Procedure for PU Painting

IRCAMTECH/MECH/GWL/Painting/ICF/1.0
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Preface

Indian Railways have adopted Epoxy cum Polyurethane painting system for exterior painting of railway coaches, diesel, electric locomotives etc.

Painting of coaches and its components is an important measure to prevent corrosion in Coaches. Painting of coaches prevent the surface from atmospheric effects i.e. corrosion. It also reduce wear-tear of surface and also from harmful insects. Painting produces an aesthetic look of coaches and increase life of coaches.

CAMTECH has described Procedure for PU Painting in this handbook. It will be helpful improve knowledge of maintenance staff in Workshops about correct procedure and usefulness of PU Painting in Coaches.

It is clarified that this handbook does not supersede any existing provisions laid down by Railway Board/ Zonal Railways. This handbook is for guidance only and it is not a statutory document.

I am thankful to all field personnel who have helped us in preparing this handbook.

Technological up-gradation & learning is a continuous process. Hence feel free to write to us for any addition or modification in this report. We shall highly appreciate your contribution in this direction.

(K.P.Yadav)
Director/Mechanical
CAMTECH/GWL
INDEX

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td></td>
<td>01</td>
</tr>
<tr>
<td>1</td>
<td>Polyurethane Paint (PU Paint)</td>
<td>03</td>
</tr>
<tr>
<td>2</td>
<td>Advantages of PU paint</td>
<td>04</td>
</tr>
<tr>
<td>3</td>
<td>Abstract recommendations by Railway board committee for PU Painting</td>
<td>04</td>
</tr>
<tr>
<td>4</td>
<td>Procedure for Exterior PU Painting of coaches.</td>
<td>07</td>
</tr>
<tr>
<td>5</td>
<td>Paint System</td>
<td>07</td>
</tr>
<tr>
<td>6</td>
<td>Paint Schedule</td>
<td>08</td>
</tr>
<tr>
<td>7</td>
<td>Touch up Painting of coaches Already Painted with Paints</td>
<td>09</td>
</tr>
<tr>
<td>8</td>
<td>PU Coat</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>Repainting of Coaches</td>
<td>13</td>
</tr>
<tr>
<td>10</td>
<td>Infrastructural facilities required for PU Painting</td>
<td>18</td>
</tr>
<tr>
<td>11</td>
<td>Specifications for EPOXY cum Polyurethane Painting system (Two Pack) for the Exterior Painting of Railway Coaches</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>(a) PU Surfacer</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>(b) Epoxy Zinc Phosphate primer</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>(c) Unsaturated Polyester Putty</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>(d) PU Surfacer</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>(e) PU Surfacer- PU full gloss Enable (two pack)</td>
<td>24</td>
</tr>
<tr>
<td>12</td>
<td>Procedure in detail in PU painting in ICF/RCF</td>
<td>26</td>
</tr>
</tbody>
</table>

:edure for Painting of ICF Coaches/2
### Coaches

- **A.** Cleaning of incoming coaches
- **B.** Cleaning of Panel
- **C.** Cleaning of under frame & Bogie
- **D.** First day schedule
- **E.** Second day schedule
- **F.** Third day Schedule
- **G.** Fourth day schedule
- **H.** Fifth day schedule
- **I.** Sixth day schedule
- **J.** Seven day schedule
- **K.** Eight day schedule
- **L.** Ninth day schedule

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Defects in painting of coaches</td>
</tr>
<tr>
<td>14</td>
<td>Quality assessment tools for painting</td>
</tr>
<tr>
<td>15</td>
<td>Hazardous in application of Painting in coaches</td>
</tr>
<tr>
<td>16</td>
<td>Safety Precautions for painting</td>
</tr>
<tr>
<td>17</td>
<td>Paint Equipments</td>
</tr>
<tr>
<td></td>
<td>1. For Spray Painting</td>
</tr>
<tr>
<td></td>
<td>2. For Touch up</td>
</tr>
<tr>
<td>18</td>
<td>Proposed Infrastructural Facilities in Workshops for PU Painting</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
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<td>27</td>
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<td>27</td>
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<td>32</td>
<td></td>
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<tr>
<td>36</td>
<td></td>
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<tr>
<td>38</td>
<td></td>
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<tr>
<td>39</td>
<td></td>
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<td>42</td>
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<tr>
<td>42</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>
1. Polyurethane Paint (PU Paint):

Polyurethane is a polymer composed of a chain of organic units joined by carbonate (urethane) links. While most polyurethanes are thermosetting polymers that do not melt when heated.

**Two-pack paint based on polyurethane substances**

- Polyurethane paint provides a hard, durable gloss for applied to almost any surface.
- There are several types of polyurethane paints, and several ways to apply them.
- The size of the product and the expected use will determine the best type of finish and method of application.
- We can choose from a simple spray, to an extremely durable and high-gloss, two-part polyurethane paint.

