

INDIAN RAILWAYS**SPECIFICATION FOR ECO-FRIENDLY AND DISPOSABLE FILMS FOR
EXTERIOR AND INTERIOR
OF
INDIAN RAILWAY AC AND NON-AC COACHES**

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| Signature | | | |
| Name & Designation | Prepared By:- Phoni Mandal SSE/Std./Carriage | Checked By:- | Approved By- S. S. Chauhan Director/CD/Carriage |

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SPECIFICATION FOR ECO-FRIENDLY AND DISPOSABLE FILMS FOR EXTERIOR AND INTERIOR APPLICATION OF INDIAN RAILWAY COACHES

0.0 Forwards:

0.1 This specification has been prepared in two parts. Part-I cover the requirements of existing RDSO specification for “Eco-friendly and Disposable” films for Advertising on Exterior of Indian Railway Coaches” with Option-A and Option-B. Part-II has been included to cover the requirements of “Eco-friendly and Disposable” films for Interior Application in AC/Non-AC Coaches of Indian Railways” with Option-A and Option-B.

PART-I

1.0 SCOPE

This specification covers the technical requirements of Non PVC, Self adhesive Eco-friendly and Disposable films here after referred as “film” to be used for advertising on the exterior of Indian Railway passenger coaches without causing any damage to the painted surface. The IR coaches are painted with either alkyd or PU top coat systems. The advertisers should procure and use the films to this specification for application on IR coaches. The film as per option - A should be used for short term application upto six months and the film as per option - B for long term application above six months and upto one year.

2.0 AREA OF APPLICATION ON COACHES

Area of application on coaches shall be the complete side panel excluding the doors & windows, barring areas carrying mandatory markings of coach. The IR logo in these coaches shall be applied in the center of the coach above the windows.

The manufacture/supplier of film shall provide the procedures dealing with the application method, position of joints and method of sealing of joints and edges, procedure for patch repair, removal with Do’s & Don’ts and mode of disposal of such films to IR/consignee.

3.0 GENERAL REQUIREMENTS

3.1 The advertiser should submit the following documents along with the tender for their offers to be technically evaluated:

- Printed/published technical data/Material safety data sheet/brochure of the product in original (Base film/Inks/Edge Sealers) proposed to be used along with attested test certificate from a government-accredited laboratory for the tests mentioned in this specification. The tests may have been got done by the OEM from a Govt. accredited laboratory.

3.2 The advertiser should submit the following documentation along with sample before starting supply and application to the concerned rolling stock engineer:

- The film, pigment and ink used for printing should not be hazardous to health and environment and should be compliant to National/International health and environmental norms (like REACH & RoHS or equivalent). A documentary proof regarding the compliance of the same should be provided. The material of film shall also be confirming to the National/ International standards and should also confirm the statutory norms of Government of India”. A documentary proof for the same shall be provided.

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- E-warranty from manufacturer of graphic film in original quoting the tender number for which the PO (Purchase Order) has been received by advertiser, specifying all tests for durability and weathering and environmental exposure for the films used with photograph of applied graphic.
- Work test certificate in original from the manufacturer of the film.
- Manufacturer of base film and finished product (giving the manufacturing plant details).
- Film material including production certificate of conformance.
- Film colour/pigmentation and/or print colour.
- Adhesive designation & group.
- Sealing material and sealing method.
- Thickness (adhesive, film, print, sealing) with production tolerances
- Characteristic values as specified in this specification.
- The keeping of the specific values determined in the specification must be proved by presenting the test certificate from a government accredited laboratory.
- The film removal and disposal procedure.
- An undertaking to follow all safety precautions at the worksite.

3.3 TESTS:

- The test shall be conducted as prescribed in relevant specification mentioned against each test.
- Test pieces shall be cut from the samples in the required number and in the appropriate manner as specified in the individual methods of test.
- In any consignment, all the rolls of film offered against one dispatch note and of same design/composition shall constitute one lot.
- Conformity of the lot to the requirements of the specification shall be ascertained for each lot separately. The number of samples to be drawn will be as follows:

Table-1

| Lot size (Rolls) | No. of rolls to be selected |
|------------------|-----------------------------|
| 1 to 10 | 1 |
| 11 to 50 | 2 |
| 51 to 100 | 3 |
| 101 to 200 | 4 |

- All the tests given in Table-1 shall be carried out on each lot except Durability and Weathering Resistance test. The test for Durability and weathering resistance test shall be done once in a year or on successful supply of 50 rolls of film whichever is earlier.

4.0 OPERATING CONDITIONS FOR GRAPHICS

4.1 Ambient conditions:

The graphics shall perform satisfactorily under the following climatic conditions:

- (i) Ambient temperature - 4°C to 50°C
Altitude Sea level to 2500m
Max. Sun temperature 70°C
Relative humidity 40% to 100%

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- (ii) The rainfall is fairly heavy.
- (iii) During dry weather, the atmosphere is likely to be dusty.
- (iv) Temperature variations can be quite high in the same journey or short period of time.
- (v) Coaches operate in coastal areas with continued exposure to salt laden air.

