# RDSO SPECIFICATION NO.
# M&C/PCN/110/2020
# (Rev 1.0)


# SPECIFICATION FOR POLYURETHANE BASED ALUMINIUM PAINT (THREE PACK)

## RESEARCH DESIGNS & STANDARDS ORGANISATION
## MANAK NAGAR, LUCKNOW – 226 011

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## SPECIFICATION FOR POLYURETHANE BASED ALUMINIUM PAINT(THREE PACK)

### 0. FOREWORD.

This standard was originally adopted in the year 1988. In this revision, requirements for Drying time, DFT, Flash point, Pot life, Keeping properties have been revised. The requirements for free isocyanate and percentage volume solids and test methods for free isocyanate group in urethane material and percentage volume solids have been incorporated. In place of viscosity, supply and spray viscosity of the paint has been introduced in the light of technological advancement & experience gathered. The test methods have been specified as per revised IS: 101.

### 1. SCOPE

1.1 This standard specifies requirements and methods of testing of **Aluminium Paint based on Polyurethane supplied in Three Packs** intended to be used as the protective and decorative finish particularly **where heat reflecting surface** is required.

**NOTE: "Firm should comply Make in India Policy and Public Procurement (Preference to Make in India) Order-2017 under this specification" and subsequent Amendment done time to time.**

### 2. TERMINOLOGY

2.1 For the purpose of this standard apart from the definition given in IS 1303 -1983, Reaffirmed 2017 or its latest version, the Glossary of Terms relating to paint and IS: 101 revised, Method of test for Ready Mixed paints and enamels shall apply.

#### 2.1.1 PACK

The term used to describe each of the Three Packs of the paint which when mixed together in the proportion recommended by the Manufacturer/Supplier forms Aluminium paint based on Polyurethane.

#### 2.1.2 PAINT

The mixture of Three Packs in the proportion recommended by the Manufacturer/Supplier.

### 3. REQUIREMENTS

3.1 The ingredients shall be provided in such a proportion that when mixed, the material shall contain not less than the equivalent of 15% by weight of Aluminium Powder. The remainder being medium and the Ready Mixed material shall contain not more than 50 % of volatile matter.

3.2 The paint shall consist essentially of Three Packs, namely pack A,B and C as given below :

**PACK A:** It shall consist of an appropriate Polyol with appropriate solvents and additives.

**PACK B:** Normally referred to as HARDENER or Catalyst shall consist of:
(i) an Aliphatic Poly Isocyanate
(ii) appropriate solvents and additives

**PACK C:** It shall consist of Aluminium in a suitable form which can be incorporated in Polyurethane medium to form a suitable paint.

## 4. PROPERTIES

### 4.1 GENERAL

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

4.1.1 Unless otherwise specified the following testing conditions shall apply:

4.1.1.1 The preparation of metal panel shall be in accordance with IS: 101-1986 (Part1/Sec3), Reaffirmed 2012 or its latest version.

4.1.1.2 All tests shall be conducted at room temperature $(27\pm2)^{o}$ C and Relative Humidity of (65±5) % in a well-ventilated chamber free from draughts and dusts.

4.1.1.3 The Three Pack Polyurethane Surfacer Pack shall be mixed in the ratio recommended by the Manufacturer/Supplier of the paint before conducting the test or tests.

4.1.1.4 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 35 microns minimum per coat.

### 4.2 PREPARATION OF PAINTED PANELS FOR TESTING

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

### 4.3 CONDITIONS IN CONTAINER

Each component(Pack A,B & C), 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 paint.

# TABLE-1:REQUIREMENTS FOR ALUMINIUM PAINT BASED ON POLYURETHANE (THREE PACK)

| SN | Characteristics | Requirements | Test Method |
|---|---|---|---|
| 1. | Drying Time<br>(a) Surface Dry, Max<br>(b) Hard Dry, Max<br>(c) Hard Dry at $70^0$ C, Max | <br>4 Hours<br>8 Hours<br>30 Minutes with 15min.flash off time | IS:101-86(Pt3-Sec1), Reaffirmed 2017 or its latest version |
| 2. | Consistency | Smooth, uniform and suitable for Brushing/Spraying | IS:101-89 (Pt1-Sec5), Reaffirmed 2019 or its latest version |
| 3. | Finish | Bright, lustrous & smooth | IS:101-87 (Pt3-Sec4), Reaffirmed 2019 or its latest version |
| 4. | Dry Film Thickness, per coat, Min. | 35 microns | IS:101-89 (Pt3-Sec2), Reaffirmed 2019 or its latest version / By Elcometer |
| 5. | Viscosity (Efflux time by Ford Cup No.4) of paint i.e. mix of three components ,<br>a) Supply<br>b) Spray | <br>20-40 seconds<br>20-25 seconds | IS:101-89(Pt1-Sec5), Reaffirmed 2019 or its latest version |
| 6. | Scratch Hardness (1.5 Kg.Load) | No such scratch so as to show bare metal | IS:101-88(Pt5-Sec2), Reaffirmed 2019 or its latest version |
| 7. | Flexibility & Adhesion (Mandrel size 6.25 mm) | No visible damage or detachment of film | IS:101-88(Pt5-Sec2), Reaffirmed 2019 or its latest version |
| 8. | Flash Point :<br>(a)Component"A"<br>(b)Component "B" | <br>Above $25^o$ C<br>Above $25^o$ C | IS:101-87 (Pt1-Sec6), Reaffirmed 2019 or its latest version |
| 9. | Protection against corrosion under conditions of condensation | No sign of corrosion within 500 hours | IS:101-87 (Pt6-Sec1), Reaffirmed 2015 or its latest version |
| 10. | Pot life, Min<br>a) 27± $2^0$C<br>b) 40± $2^0$C | <br>3 hours 30 min.<br>2 hours | **APPENDIX-A** |