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 physio-chemical requirements of epoxy cum Polyurethane system.
2. **Advantages of PU Paint:**

- Polyurethane is a plastic-based resin, and it's available in satin, semi-gloss and high-gloss finishes.
- It can be applied to most types of plastic, fiberglass, wood, metal and fabrics.
- The most valuable feature of polyurethane paints, apart from a flawless, glossy finish, is resistance to water and chemicals, including gasoline.
- It is high in solids, making it slow to dry, but creating a thick, durable film.
- Thin film - Conventional or airless spray.

3. **Abstracts of recommendations by Railway Board Committee for PU Painting:**

(Ref: RB L. NO. No.2011/M (M&P)/1063/51 Dated: 03.03.2011)

1. Since PU Epoxy Painted coaches are well protected initially and extremely. Those will not required removal of paint Up to bare metal in POH Workshop They removal of old PU Paint prior to repainting can be done by rubbing with emery paper/ grinding.

2. Since exterior painting using alkyd paint will phase out in near further the surface preparation for the ‘A’ schedule painting for application of alkyd paint may be continued as per the existing practice without the need of shot blasting. The shot/sand blasting facilities with proper control of air pollution are, however, necessary for cleaning of the coach component like bogies bogie brake beams, helical springs
etc. Therefore, the committee recommends shot/sand blasting facilities in coaching workshops for those components where the maintenance and use of the same can be outsourced.

3. The sort/ grit blasting facilities are recommended for all manufacturing unit and mid life rehabilitation (MLR coaches).

4. Air and Airless Spray painting on coaches in workshop should be done in properly design in painting both with drying oven.

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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Painting operation</th>
<th>Description of paint</th>
<th>Method of Application</th>
<th>Chapter of Specification No. M&amp;C/PCN/100/2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Priming</td>
<td>Epoxy Zinc Phosphate primer</td>
<td>Airless spray</td>
<td>Chapter-II</td>
</tr>
<tr>
<td>2</td>
<td>Putty</td>
<td>Unsaturated Polyester Putty</td>
<td>By Knife/Spatula</td>
<td>Chapter-III</td>
</tr>
<tr>
<td>3</td>
<td>Surfacer</td>
<td>PU Surfacer</td>
<td>Airless Spray</td>
<td>Chapter-IV</td>
</tr>
<tr>
<td>4</td>
<td>Finishing</td>
<td>PU Full Gloss enamel</td>
<td>-do-</td>
<td>Chapter-V</td>
</tr>
</tbody>
</table>
4. Procedure for exterior PU painting of coaches

This procedure covers PU painting as applicable to Sidewalls and End walls of all BG passenger coaches inclusive of LHB coaches MEMs, EMUs and DEMUs previously painted with either Polyurethane (PU) base Paint system or Alkyd Paints.

Railway Board vide their letter no. 89/M(C)/137/22/Vol.III dated 03.01.2014 have communicated approval of Board (MM) of the report of committee regarding review of the requirement of Shot/Grit/Sand blasting plants in coaching workshops over Indian Railways (IR) and advised RDSO to review the ‘Procedure for PU Painting of Coaches in Railway workshops’ issued to Railways vide RDSO letters no. MC/Paints dated 03.08.2007 & 07.03.2011.

Carriage Directorate/RDSO has reviewed the existing ‘Procedure for PU painting of Coaches in Railway Workshop’ issued to railways vide this office letters no. MC/Paints dated 03.08.2007 & 07.03.2011 after considering report of the committee regarding review of requirement of Shot/Grit/Sand blasting plants in coaching workshops. Finalized revised ‘Procedure for PU Painting of Coaches in Railway workshops’ is as below.

5. Paint System:

Presently, for painting of coaches in Production Units (PUs) only Poly Urethane (PU) paints are used. In newly built coaches, the paint system used in painting at Pus shall be
marked on top of the End Wall of each coach, similarly, workshops shall also mark “PU Paint” or “Alkyd Paint” at the above location along with the date & year of painting.


The paints used for lettering/stencilling work shall be the finishing paint as per RDSO Spec. No. M&C/PCN100/2009.