4.2 Maintenance conditions:

The coach exteriors are cleaned with mildly acidic cleaning agents (pH value 2.5 to 5.0) and using brushes with non-metallic bristles or automatic car washing plants.

5.0 TECHNICAL REQUIREMENTS OF GRAPHIC FILMS – OPTION-A

The graphic film shall be Non PVC, Self-adhesive Eco-friendly and Disposable. It will consist of three layers namely the base film, adhesive layer and release liner. The completed film should be over laminated and edge sealed.

5.1 BASE FILM REQUIREMENTS

5.1.1 Base Film will be Non-PVC, self adhesive eco-friendly and disposable having thickness not more than 80 microns. The film should be free from halogen, chlorine or any plasticiser which has been banned by National/International environment and health agency like MoEF, ROHS, REACH etc.

5.1.2 The film shall be white in colour. The unprocessed base film shall have a gloss value of more than 70 when measured with 60° angle of incidence by gloss meter.

5.1.3 Thickness:

The nominal thickness of the unprinted film including adhesive shall be between 0.080mm to 0.130mm. The test procedure for measuring thickness is ASTM D3652.

5.2 REQUIREMENTS FOR ADHESIVES

5.2.1 The adhesive shall stick, without the use of an activator such as solvents or heat, on any metallic and non-metallic, polished and clean surfaces, free from any grease or silicone without producing wrinkles, rolling up, tearing or detaching.

5.2.2 The adhesive should be of gray colour acrylate base. The gray colour removable adhesive shall provide good hiding power so that colour of the coach does not affect the printed graphic colours and they appear vibrant.

5.2.3 The graphics film should have inbuilt air channels in the adhesive layer to ensure release of air bubbles during application which will result in fast application and the same should be clearly marked on the backing liner.

5.3 REQUIREMENTS FOR RELEASE LINER

5.3.1 The release liner protects the adhesive against dirt contamination and prevents the film from unintended agglutination.

5.3.2 The release liner will be paper, coated with disposable polyethylene to have resistance to moisture and solvent during printing and application.

5.3.3 In addition, the adhesive power of the release liner shall not be so strong that the adhesive detaches on removal of the release liner.

5.4 REQUIREMENTS FOR PRINTING OF BASE FILMS TO CONVERT INTO GRAPHICS

Films shall be printed with digital printing technology.

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5.5 REQUIREMENTS OF EDGE SEALING OF PRINTED GRAPHICS

- 5.5.1 Edge sealing is required on the edges of the film to give protection against peeling off of the graphics film and preventing damages of the graphics film against vandalism.
- 5.5.2 The edge sealing material shall be clear acrylic/alkyd/PU resin applied on all the overlap joints of the film and the end edges of the film with at least 10mm footprint covering 5mm on both the exposed edges.
- 5.5.3 The edge sealer should become water resistant within four hours of application.

5.6 REQUIREMENTS OF OVER LAMINATE

- 5.6.1 The surface of the graphic films shall be over laminated in an appropriate way in order to guarantee the resistance against operating stress and weather, acids, alkalis, salt solutions, scratch and tear from foreign objects.
- 5.6.2 The graphics film should have an over laminate supplied by the same manufacturer of the graphics film. The over laminate should be a Non PVC, Self adhesive Eco-friendly and Disposable film attractive gloss finish and should be UV stabilized, which is to be tested to ASTM G152 using xenon arc/QUV panel machines at 0.63 nanometer UV A lamps with 4 hour condensation and 4 hour UV exposure for min at 250 hrs. Post cycle specular gloss value, delta E colour change; visual discolouration has to be reported. The colour change should not be more than delta E=3, measured by approved photo spectro densito meter (The instrument measures colour value) for protection against deterioration and fading.
- 5.6.3 Over laminate should be applied on the printed graphics as per recommendation by the manufacturer of the graphics film after the printing has been done on the graphics film.

6.0 CHARACTERISTICS OF FINISHED GRAPHICS PRIOR TO APPLICATION:

The finished graphic film prior to application should be able to pass the anti-graffiti test when tested as per ASTM D6578 where all the marking agents should be removed with an average rating of not less than 8.

6.1 Thickness:

The film thickness shall be not more than 0.180mm +/- 15%, with sealing and print colour. The test procedure for measuring thickness is ASTM D3652.

6.2 Adhesive Power:

The films shall stick on any metallic and non-metallic surface, free from grease and silicone, without producing wrinkle, roiling up, detaching or tearing. The adhesive power of at least 15N/25mm on standard steel panel. When tested as per ASTM D-4541.

6.3 Flammability:

The graphic film should fall under min. Class-A when tested as per UIC-564-2 OR Appendix-4 (for Non-thermoplastic material) or Film should meet EN45545-2, HL-3.