| | | | |
|---|---|---|---|
| 11. | Mass in Kg./10 litres, Min | 9.00 | IS:101-87(Pt1-Sec7), Reaffirmed 2019 or its latest version |
| 12. | Keeping Properties | Not less than 12 months | IS:101-89 (Pt6-Sec2), Reaffirmed 2019 or its latest version |
| 13. | Resistance to oil | Shall not show any sign of blistering wrinkling or lifting | **APPENDIX-B** |
| 14. | Identification of Polyisocyanates | Aliphatic Polyisocyanate | **APPENDIX-C** |
| 15. | Pigment Content,% by mass, Min | 15.0 | IS:101-90(Pt1-Sec7), Reaffirmed 2019 or its latest version |
| 16 | Unreacted Monomer, % by Mass | 2.0 | **APPENDIX-D** |
| 17. | Volume Solids,%, Min | 40.0 | **APPENDIX-E** |

## TABLE-2: DETAILS OF PREPARING PAINTED PANELS FOR ALUMINIUM PAINT BASED ON POLYURETHANE (THREE PACK)

| SN | Test | Type of Metal Panel | Size in mm | Painting detail | DFT (microns) min. | Method of application | Duration of Air drying before commencement of test | Special Instruction |
|---|---|---|---|---|---|---|---|---|
| 1. | Drying time | M.S. | 150x 100x 1.25 | Three components , P.U Al paint | 35 | Air/ Air less Spray | - | - |
| 2. | Finish | -do- | -do- | -do- | -do- | -do- | 24 hrs. | - |
| 3. | Dry Film Thickness | -do- | -do- | -do- | -- | -do- | -do- | - |
| 4.. | Scratch Hardness | Tinned | 150x 50x 0.315 | -do- | 35 | -do- | 7 days | Apply a load 1.5 kg instead of 1.0 kg. |
| 5. | Flexibility & Adhesion | -do- | -do- | -do- | -do- | -do- | -do- | -- |
| 6. | Resistance to Oil | -do-. | -do- | -do-. | -do- | -do- | -do-. | Prepare and paint both sides of the panels and seal the edges of the panel with wax. |
| 7. | Protection against corrosion under conditions of condensation | MS | 150x 100x 1.25 | -do- | -do- | -do- | -do- | -do- |

## APPENDIX-A

### PROCEDURE FOR DETERMINING THE 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± $2^0$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.

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## APPENDIX-B

### Resistance to Oil Test

Prepare the panel as per Sl No. 6 of TABLE 2. Immerse ¾th of the panel in a mineral lubricating oil (As mentioned in Clause 19.1 of IS: 101(relevant part/section)-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.

## APPENDIX–C

### 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 in found both with the mono and Poly Isocyanates 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 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% Hydrogen Peroxide Solution in Acetone.

**RESULTS**

Aliphatic Polyisocyanates show no discoloration at all. Aromatic Poly Isocyanates 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 Isocyanates are commercially marketed as clear water white liquids thus necessitating the above identification method to be conducted.

**APPENDIX–D**

**Standard Test Method for Isocyanate Groups in Urethane Materials or Prepolymers**

**1.0 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 made 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.

**2.0 Calculations**

**2.1** Calculate the NCO content as follows:

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

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= milli equivalent weight of the NCO group, and
W = grams of specimen weight, g.

**APPENDIX–E**

**PROCEDURE FOR DETEMINING 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:

$$V = \frac{W1 - W2}{d}$$ 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° C for 3 hours. Let it be W gms.

(vi) Determine the specific gravity ofthe 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°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 (Vd) = V1 - V

(xiii) Calculate the volume of wet coating as follows:

$$V_w = \frac{W3 - W1}{W \times P}$$

where W = grams of non volatile matter in 1.0 gm paint.
P = specific gravity of the paint.

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

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

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

(a) $$\frac{\% \text{ Volume solids}}{\text{Dry film thickness (microns)}} \times 10 = \text{Covering Capacity (sq.m/l)}$$

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