6. Paint Schedule

The painting of the coaches in the Railway Workshops should be done as per schedule below. The PU painted coaches should be taken up for repairing as per the following schedules:

- Touch up painting for minor damages (as per clause 3.1).
- Complete PU Top coat as per clause 3.2 after every 3 years or earlier if the condition so warrants or on condition basis depicted below:
  i) If the gloss retention of the coach comes down to 60% of the initial gloss
  ii) If coach has undergone heavy corrosion repair.
  iii) If coach has undergone refurbishment in workshop.
  iv) If damaged paint surface area is up to 25% on account of flaking, peeling off, mechanical damage etc.
- Complete repainting by exposing the metal surface (as per clause 3.3) as a part of mid-life repairs or on condition basis i.e. more than 25% surface area of paint coating of exterior surface of coach has affected by flaking, peeling, blistering, corrosion or mechanical damages which can not be touched up properly to produce uniform and even finish.
Coaches painted with Alkyd paints shall not be taken up for complete PU painting in workshops as there population is declining. With this in background it is recommended to done away with the provision of shot blasting in workshops. Under these circumstances, ICF design coaches already painted with Alkyd paints shall be painted with Alkyd paints till taken up MLR or until completion of their residual life.

In case, coaches which are having Alkyd paint systems and are taken up for repainting with PU paint systems should be painted as per the procedure for complete repainting with exposure of bare metal as laid down in clause 3.3.1. Since, the Alkyd based primer and under coats are chemically and mechanically different, there is need to remove the old paints. The old Alkyd paints can be removed by grinding or rubbing with emery paper or process similar to followed in Paint Schedule ‘A’ painting of coaches applied with Alkyd paint systems followed by application of the PU paint systems.

7. **Touch up painting of coaches (already painted with PU paints)**:

   For Coaches already painted with PU paints, if the condition of the coach is
   Such that it has scratches or minor damages at scattered locations, the Touch up schedule given below should be followed:

   1. Clean the affected area on the coach with 10% solution of Sodium Hydroxide (NaOH) and then with 5 % solution of Phosphoric acid (H₃ PO₄ ) with water wash in between. Then wash with clean to remove residual acid.
   2. Rub down the affected portion with Silicon Carbide-150 Emery paper & clean with water.
3. If bare metal is visible on damaged portion, touch up with Epoxy Zinc Phosphate Primer to Chapter-II of RDSO specification No. M&C/PCN/100/2009 by brush/spray so as to get Dry Film Thickness (DFT) 60 microns (minimum) and allow to hard dry.


5. Apply PU Surface to Chapter-IV of RDSO M&C/PCN/100/2009 by brush/spray and allow it become hard dry. Slightly wet rub down with silicon Carbide-220 Emery Paper so as to get Dry film Thickness (DFT) 60 microns (minimum).

6. Apply PU Top Coat to Chapter-V of RDSO Spec. No. M&C/PCN/100/2009 to the affected area by airless spray so as to get Dry Film Thickness 9DFT) 35 microns (minimum). Additional coat may be applied to get the desired surface finish & gloss value, if required. Allow it to become hard dry. If the area of touch up painting is small then the top coat can be applied by brush. However, DFT of 35 microns (minimum) should be ensured.

7. Overall level of surface should not less than or more than the previously painted neighbouring area. Overall level of the surface shall match with neighbouring area.

8. In case the cumulative affected area is quite large or there are many areas that require touch up then a coat of PU Top Coat Chapter-V of RDSO no. M&C/PCN/100/2009 to a DFT of 35 microns (minimum) shall be applied on the full coach using airless spray. However, if affected area is small, application of PU paints by brush can be done in workshops (other than MLR workshops).

9. The coach shall be subjected to force curing in an oven after stage 3, 5 and 6 or 8 as per requirements. Forced curing after the stage 3,5, and 6 or 8 may be carried out for a period of 30 minutes at 70ºC with a flash off time of 15 minutes and with circulating heat and the doors and windows tightly closed. The
coach shall be subjected to force curing in an oven after the stage 4 as per requirement. For oven curing, forced curing after stage 4 shall be carried out for a period of 2 hours at 70ºC with a flash off time of 15 minutes and with circulating heat and the doors and windows tightly closed. The coach shall be subjected to forced curing in an oven after the stage 4 shall be carried out for a period of 2 hours at 70ºC with a flash off time of 30 minutes and with circulating heat and the doors and windows tightly closed. Under no circumstances direct heating should be resorted to as these are also furnished coaches. Prior to forced curing the painted surface shall be allowed to be air dry for 15 minutes (minimum), alternatively, normal curing at ambient temperature may not have any adverse effect on the life/quality of PU painted coaches provided sufficient time is allowed for full curing of the system. However, the drying time for Epoxy Zinc Phosphate Primer, Unsaturated Polyester Putty, PU Surfacer and PU Top Coat specified below:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Items as per RDSO Spec. No. M&amp;C/PCN/100/2009</th>
<th>Drying Time at 27±5 RH as per IS: 101, Part-3, Sec.1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Surface</td>
</tr>
<tr>
<td>1.</td>
<td>Epoxy Zinc Phosphate Primer</td>
<td>3 Hrs. (max.)</td>
</tr>
<tr>
<td>2.</td>
<td>Unsaturated Polyester Putty</td>
<td>2 Hrs. (max.)</td>
</tr>
<tr>
<td>3.</td>
<td>PU Surfacer</td>
<td>4 Hrs. (max.)</td>
</tr>
<tr>
<td>4.</td>
<td>PU Top Coat</td>
<td>4 Hrs. (max)</td>
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</table>
However, the actual timer for normal curing is to be decided based on ambient temperature and climatic conditions of the place.