6.4 Temperature Resistance:

The film shall be resistant to temperatures between -10°C and +70°C without any visible changes such as detachment cracks, bubble formation and colour changes. This property is to be tested as per clause 9.3.

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6.5 Resistance to Detergents:

The graphic films shall be resistant to detergents used by the IR for exterior cleaning of the coaches. The surface of the sealed film shall not soften and the colour and the adhesive power shall not change. The same applies to surface softening and to all kind of detachments (waves, bubbles etc.). This should be tested as per clause 9.4.

6.6 Marking of the Product:

6.6.1 For identification, the box of the accepted finished products shall be clearly printed/marked with capital letters having height of more than 50mm.

6.6.2 The marking should consist of the date of manufacture (month and year for example 12/04) of the finished product as well as manufacturer of the base material.

7.0 APPLICATION OF GRAPHICS

7.1 Applications of Graphics have to be done using recommended application tools as mentioned by the manufacturer of the graphic film. The applicator has to show experience/training certificate of doing similar application on any moving vehicle by the manufacturer of the graphic film.

7.2 Application of the graphic film has to be done on the surface without using any soap solution and water. (Dry application to make faster application and protect the paint of the coach).

7.3 The application tool should be a nylon moulded squeeze with low friction sleeve, which will prevent scratches on the graphics, and a nylon rivet brush with wooden handle to apply graphics on the rivets.

8.0 REMOVAL OF FILMS

8.1 The time taken for removal of previous graphic & application of new graphic films should not be more than three hours per coach.

8.2 The removal of the applied film should not be tedious. The removal should be done using a hot air blower but the temperature should not exceed 70°C. In case any film or adhesive residue is observed after removal of the film, it should be possible to remove by it by the use of Iso-propyl alcohol and lint free cloth.

8.3 The removal in no way should damage the painted surface of the coach. The advertiser shall be liable for damages evident after removal of the film. The coach should be returned in the same condition as it was handed over initially.

8.4 The advertiser shall be responsible for removal and disposal of the film at the time of termination of contract. The security deposit may accordingly be retained till the time of termination of contract.

9.0 TESTING OF THE GRAPHIC FILM

9.1 Adhesive power:

The adhesive power shall be tested as per ASTM D3330, procedure A for 180° peel strength on a standard test panel of Stainless Steel, conditioned as per ASTM D4332 at a peel off velocity of 360mm/minute.

9.2 Controlled release adhesion:

This shall be tested visually for presence of air channels on the adhesive side of the base film after the removal of release liner.

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9.3 Temperature resistance:

Two test specimens 25mm x 200mm are stuck onto test plates of stainless steel, polished to a completely plane surface and are subsequently stored at standard reference atmosphere. The specimens are subjected to temperature changes for seven cycles, each cycle comprising of 8 hours of -10°C and 16 hours of 90°C.

9.4 Resistance against detergents:

The test is to be carried out with two test solutions.

Duration of test: 24 hrs.

| ‘A’ Solution: | ‘B’ Solution: |
|-----------------------|---|
| 40% phosphoric acid | 10% Fatty alcohol polyethylene Glycol ether - 10% |
| 15% emulsifying agent | Sodium cumene sulphonate (40% solution) - 5% |
| 45% water (distilled) | NTA liquid (40% solution) Triton A, BASF - 5% |
| | Triethanolamine - 20% |
| | Totally demineralized water - 60% |

Emulsifying agent: Oleyl-stearyl alcohol mix (with Iodine value 50) with 10-mol ethylene oxide.

Maximum application concentration for test solution A and B 1:4 respectively.

10.0 Packing:

Cut films are to be dispatched, bundled up and securely packed in cardboard. Other graphics are to be rolled up on a cardboard roll/tube with the film side on the outside and shall be dispatched under safe transit. Supplier shall take all precautions to avoid any damage to films during the transit.

11.0 Guarantee and replacement:

11.1 The time period of guarantee should be six months for stuck films.

11.2 The supplier shall replace all the graphics rejected on final acceptance due to their non-compliance with the requirements and those product that show deficiencies during the time period of guarantee by products complying with the requirements within a period of four weeks.

11.3 The warranty for the printing inks should be available with the manufacturer /printer of the graphic film from the ink supplier. The firm shall provide E-warranty of the film from the OEM.

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12.0 TECHNICAL REQUIREMENTS OF GRAPHICS FILM - OPTION B

The graphic film will consist of three layers namely the base film, adhesive layer and release liner. The completed film should be over laminated and edge sealed.

12.1 BASE FILM REQUIREMENTS

12.1.1 Base film will be Non-PVC, Self adhesive, Eco-friendly and disposable film having thickness not more than 80 microns. The film should be free from halogen, chlorine or any plasticiser which has been banned by National/International environment and health agency like MoEF, ROHS, REACH etc. The films shall not include any materials having harmful effect on painted surfaces, human beings and environment.

