48 hours before assessing the performance.

3. The material shall be deemed to have passed the test, if the resultant finish is uniform all over the surface with regard to gloss and colour. The gloss when measured shall have a value specified in the specification.

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APPENDIX-XII

DETERMINATION OF ADHESION AND COMPATIBILITY IN PAINT SYSTEM

1. Outline of method:

The material is tested in a painting system and schedule simulating actual use. Satisfactory adhesion and compatibility between the coats is taken as criteria for having passed the test.

3. Procedure:

A panel 300x150x0.9 mm, mild steel, with full paint system shall be prepared as described below:

a) Clean the surface either by shot or grit blast/ Phosphating / any appropriate chemical treatment/ roughen the panel with emery paper no. 180 and wipe this with petroleum hydrocarbon solvent, 145/205 (low aromatic) (see IS: 1745- 1978) and allow to dry.

b) Apply one coat of epoxy based zinc phosphate primer (two pack), 60 microns, minimum DFT as per the specification and allow to air dry for at least 8 hours, minimum. Dry rub with emery paper no. 400 and wipe clean with a dry soft cloth.

c) Make 3 applications of polyester based putty with a suitable knife, each application having a dry film thickness of 350 microns, minimum, at an interval of not less than 8hrs. and not more than 24 hrs between successive applications. The overall dry film thickness of 3 applications shall be minimum 1000 microns. Allow the final coat to air dry for at least 8 hours and not more than 24 hours. Wet rub with 280 grade water proof abrasive paper and allow to dry.

d) Spray apply one coat of polyurethane surfacer (two- pack), 60 microns, minimum DFT, as per the specification. Allow to air dry for 8 hours, minimum .Dry rub with emery paper no. 400 and clean the surface.

e) Apply two coats of full gloss polyurethane enamel (two-pack), minimum 40 microns DFT per coat, as per the specification at an interval of 8 hours, minimum between 1st and 2nd coat. Allow to air dry for at least 7 days before assessing the performance.

f) The material shall be deemed to have passed the test, if the material shows good adhesion over substrate and between various coats, and compatibility between primer, putty, surfacer and finish coat of the system.

This shall be assessed as per Test Method A- X Cut Tape Test of ASTM D 3359-09 and the acceptance level of the test shall be 5A of the specification.

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SN	Different Components of PU Paint to RDSO Specn No. M&C/PCN/100/2013	Quantity (in liters) per set for different types of Coaches							
		Conventional Coaches (with Aluminum Paint)	MEMU Driver Motor Coaches	LHB Type Power Car Coaches	LHB Type Rajdhani Coaches	Conventional Coaches (without Aluminum Paint)	MEMU Trailer Coaches	Parcel Van Coaches	LHB Type Shatabdi Coaches
	PU Based Top Coat Color Grey to RAL7001	-	-	72.00	47.00	-	-	-	-
	PU Based Top Coat Color Grey to RAL DS 240 60 05	-	-	-	-	-	-	-	60.00
	PU Based Top Coat (two packs) Color Satin Blue to RAL DS 240 6035	-	-	3.00	-	-	-	-	-
	PU Based Top Coat (two packs) Color Blue to RAL DS 260 6035	-	-	-	-	-	-	-	35.00
	PU Paint Off White to ICI Shade No. 28-1004	-	-	-	-	-	-	2.00	-
5.	Thinner for Epoxy Paint compatible with Epoxy Primer & Putty	20.00	20.00	40.00	40.00	20.00	20.00	20.00	40.00
6.	Thinner for PU Paint compatible with PU Top Coats	50.00	50.00	65.00	65.00	50.00	50.00	50.00	65.00

N.B.

“All the provisions contained in RDSO’s procedures laid down in Document No.QOD-7.1-11 dated 19.07.2016 (titled “vendor –changes in approved status”) and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.”

Ref.-MCM-1706	Page 34 of 34	Effective from January-2018	Specification No. M&C/PCN/100/2018
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Effective from 08.09.2016	Additional requirement of ISO provisions in all RDSO specifications of paint items appeared in vendor directory.
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RDSO AMENDMENT No.1B as an additional requirement as follows

“All the provisions contained in RDSO’s ISO procedures laid down in Document No.QO-D-7.1-11 dated 19.07.2016(titled “vendor –changes in approved status”) and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways” for the following RDSO specifications of paints:

1. Epoxy Cum Polyurethane Painting System (Two Pack) for the Exterior Painting of Railway Coaches, Diesel and Electric Locomotives and Other Industrial applications to RDSO Specification No. M&C/PCN/100/2013.
2. Paints based on
 - (a) Epoxy based Zinc Phosphate Primer (Two Pack) as per RDSO specification no. M&C/PCN/102/2009.
 - (b) Full Gloss Red-oxide Polyurethane Enamel (Two Pack) for Wagons, Bridges & Structures and other Industrial Applications as per RDSO Specification No. M&C/PCN/109/2009.
3. High Performance Anticorrosion Epoxy Coating (Two Pack) to RDSO Specification No. M&C/PCN/123/2012.
4. R/M Paint, Red-Oxide (ISC: 446), Brushing, Finishing, Glossy, for General Purposes (Version.0), Specification No.M&C/PCN/122/2006.
5. Enamel, Interior (a) Undercoating (b) Finishing with Fire Retardant Properties to Specn. No. M&C/PCN/120-05 (Reaffirmed 2011).

AED/M&C

(S.S.Sidar)
Dy. Director/M&C

This has been vetted by Law Officer and approved by DG/RDSO/Lucknow