8. **PU top coat:**

1. The coach should be washed thoroughly with soap and water and allowed to dry.
2. Rub down glaze coat and finish coat with silicon Carbide-150 Emery Paper & clean with water and allow it to dry.
4. Apply PU Surfacer to Chapter-IV of RDSO Spec. No. M&C/PCN/100/2009 by brush/spray and allow it become hard dry at locations exposed to bare metal due to flaking, peeling, blistering, corrosion or mechanical damages of paint coating.
5. To retain proper gloss value up to the service life of the paint system, apply one coat of PU Top Coat to Chapter-V of RDSO Spec. M&C/PCN/100/2009 on the whole surface by airless spray so as to get DFT of 35 microns(minimum). Additional coat may be applied to get the desired surface finish & gloss value, If required. Allow it to become hard dry.
6. The coach shall be subjected to forced curing in an oven after application of PU Surfacer and PU top coat as per requirements. Forced curing should be carried out for a period of 30 minutes at 70°C with a flash off time of 15 minutes and with circulating heat and the doors and windows tightly closed. Under no circumstances direct heating should be resorted to as these are also furnished coaches. Prior to forced curing the painted surface shall be allowed to be air dry for 15 minutes.
(minimum). Alternatively, normal curing at ambient temperature may not have any adverse effect on the life/quality of PU painted coaches provided sufficient time is allowed for full curing of the system. However, the drying time for Epoxy Zinc Phosphate Primer, Unsaturated Polyester Putty, PU surface and PU Top Coat has been mentioned in Para (9) of Clause 3.1.

7. Do lettering/stencilling work on side wall, end wall, under gear and other miscellaneous work like cleaning windows, glasses etc.

9. Repainting of Coaches:

(a) Repainting of coaches already painted with alkyd paints in other than mid-life rehabilitation (MLR):

This Railway coaches manufactured by production units are well protected from corrosion on their exterior and interior surfaces using PU/Epoxy and Epoxy Paint Systems respectively where the primer and under coats are expected to remain adhered to the steel surface up to mid-life of coaches. Therefore, these coaches do not require paint removal up to bare metal for repainting in workshops. Do not carry out complete repainting of the due MLR coaches either applied with Alkyd paint systems or PU paint systems in workshops.

1. Remove complete old Alkyd paint system to achieve desired surface finish. The old Alkyd paint can be removed by adding/wire brush or rubbing with rubbing with Emery paper or process similar to followed in Paint Schedule ‘A’ Painting of coaches applied with Alkyd paint systems. Ensure that no stains or fingerprints/marks remain on the surface.
2. Mask windows with tape or paper, which can withstand the temperature in the oven.

3. Apply one coat of Epoxy Zinc Phosphate Primer to Chapter-II of RDSO Spec. No. M&C/pcn/100/2009 by airless spray so as to get Dry film Thickness (DFT) of 60 micron (minimum). Allow it to become hard dry. DFT specified may be achieved by applying wet on wet coat if it is not possible to achieve the same in one coat.


5. Apply 1st coat of Unsaturated Polyester Putty to Chapter-III of RDSO Spec. No. M&C/PCN/100/2009 by touching knife to get DFT up to 300 microns. Allow it to become hard dry.

6. Wet cutting of Polyester Putty with Silicon Carbide-220 Emery Paper and air dry to make it free from moisture.


8. Wet cutting of Polyester Putty with Silicon Carbide-220 Emery Paper. Air dry to make it free from moisture. Apply necessary Polyester Putty wherever required. Wet rub down of Polyester Putty and then clean with cloth and air dry to make it free from moisture.

10. Apply PU Top Coat to Chapter-V of RDSO Spec. No. M&C/PCN/100/2009 on whole surface by airless spray so as to get DFT of 35 micron (minimum). Additional coat may be applied to get the desired surface finish & gloss value, if required. Allow it to become hard dry.