12.1.2 The film shall be white in colour with whiteness index of 100 to 90 as per test method ASTM E313.

12.1.3 **Thickness:** The nominal thickness of the unprinted film including adhesive shall be between 0.080mm to 0.130mm. The test procedure for measuring thickness is ASTM D3652.

12.2 REQUIREMENTS FOR ADHESIVES

12.2.1 The adhesive shall stick, without the use of an activator such as solvents or heat, on any metallic and non-metallic, polished and clean surfaces, free from any grease or silicone without producing wrinkles, rolling up, tearing or detaching.

12.2.2 The adhesive should be of gray colour acrylate base. The gray colour adhesive shall provide good hiding power so that colour of the coach does not affect the printed graphic colours and they appear vibrant.

12.2.3 The adhesive should have feature of controlled adhesive release, which shall protect the paint of the coach. After the release liner has been removed, the films having controlled release adhesive shall be able to slide freely on the substrate before its final installation. Film can be positioned and finally applied by squeezing out permanent adhesive using a nylon moulded squeeze without using any activator such as solvent or heat.

12.2.4 The graphics film should have inbuilt air channels in the adhesive layer to ensure release of air bubbles during application which will result in fast application and the same should be clearly marked on the backing liner as controlled release type.

12.3 REQUIREMENTS FOR RELEASE LINER

12.3.1 The release liner protects the adhesive against dirt contamination and prevents the film from unintended agglutination.

12.3.2 The release liner will be paper, coated with disposable polyethylene to have resistance to moisture and solvent during printing and application.

12.3.3 In addition, the adhesive power of the release liner shall not be so strong that the adhesive detaches on removal of the release Liner.

12.4 REQUIREMENTS FOR PRINTING OF BASE FILMS TO CONVERT INTO GRAPHICS

12.4.1 Films shall be printed with digital printing technology with eco-friendly inks and shall be certified by any National/International norms for low emission of chemicals.

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12.4.2 The graphic has to be printed with printing resolution of the minimum of 360 dpi by 760 dpi to maximum of 720 dpi by 1440 dpi (Dots/inch).

12.4.3 The printing Inks shall be approved by the manufacturer of the graphics film and should carry a comprehensive warranty for maximum of 2 years against any kind of fading of colours and cracking.

12.5 REQUIREMENTS OF EDGE SEALING OF PRINTED GRAPHICS

12.5.1 Edge sealing is required on the edges of the film to give protection against peeling off of the graphics film and preventing damages of the graphics film against vandalism.

12.5.2 The edge sealing material shall be clear acrylic/alkyd/PU resin applied on all the overlap joints of the film and the end edges of the film with at least 10mm footprint covering 5mm on both the exposed edges.

12.5.3 The edge sealer should become water resistant within four hours of application.

12.6 REQUIREMENTS OF OVER LAMINATE

12.6.1 The surface of the graphic films shall be over laminated in an appropriate way in order to guarantee the resistance against operating stress and weather, acids, alkalis, salt solutions, scratch and tear from foreign objects.

12.6.2 The graphics film should have an over laminate supplied by the same manufacturer of the graphics film. The over laminate should be a Non PVC, Eco-friendly and disposable film attractive gloss finish and should be UV stabilized, which is to be tested to ASTM G152 using xenon arc/QUV panel machines at 0.63 nanometer UV A lamps with 4 hour condensation and 4 hour UV exposure for min at 500 hrs. Post cycle specular gloss value, delta E colour change; visual discolouration has to be reported. The colour change should not be more than delta E=3, measured by approved photo spectro densito meter (The instrument measures colour value) for protection against deterioration and fading.

12.6.3 Over laminate should be applied on the printed graphics as per recommendation by the manufacturer of the graphics film after the printing has been done on the graphics film.

13.0 CHARACTERISTICS OF FINISHED GRAPHICS PRIOR TO APPLICATION:

The finished graphic film prior to application should be able to pass the anti-graffiti test when tested as per ASTM D6578 where all the marking agents should be removed with an average rating of not less than 8.

13.1 Thickness:

The film thickness shall be not more than 0.150mm +1- 15%, with sealing and print colour. The test procedure for measuring thickness is ASTM D3652.

13.2 Gloss Value:

13.2.1 The minimum gloss value shall be 70 achieved at 60° measured by gloss meter as per ASTM D523, Gloss retention after two years should not be less than 30 at 60° angle of incidence when measured by gloss meter as per ASTM D523.

13.2.2 For every tender, a control sample of size 8' x 4' appropriately numbered shall be preserved for comparing gloss values and colour properties of the finished coaches in service for that particular tender.

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13.3 Durability & Weathering Resistance:

The graphic films shall be durable & resistant to weathering for at least one year in permanent outdoor-exposure. No kind of detachment, cracks, bubbles or similar effects shall occur during the applied state. The supplier shall submit proof of test from reputed independent laboratory (Govt. Accredited) of accelerated weathering, UV and environmental exposure as per ASTM G152 using xenon arc/QUV panel machines at 0.63 nanometer UV A lamps with 4 hour condensation and 4 hour UV exposure for min at 500 hrs. Post cycle specular gloss value, delta E colour change; visual discolouration has to be reported. The colour change should not be more than delta E=3, measured by approved photo spectro densito meter (The instrument measures colour value).

13.4 Adhesive Power:

The films shall stick on any metallic and non-metallic surface, free from grease and silicone, without producing wrinkle, rolling up, detaching or tearing. The adhesive power shall be between 17N- 25N as per clause 16.1.

13.5 Flammability:

The graphic film should fall under min. Class-A when tested as per UIC-564-2 OR Appendix-4 (for Non-thermoplastic material) or Film should meet EN45545-2, HL-3.

13.6 Temperature Resistance:

The film shall be resistant to temperatures between -10°C and +100°C without any visible changes such as detachment cracks, bubble formation and colour changes. This property is to be tested as per clause 16.3.

13.7 Dimensional Stability:

The shrinkage of the graphic films after application shall not exceed 0.2%. This is to be tested as per clause 16.4.

13.8 Resistance to Detergents:

The graphic films shall be resistant to detergents used by the IR for exterior cleaning of the coaches. The surface of the sealed film shall not soften and the colour and the adhesive power shall not change. The same applies to surface softening and to all kind of detachments (waves, bubbles etc.). This should be tested as per clause 16.5.

13.9 Wash and Attrition Resistance:

The graphic films shall not suffer any visible colour and gloss changes, detachments, cracks, bubbles etc. during external coach washing in accordance with IR field practices. Furthermore the films shall not expand. The graphic films along with over laminate shall not show any visible colour and gloss changes when tested as per ASTM D1044 using cleaning solution as per clause 16.5.

13.10 Marking of the Product:

13.10.1 For identification the box of the accepted finished products shall be clearly marked with a capital letters having height of more than 50mm either by printing, stamping or needle perforation.

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13.10.2 The marking should consist of the date of manufacture (month and year for example 12/04) of the finished product as well as manufacturer of the base material.

14.0 APPLICATION OF GRAPHICS

14.1 Applications of Graphics have to be done using recommended application tools as mentioned by the manufacturer of the graphic film. The applicator has to show experience/training certificate of doing similar application on any moving vehicle by the manufacturer of the graphic film.

14.2 Application of the graphic film has to be done on the surface without using any soap solution and water. (Dry application to make faster application and protect the paint of the coach).

14.3 The application tool should be a nylon moulded squeeze with low friction sleeve, which will prevent scratches on the graphics, and a nylon rivet brush with wooden handle to apply graphics on the rivets.

15.0 REMOVAL OF FILMS

15.1 The time taken for removal of previous graphic & application of new graphic films should not be more than three hours per coach.

15.2 The removal of the applied film should not be tedious. The removal should be done using a hot air blower but the temperature should not exceed 70°C. In case any film or adhesive residue is observed after removal the film, it should be possible to remove it by use of Iso-propyl alcohol and lint free cloth.

15.3 The removal in no way should damage the painted surface of the coach. The advertiser shall be liable for damages evident after removal of the film. The coach should be returned in the same condition as it was handed over initially.

15.4 The advertiser shall be responsible for removal of the film at the time of termination of contract. The security deposit may accordingly be retained till the time of termination of contract.

16.0 TESTING OF THE GRAPHICS FILM:

16.1 Adhesive power:

The adhesive power shall be tested as per ASTM D3330, procedure A for 180° peel strength on a standard test panel of Stainless Steel, conditioned as per ASTM D4332 at a peel off velocity of 360mm/minute.

16.2 Controlled release adhesion:

This shall be tested visually for presence of air channels on the adhesive side of the base film after the removal of release liner.

16.3 Temperature resistance:

Two test specimens 25mm x 200mm are stuck onto test plates of stainless steel, polished to a completely plane surface and are subsequently stored at standard reference atmosphere. The specimens are subjected to temperature changes for seven cycles-each cycle comprising of 8 hours of -10°C and 16 hours of 90°C.

16.4 Dimensional stability:

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Four 160mm x160mm test specimens are stuck onto degreased and etched aluminum plates with the dimension of 150x150x8mm and are stored for 72 hours in standard reference atmosphere. The projecting test specimen is then cut with a sharp knife (razor blade) along the test plate. Afterwards, the test specimens are stored for 48 hrs at 70°C and are then cooled down for 2 hours in standard reference atmosphere of 23+/-1°C and 50% relative humidity. Measurement of the shrinkage at two measuring points in longitudinal and transverse directions should be done.

16.5 Resistance against detergents:

The test is to be carried out with two, test solutions.