11. The coach shall be subjected to force curing in an oven after stage 3, 9 & 10 as per requirements. Forced curing after the stage 3, 9 & 10 should be carried out for a period of 30 minutes at 70°C with a flash off time of 15 minutes and with circulating heat and doors and windows tightly closed. The coach shall be subjected to forced curing in an oven after stage 5, 7 and 8 as per requirement. Forced curing after the stage 5, 7 and 8 should be carried out for a period of 2 hours at 70°C with a flash off time of 30 minutes and with circulating heat and the doors and windows tightly closed. Under no circumstances direct heating should be resorted to as these are also furnished coaches. Prior to forced curing the painted surface shall be allowed to be air dry for 15 minutes (minimum). Alternatively, normal curing at ambient temperature may not have any adverse effect on the life/quality of PU painted coaches provided sufficient time is allowed for full curing of the system. However, the drying time for Epoxy Zinc Phosphate Primer, Unsaturated Polyester Putty, PU Surfacer and PU Top Coat has been mentioned in Para (9) 0f Clause 3.1.
12. Do lettering/stencilling work on side wall, end wall, under gear and other miscellaneous works like cleaning windows, glasses etc.

(b) Repainting of coaches in mid-life rehabilitation (MLR):

For repainting of coaches as a part of mid-life repairs as per Clause -3.3, the following schedule should be followed:

1. Remove Complete old paint film on exterior and interior of the coaches by shot/Grit/Sand blasting in a suitable Shot/Grit/Sand blasting booth to expose bare metal surface to achieve a surface finish to Sa2\(^{1/2}\) as per ISO 850 1-1-1. Clean with wire brush. Ensure that no stains or finger prints/marks remain on the surface. Moreover, shot/Grit/Sand blasting facilities are necessary for cleaning of the coach component like bogie frame, brake beams, helical springs etc. Subsequent procedure repainting of coaches in MLR.

2. Mask windows with tape or paper, which can withstand the temperature in the oven.

3. Apply one coat of Epoxy Zinc Phosphate Primer to Chapter-II of RDSO Spec. No. M&C/PCN/100/2009 by airless spray so as to get Dry Film Thickness (DFT) of 60 micron (minimum). Allow it to become hard dry. DFT specified may be achieved by applying...
wet on wet coat if it is not possible to achieve the same in one coat.


6. Wet cutting of Polyester putty with silicon Carbide-220 Emery paper and air dry to make it free from moisture.


8. Wet cutting of Polyester Putty with silicon carbide-220 emery paper. Air dry to make it free from moisture. Apply necessary polyester putty wherever required. Wet rub down of Polyester putty and then clean with cloth and air dry to make it free from moisture.

surface with a soft cotton cloth and dry to make it free from moisture.

10. Apply PU top coat to Chapter-V of RDSO Spec. No. M&C/PCN/100/2009 on whole surface by airless spray so as to get DFT of 35 micron (minimum). Additional coat may be applied to get the desired surface finish & gloss value, if required.

11. The coach shall be subjected to force curing in an oven after stage 3, 9 & 10 as per requirement. Forced curing after the stage 3, 9 & 10 should be carried out for a period of 30 minutes at 70°C with a flash off time of 15 minutes and with circulating heat and doors and windows tightly closed. The coach shall be subjected to forced curing in an oven after stage 5, 7 and 8 as per requirement. Forced curing after the stage 5, 7 and 8 should be carried out for a period of 2 hours at 70°C with a flash off time of 30 minutes and with circulating heat and the doors and windows tightly closed. Under no circumstances direct heating should be resorted to as these are also furnished coaches. Prior to forced curing the painted surface shall be allowed to be air dry for 15 minutes (minimum). Alternatively, normal curing at ambient temperature may not have any adverse effect on the life/quality of PU painted coaches provided sufficient time is allowed for full curing of the system. However, the drying time for Epoxy Zinc Phosphate Primer, Unsaturated Polyester Putty, PU Surfacer and PU Top Coat has been mentioned in Para (9) of Clause 7.
12. Do lettering/stencilling work on side wall, end wall, under gear and other miscellaneous works like cleaning windows, glasses etc.

10. **Infrastructural facilities required for pu painting:**

1. Emery paper/Grinding facility/Pneumatic orbital sanders.

2. Shot/Grit/sand blasting booth for MLR workshops only.

3. Painting of coaches in coaching workshops is normally done by air or air-less spray methods. Therefore, for better productivity and quality of paints and in keeping with the recommendations of the committee, all the coaching workshops should be equipped with paint booths along with all facilities to control air pollution and protection of workman doing the painting operations. Painting booth shall be of one coach length with complete accessories consisting of the following:

   - Airless spray painting unit, air supply unit exhaust arrangement and automatic desludging system.
   - A full-fledged Effluent treatment plant (ETP) with neutralizer, clarifier, settling tanks, filter press etc.
   - Dedicated Compressor with sufficient capacity with air dryer for maintaining continuous supply of compressed air for operating the paint booth.
   - Winches for movement of coach in and out of the booth during different stages of painting.

4. For better productivity and quality of paint coatings and in keeping with the recommendations of the committee,
banking oven for forced curing the paint coatings with suitable temperature-range. Banking ovens are suitably designed to handle furnished coaches.