Duration of test: 24 hrs.

| 'A' Solution: | 'B' Solution: |
|-----------------------|---|
| 40% phosphoric acid | 10% Fatty alcohol polyethylene Glycol ether - 10% |
| 15% emulsifying agent | Sodium cumene sulphonate (40% solution) - 5% |
| 45% water (distilled) | NTA liquid (40% solution) Triton A, BASF - 5% |
| | Triethanolamine - 20% |
| | Totally demineralized water - 60% |

Emulsifying agent: Oleyl-stearyl alcohol mix (with iodine value 50) with 10 mol ethylene oxide. Max application concentration for test solution A and B 1:4 respectively.

17.0 Packing:

Cut films are to be dispatched, bundled up and securely packed in cardboard. Other graphics are to be rolled up on a cardboard roll/tube with the film side on the outside and shall be dispatched under safe transit. Supplier shall take all precautions to avoid any damages to film during the transit.

18.0 Guarantee and replacement:

18.1 The time period of guarantee should be 1year for stuck films.

18.2 The supplier shall replace all the graphics rejected on final acceptance due to their non-compliance with the requirements and those product that show deficiencies during the time period of guarantee by products complying with the requirements within a period of four weeks.

18.3 The warranty for the printing inks should be available with the manufacturer /printer of the graphic film from the ink supplier. The firm shall provide E-warranty of the film from the OEM.

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Part-II

**ECO-FRIENDLY AND DISPOSABLE FILMS FOR INTERIOR APPLICATION IN
AC/NON-AC COACHES OF INDIAN RAILWAYS**

1.0 Scope:

- 1.1 Non PVC, Self adhesive Eco-friendly and Disposable films here after referred as “film” to be used on interiors of Indian Railways Passenger Coaches to improve coach interior aesthetics with its technical & infrastructural requirements and testing methods.
- 1.2 Requirements of adhesion with coach interior panels (metallic, non-metallic and composite materials), washability, cleanability, edge sealing, scratch resistant and damage repair (patch repair) of the film.

2.0 Area of Application on Coaches:

Area of application on coaches shall be the coach interior panels of metallic, non-metallic and composite materials excluding the window area. The manufacturer/supplier of the film for interior shall provide the procedures dealing with the application method, position of joints and method of sealing of joints and edges, procedure for patch repair, removal with Do's & Don'ts and mode of disposal of such the films to IR/consignee. The manufacturer/supplier should study the coach interior of Indian Railways AC and Non-AC coaches for better appreciation of coach interiors.

3.0 General Requirements:

The general requirement for the film for interior of IR coaches shall be as per clause 3.0 of Part-I for Specification for the films for advertising on exterior of Indian Railway Coaches.

4.0 Coach Inside Conditions:

- 4.1 Inside condition of the coach may be considered as under:
- 4.1.1 The ambient conditions inside a Non-AC coaches may be considered similar to the ambient condition as mentioned under para 5.4 below, as there is no environment control inside a Non-AC coach. However in summer days, the value of upper range of the temperature may go up to 60°C nearby the roof ceiling. There may be remarkable variation in temperature inside of the coach from floor level to roof level.
- 4.1.2 Wind flow velocity nearby the windows may be considered in Non-AC coaches as windows may remain in open condition during journey.
- 4.1.3 Ingress of water/moisture through windows of Non-AC coaches during rainy season may also be considered. Outside and inside areas of lavatories are more prone to splashing of water/accelerated moisture. Cleaning agents are generally used for cleaning of lavatories.
- 4.1.4 In AC coaches, the passenger area has a control environment except lavatory area and doorways area. However, windows have been provided with sealed windows.
- 4.1.5 The provisions of interior furnishings and amenities provided in the coach may vary from coach to coach. In some areas of coach, the furnishing surface may be sunk-in type or projected.

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5.0 Operating and General Requirements of Coach:

5.1 The film should work satisfactorily under the following operating conditions of IR coaches.

5.2 **Coach Dynamics:**

The film shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below:

- | | | |
|------|-----------------------------------|------|
| i) | Maximum vertical acceleration | 1.0g |
| ii) | Maximum longitudinal acceleration | 3.0g |
| iii) | Maximum transverse acceleration | 2.0g |

The vibrations are of sine wave form and the frequency vibration is between 10 Hz to 50 Hz.

The amplitude 'a' expressed in millimeters is given as a function of f, by equations $a = 25/f$ for values of f from 1 Hz to 10 Hz.

$a = 250/f^2$ for values of f exceeding 10Hz and up to 50 Hz.

In the direction corresponding to the longitudinal movement of the vehicle, the film shall be capable of withstanding for 30 min. at 50 Hz. Vibrations of such a value that the maximum acceleration is equal to 3g.

5.3 **Coach-body displacement encountered under dynamic conditions:**

- | | | |
|------|------------------------------------|--------------|
| i) | Vertically- | ± 100 mm |
| ii) | Laterally - | ± 55 mm |
| iii) | Longitudinally- | ± 10 mm |
| iv) | Bogie rotation about center pivot- | $\pm 4^0$ |

5.4 **Ambient conditions for a coach fitted with the film:**

- | | | | |
|-------|---|---|--------------------|
| (i) | Ambient temperature | : | -4°C to 50°C |
| | Altitude | : | Sea level to 2500m |
| | Relative humidity | : | 40% to 95% |
| (ii) | The rainfall is fairly heavy. | | |
| (iii) | During dry weather, the atmosphere is likely to be dusty. | | |
| (iv) | Temperature variations can be quite high in the same journey or short period of time. | | |
| (v) | Coaches operate in coastal region with continued exposure to salt laden air. | | |

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6.0 Technical Requirements of Pre-patterned Films: Option-A

Pre-patterned Films:

- 6.1 The pattern, design and print colour of the film shall be mutually agreed between the IR/Consignee and manufacturer/supplier of pre-patterned film for interior application of the IR coaches and shall meet the following requirements:
- 6.1.1 The pre-patterned film should not require any printing or lamination activity prior to application on coach interior substrate.
- 6.1.2 The pre-patterned film for interiors of the coach shall have a proven and established technology/system on National/International Railway Systems. The documentary proof for the same should be provided.
- 6.1.3 The pre-patterned film shall be decorative, attractive and shall be enhancing/improving interior aesthetics of Indian Railways AC & Non-AC coaches.
- 6.1.4 The patterned film shall be able to be applied as per the actual furnishings (metal, FRP laminates, composite materials etc) inside the coach and shall perform satisfactorily under Indian weather conditions, Indian Railway operating conditions as mentioned in clause 4.0 & 5.0 above and wide spectrum of users of Indian Railways AC and Non-AC coaches. The manufacturer/supplier shall advise the adhesive designation and group used for self adhesion of pre-patterned film which shall be capable to release air during application.
- 6.1.5 The material, thickness and production tolerances of pre-patterned Non PVC, self adhesive eco-friendly and disposable film shall be 150-200 microns and shall be confirming to National / International standards and should also confirm the statutory norms of Government of India. The pre-patterned film, pigment and ink used for printing should not be hazardous to health and environment and should be compliant to National/International health and environmental norms. A documentary proof regarding the compliance of the above should be provided. The test procedure for measuring thickness of the film shall be as per ASTM-D3652.
- 6.1.6 The pre-patterned film shall not show any effect and any damage to the actual interior substrate during application/removal of the film.
- 6.1.7 The pre-patterned film shall not sustain tea, coffee, lipstick, any natural & artificial colour, oil, grease stain etc and shall be easily removed by water/recommended cleaning agent. Dust and dirt shall not be easily stuck on the surface of pre-patterned film.
- 6.1.8 The pre-patterned film shall be Hydrophobic, resistance to UV aging and weathering and shall have good abrasion resistance, cleanability, washability and should not be easily removed by nail/keys or by any other manual activity of the coach occupant etc.
- 6.1.9 The pre-patterned film shall be capable for edge sealing at the edges/joints/ends of the film for protection against peeling off and shall prevent damages to the film by vandalism. The pre-patterned film shall allow maintainer of the coach to do patch work if and when required during maintenance of the coach.
- 6.1.10 The manufacturer of pre-patterned film shall advise edge sealing material for sealing of overlap joints/edges/ends of the film. The edge sealing material shall not affect the interior aesthetics of the coach and should also be capable to address the requirements mentioned under clauses (iii) to (v) above.

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6.1.11 The pre-patterned film for interior application of the coach shall comply with the fire worthiness property as mentioned below:

| S. No. | Property | Required value | Test Method |
|--------|--|---|-------------------------------------|
| 1. | Resistance to spread of flame | Class A | Appendix-4 of UIC 564-2 OR |
| 2. | Deterioration of visibility due to smoke | Class A | Appendix-15 of UIC 564-2 OR |
| 3. | Limiting Oxygen Index | Min. 35 | IS: 13360 Part-6, Section-19 |
| 4. | Toxicity | <1 | NCD:1409 |
| 5. | Heat Release Rate (MARHE i.e. Maximum Average Rate of Heat Emission in KW/m ²) | Max. 60 kW/m ² (The value is as per (R1-HL3) in table-5 of EN 45545-2:2013) | ISO 5660-1: 50 kW/m ² |

Alternatively the tests prescribed as above in this clause can be done as per EN45545-2 (R1-HL3) by the accredited lab.

6.1.12 The film for interior application of the coach shall meet the requirements of adhesive power, control release adhesion, temperature and resistance against detergent as per clause 9.0 (testing the graphic film) of Part-I of this specification. The dimensional stability of the films should be tested as per clause 16.4 of Part-I of this specification and shall not show shrinkage of film exceeding 0.2%. The film used for interior shall have an adhesive power of atleast 17N/25mm when tested as per ASTM D-4541.