5. Fire fighting equipments to be installed in the paint shed, near the paint booth and oven.

6. Paint/putty mixing/grinding machines, material handling trolley and ladies.


8. Personnel protective Equipments (PPEs) such as nose masks, goggles, gloves, gum boots etc.

9. Quality measuring equipments for painted coach, such as:
   - Surface roughness profile measuring equipment (as per ISO 8501-1).
   - Ford cup No. 4 (for measuring viscosity).
   - Gloss meter (for measuring gloss value).
   - Alco meter (for DFT measurement).
   - Shade card.
   - Ladders.
   - Safety equipments.

11. Specification for epoxy cum polyurethane painting system (two pack) for the exterior painting of railway coaches:

**PU Surfacer:**
   (a) **PU Full Gloss Enamel (Two Pack)**:
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Painting operation</th>
<th>Description of paint</th>
<th>Method of Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Priming</td>
<td>Epoxy Zinc Phosphate primer</td>
<td>Airless spray</td>
</tr>
<tr>
<td>2</td>
<td>Putty</td>
<td>Unsaturated Polyester Putty</td>
<td>By Knife/ Spatula</td>
</tr>
<tr>
<td>3</td>
<td>Surfacer</td>
<td>PU Surfacer</td>
<td>Airless Spray</td>
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<tr>
<td>4</td>
<td>Finishing</td>
<td>PU Full Gloss enamel</td>
<td>-do-</td>
</tr>
</tbody>
</table>

(b) Epoxy Zinc Phosphate primer:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Drying time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Surface Dry, max</td>
<td>3 hours</td>
</tr>
<tr>
<td></td>
<td>b) Hard Dry, max</td>
<td>8 hours</td>
</tr>
<tr>
<td></td>
<td>c) Hard Dry at 70°C, max</td>
<td>30 minutes, with 15 minutes flash off time</td>
</tr>
<tr>
<td>2.</td>
<td>Consistency</td>
<td>Smooth and uniform, suitable for brush/spray application</td>
</tr>
<tr>
<td>3.</td>
<td>Finish</td>
<td>Smooth and matt to egg shell flat</td>
</tr>
<tr>
<td>4.</td>
<td>Colour</td>
<td>Self standard Red Oxide or Grey</td>
</tr>
<tr>
<td>5.</td>
<td>Dry film thickness/Per coat, min.</td>
<td>60 microns</td>
</tr>
<tr>
<td>6.</td>
<td>Volume solids, %, min</td>
<td>50.0</td>
</tr>
<tr>
<td>7.</td>
<td>Scratch hardness (1.5 Kg LOAD)</td>
<td>No such scratch so as to show base metal</td>
</tr>
<tr>
<td>8.</td>
<td>Flexibility &amp; Adhesion (6.25mm mandrel)</td>
<td>No visible damage or detachment of film</td>
</tr>
</tbody>
</table>
9. Flash Point
   (a) Component A
   (b) Component B
   Above 20°C
   Above 20°C

10. Resistance to salt spray
    No sign of corrosion & no sign of deterioration viz. blistering, detachment of film up to 500 hrs.

11. Protection against corrosion under condition of condensation.
    -do-

12. Keeping Properties for both the packs
    Min. 12 months

13. Mass in Kg/10 litres,
    12.5-14.5

14. Pot life(After induction time) at i) 27 ± 2°C, min
    ii) 40 ± 2°C, min
    3 hours 30 minutes
    2 hours

15. Theoretical Spreading Capacity, min
    8 Sq.m/ lt., at 60 microns DFT

16. Fineness of grind
    20-30 microns

17. Viscosity(Efflux time by Ford cup No. 4 of paint i.e. mixture of two components at 27± 2°C in Supply condition.)
    70 sec, max

(c) Unsaturated Polyester Putty:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

:edure for Painting of ICF Coaches/22
1. Drying time  
   a) Surface dry, max.  
   b) Hard dry, max.  
   c) Hard dry time at 70°C, max.  
   | 2 hours  
   | 8 hours  
   | 2 hours, with 30 minutes flash off time

2. Consistency  
   Smooth and uniform and suitable for knife application

3. Stopping properties  
   Shall show no sagging, cracking or shrinkage

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.