6.1.13 The pre-patterned films shall not show any visible colour changes when tested as per ASTM D1044 using cleaning solution as per clause 9.4 of Part-I of this specification.

6.1.14 The abrasion resistance test of the film shall be tested as per ASTM-D4060 for a minimum 7000 cycles.

6.1.15 The pre-patterned film shall be temperature resistance and shall withstand a temperature of (-) 10°C to (+) 80°C without any visible change like detachment, cracks, bubble formation, fading of colour etc.

6.1.16 The pre-patterned film shall be temperature resistance and shall be tested as per ASTM D 2115-17. There shall be no delamination or visible change in film.

6.1.17 The pre-patterned film shall be thermal cycle resistance and shall be tested as per ISO 14188:2012(E). There shall be no delamination or visible change in film.

6.1.18 The pre-patterned film shall be moisture resistance and shall be tested as per ASTM D5637-05. There shall be no delamination or visible change in film.

6.1.19 The pre-patterned film shall be cold impact resistance and shall be tested as per ASTM D1790-14. There shall be no crack in film.

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6.1.20 The pre-patterned film shall be Resistance to Solvents, Cleaners, and other Chemicals as listed below:

- Water, Chloride (10%), Sodium Hydroxide (10%) & Ethanol – 24hrs.
- Hydrogen Peroxide & Isopropyl Alcohol – 72hrs.

The Test method shall be as per ASTM D-543. There shall be no visible change in the films.

6.1.21 Durability & Weathering Resistance:

The films shall be durable & resistant to weathering for at least six years in permanent indoor-exposure. No kind of detachment, cracks, bubbles or similar effects shall occur during the applied state. The supplier shall submit proof of test from reputed independent laboratory (Govt. Accredited) of accelerated weathering, UV and environmental exposure as per ASTM G152 using xenon arc/QUV panel machines at 0.63 nanometer UV A lamps with 4 hour condensation and 4 hour UV exposure for min at 1000 hrs. Post cycle specular gloss value, delta E colour change; visual discolouration has to be reported. The colour change should not be more than delta E=3, measured by approved photo spectro densito meter (The instrument measures colour value).

7.0 Marking of the Product:

7.1 The marking of the product shall be as per clause 6.6 of Part-I of this specification.

8.0 Packing:

8.1 The packing of the product shall be as per clause 10.0 of Part-I of this specification.

9.0 Guarantee and replacement:

9.1 Guaranty of the product shall be 6 years from the date of application against manufacturing defects, fading of colour / pigments, loss of adhesion, poor workmanship and any other defects which may contribute to unsatisfactory performance of film.

9.2 The manufacturer/supplier shall replace all the films rejected on final acceptance due to their noncompliance with the requirements and those product that show deficiencies during the time period of guarantee by products complying with the requirements within a period of four weeks. The firm shall provide E-warranty of the film from the OEM.

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10.0 Printable Films- Option-B

- 1.0 The colour of printable film shall be mutually agreed between the IR/Consignee and manufacturer/supplier of printable film for interior application of the IR coaches and shall meet the following requirements:
 - 1.1 The printable film shall be provided with anti-graffiti over laminate to avoid any manual graffiti on the surface of the film.
 - 1.2 Films shall be printed with digital printing technology with eco-friendly inks and shall be certified by any National/International norms for low emission of chemicals. A documentary proof regarding the compliance of the above should be provided.
 - 1.3 The manufacturer/supplier shall get approval of design/pattern to be printed on printable film by the IR/Consignee.
 - 1.4 The finished graphic prior to application should be able to pass the anti-graffiti test when tested as per ASTM D6578 where all the marking agents should be removed with an average rating of not less than 8.
 - 1.5 The printable film shall also confirm the requirements given under clauses 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7, 6.1.8, 6.1.9, 6.1.10, 6.1.11, 6.1.12, 6.1.13, 6.1.14, 6.1.15, 6.1.16, 6.1.17, 6.1.18, 6.1.19, 6.1.20 and 6.1.21 of Part-II, Option-A of this specification.

2.0 Marking of the Product:

- 2.1 The marking of the product shall be as per clause 6.6 of Part-I of this specification.

3.0 Packing:

- 3.1 The packing of the product shall be as per clause 10.0 of Part-I of this specification.

4.0 Guarantee and replacement:

- 4.1 Guaranty of the product shall be 6 years from the date of application against manufacturing defects, fading of colour / pigments, loss of adhesion, poor workmanship and any other defects which may contribute to unsatisfactory performance of film.
- 4.2 The manufacturer/supplier shall replace all the films rejected on final acceptance due to their noncompliance with the requirements and those product that show deficiencies during the time period of guarantee by products complying with the requirements within a period of four weeks. The firm shall provide E-warranty of the film from the OEM.

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