5. Hold out Property  
   Finish with uniform gloss and colour

6. Adhesion & Compatibility of Paint System  
   Good adhesion and compatibility of the paint system

7. Pot life, at 27 ± 2°C, min  
   30 minutes

8. % solids, min  
   85

9. Keeping properties  
   Not less than twelve months

---

**(d) PU Surfacer:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

2. **Consistency**  
   Smooth and uniform, and suitable for spray application (as per Chapter I, Para 3)

3. **Finish**  
   Smooth and Matt to egg shell flat

4. **Colour**  
   Self standard grey

5. **Dry film thickness, min**  
   60 microns

6. **Volume solids, % min**  
   50.0

7. **Scratch hardness (1.5 Kg Load)**  
   No such scratch so as to show base metal

8. **Flexibility & Adhesion**  
   No visible damage or detachment of film

9. **Flash point**  
   a) Component ‘A’  
   b) Component ‘B’  
   
   Above 200°C

10. **Fineness of Grind**  
    20-30 microns

11. **Pot life (After induction time), min**  
    i) 27± 2°C  
    ii) 40± 2°C  
    
    3 ½ hours  
    2 hrs.

12. **Mass in Kg/10 litres, min**  
    12.0

13. **Keeping properties**  
    Min 12 months

14. **Theoretical spreading rate, min**  
    8 Sq.m./lt. at 60 micron DFT

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

---

(e) **PU Full Gloss Enamel (Two Pack)** :

:edure for Painting of ICF Coaches/24
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Identification of polyisocyanate</td>
<td>Aliphatic poly isocyanate</td>
</tr>
<tr>
<td>2.</td>
<td>Drying time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Surface dry, max</td>
<td>4 hrs.</td>
</tr>
<tr>
<td></td>
<td>b) Hard dry, max</td>
<td>8 hrs.</td>
</tr>
<tr>
<td></td>
<td>c) Hard dry at 70°C</td>
<td>30 minutes, with 15 minutes flash off time</td>
</tr>
<tr>
<td>3.</td>
<td>Consistency</td>
<td>Smooth and uniform, and suitable for spray application (as per Chapter I, Para 3)</td>
</tr>
<tr>
<td>4.</td>
<td>Finish</td>
<td>Smooth and full glossy</td>
</tr>
<tr>
<td>5.</td>
<td>Colour</td>
<td>Close match to the specific IS/RAL colour or to an agreed colour where IS colour is not specified</td>
</tr>
<tr>
<td>6.</td>
<td>Dry film thickness, min</td>
<td>35 microns</td>
</tr>
<tr>
<td>7.</td>
<td>Volume solids, % min</td>
<td>45.0</td>
</tr>
<tr>
<td>8.</td>
<td>Scratch hardness (1.5 Kg Load)</td>
<td>No such scratch so as to show base metal</td>
</tr>
<tr>
<td>9.</td>
<td>Flexibility &amp; Adhesion (6.25 mm mandrel)</td>
<td>No visible damage or detachment of film</td>
</tr>
<tr>
<td>10.</td>
<td>Flash point</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Component ‘A’</td>
<td>Above 200°C</td>
</tr>
<tr>
<td></td>
<td>(b) Component ‘B’</td>
<td>Above 200°C</td>
</tr>
<tr>
<td>11.</td>
<td>Fineness of Grind, max</td>
<td>15 microns</td>
</tr>
<tr>
<td>12.</td>
<td>Pot life (After induction time), min</td>
<td></td>
</tr>
<tr>
<td></td>
<td>at a) 27 ± 2°C</td>
<td>3 ½ hrs</td>
</tr>
<tr>
<td></td>
<td>b) 40 ± 2°C</td>
<td>2 Hrs</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Requirement</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>13.</td>
<td>Gloss at 60° angle of incidence, min</td>
<td>85 (for glossy finish)</td>
</tr>
<tr>
<td>14.</td>
<td>Mass in Kg/10 litres, min</td>
<td>10.0</td>
</tr>
<tr>
<td>15.</td>
<td>Keeping properties</td>
<td>Min. 12 months</td>
</tr>
<tr>
<td>16.</td>
<td>Theoretical spreading rate, min</td>
<td>12.0 Sq. m./lt. at 35 micron DFT</td>
</tr>
<tr>
<td>17.</td>
<td>Unreacted monomer, % by mass, max</td>
<td>2.0</td>
</tr>
<tr>
<td>18.</td>
<td>% poly isocyanate by mass, in hardner</td>
<td>16.min.</td>
</tr>
</tbody>
</table>

A. Cleaning of Incoming Coaches:

(B. Cleaning of panel:)

(Cleaning of Coaches)
i. Moisten with water panel.
ii. Apply a cleaning agent to clean the surface.
iii. Use Hot and cold water to clean the surface.

C. **Cleaning of under frame and Bogie.**
   (i). Wash with low pressure water by water jet.
   (ii). After some time again wash by high pressure jet of hot and cold water.

D. **First day Schedule:**
   Complete repainting by exposing the metal surface.
   Place the coach in Grit blasting booth after masking window area of coach to remove old paint.

E. **Second day schedule:**
   Mask the window area by masking with paper and tape.
Rub down with Silicon carbide water proof gr. 120. Apply Epoxy zinc phosphating primer by brush or spraying according to schedule-II of RDSO Spec. No. M&C/PCN/100-2006.

F. Third day schedule:
G. Forth day Schedule:

H. Fifth day Schedule:

I. Sixth day schedule
Apply PU top coat as described in schedule-V of RDSO Spec. No. M&C/PCN/100-2006.
J. Seventh day schedule:
Apply PU top coat after removing of mask from window area.

K. Eighth day schedule:
Place coach in oven area if required for gradually drying.

L. Ninth day schedule:

Lettering and Misc Painting Work:
1. Flatted Patch Painting.
2. Window Glass Cleaning.
3. Paint of Moulding.
4. Painting of window frame.
5. Remove stains by Paint Remover
6. Cleaning of laminated panel.
7. Interior intensive cleaning.
8. Door Handle Painting.
13. Defects in Painting of Coaches:

1. **Blistering**: Bubbles or pimples, appearing in the top coat film

   **Causes**
   - Improper surface preparation
   - Insufficient drying time between coats
   - Contamination of compressed air line

   **Remedy**
   - Proper surface preparation
   - Allow proper drying time for undercoat
   - Drain and clean the air lines to remove trapped moisture

2. **Dry Spray**
Granular texture or rough feel on the surface

**Causes**
- Incorrect viscosity
- Spraying too fast
- Air pressure too high
- Spray gun too far away from the surface
- Improper spray gun set up.

**Remedy**
- Use correct viscosity
- Proper spraying technique, adjust spray gun settings, spray pattern etc.
- Use recommended air pressure

3. **Peel Effect**
Dried Paint Film looks like the Peel of an Orange.

**Causes**
- Improper gun adjustment and techniques.
• Improper recoat time
• High viscosity
• Material not mixed uniformly
• Improper surface preparation

**Remedy**
• Proper gun adjustments and techniques
• Allow sufficient recoat time
• Use recommended viscosity
• Through mixing of paints
• Prepare surface properly

4. **Run Down**
   Run Down /Sagging

**Causes**
• Incorrect spray viscosity
• Insufficient drying time
• Surface contaminated
• Incorrect spraying technique
Remedy

• Use correct viscosity
• Allow sufficient drying time
• Remove contamination from surface
• Follow correct spraying technique

5. Slow Drying

Causes
• Incorrect mixing ratio
• Heavy application
• Poor drying condition
• Insufficient drying time of undercoat

Remedy
• Use correct mixing ratio
• Apply recommended film thickness
• Infrastructure to be developed for required temperature
  Allow sufficient drying time
14. Quality assessment tools for Painting:

1. Paint Dry Film Thickness measuring gauge:

2. Microscope for observing painting defects
3. **Gloss meter: Measuring Standard Rang in Coaches**
Initial Gloss Retention: Gloss > 85 unit at 60 °
After One Year : 80% of Initial Gloss
After Two Year : 70% of Initial Gloss
After Three Year : 60% of Initial Gloss

4. **Shade card:**
5. Viscosity Measuring arrangements (Ford Cup):
15. Hazardous in application of painting in Coaches:

**Smell:** Solvent cause heavy odor and cause irritation to skin, nose and eye. The spills also cause irritation on skin.

**Emission:** Almost 50% of the paint consists of solvents; which, when burn-out, heavily pollute the atmosphere.

**High Fire Risk:** Because of low flash points, solvents catch fire easily and the risk of auto ignition is also high.

**Toxicity:** Because of the free monomers present during the spray, it causes damage to respiratory organs if exposed and inhaled.
16. Safety precautions for painting

**Respiratory mask:** Inhalation of solvent vapours or paint mist should be avoided by using proper Respiratory mask.

**Hand gloves:** Contact of liquid paint with skin should be avoided by using proper gloves.
**Goggles:** Contact of liquid paint with eye should be avoided by goggles.

**Forced ventilation:** Forced ventilation should be provided when applying paint in confined spaces or stagnant air.
Material Data Sheet:
Refer material safety data sheet (MSDS) for safety provided by paint supplier
17. Paint Equipments

1. *For Spray Painting:*

![Image of spray painting equipment]
2. *For Touch up:*

18. **Proposed Infrastructural Facilities in Workshops for PU Painting:**

- Painting booth of one coach length with complete accessories consisting of Airless spray painting unit, air supply unit, exhaust arrangement and automatic de-sludging system.
- A fully fledged Effluent Treatment Plant (ETP) with neutralizer, clarifier, settling tanks, filter press.
- Dedicated compressor with sufficient capacity with air dryer for maintaining continuous supply of air for painting booth.
- Winches for movement of coach in & out of the booth during different stages of painting. Oven for forced curing of paint.
- Fire fighting equipments.
- Surface roughness comparator (as per ISO 8501-1)
- Ladders