RDSO SPECIFICATION No. M&C/PCN/127-2020 (Rev.2.0)

SPECIFICATION FOR ANTIGRAFFITI CLEAR COAT FOR THE EXTERIOR PAINTING OF RAILWAY COACHES, DIESEL AND ELECTRIC LOCOMOTIVES

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SPECIFICATION FOR ANTIGRAFFITI COATING SYSTEM FOR EXTERIOR PAINTING OF RAILWAY COACHES DIESEL AND ELECTRIC LOCOMOTIVES

1.0 SCOPE:

This standard prescribes the technical requirements, methods of testing and the provision of graffiti prevention measures by the application of Anti Graffiti coatings to Exterior of Railway Coaches, Diesel and Electro Locomotives and others. The scope also includes the removal of graffiti and/or the painting over Anti Graffiti coating. This standard also covers of basic method for evaluating graffiti resistance of coating. The graffiti resistance is based on how a defined set of marking is removed by a defined set of cleaning agent. The material may be used on surfaces having slight roughness developed by rubbing with emery paper and subsequently cleaning by Silicon cleaner. It should be suitable for application by Spray, Dipping, Roller and Wiping.

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.

1.1 Uses :

Material complying with the standard is intended to be used as top coat in Anti Graffiti coating system over Nano Metal Primer , over already painted coaches by conventional painting system for protection of exterior of Railway Coaches, diesel & electric locomotives and others against corrosion under condition of condensation, chemicals, wet abrasion against solvent & graffiti and UV light.

2.0 TERMINOLOGY:

2.1 For the purpose of this standard apart from the Glossary of Terms given in IS: 1303-83, Reaffirmed 2017 or its latest version and Terminology as per Clause 2 of IS : 9162-79, Reaffirmed 2016 or its latest version and IS:9954- 81 or its latest version, the following shall also apply. Rounding off, of observed values on different tests shall be in accordance with IS: 2-1960, Reaffirmed 2016 or its latest version.

2.2. **PACK** : The term used to describe each of the Single Packs of moisture curable material , so taking care of sealing the container tightly after use is essential.

2.3. **MATERIAL** : The term used to describe the Anti Graffiti coating given by the Manufacturer.

2.4. **COMPONENT** :

The product is Single Pack Ready-Mix Nano-Technology based material which on application forms a ultra thin clear coat finish.

2.5. COATING/PAINT :

The product is Single Component Ready- Mixed Nano-Technology enabled clear coating which reacts under ambient temperature with moisture present in the air to form a dense and extremely thin –(Si-N-)n, (-Si-O-) unit which dry fast and adhere well to substrate.

3.0 COMPOSITION :

The paint shall be based on Nano Technology enabled Poly Silazane resin which form a transparent protective coating. Besides resin, coating shall consist of suitable additive and appropriate solvent.

3.1. SPECIFIC :-To determine whether resin is Poly-Silazane, match the Infra Red (IR)Spectra of the resin components to those of the evaluation samples to confirm the presence of Poly-Silazane resin by FTIR Method (APPENDIX – V)

3.1.1 Materials required to complete the works shall be supplied, delivered by the Manufacturer.

3.1.2 Prior to the use of any materials on works , Product Data Sheets and current Materials Safety Data Sheets (MSDS)detailing the properties of the proposed products shall be provided by the Manufacturer to the Workshops.

3.1.3 All coatings and treatments shall be applied in accordance with good painting practice and in accordance with the Manufacturer's Published Recommendations.

4.0. ANTI-GRAFFITI COATINGS:

4.1. REQUIREMENT

1. The type of Anti-graffiti coatings shall be selected as per requirements. The specification mentioned should be taken latest or whatsoever is applicable.
2. The selected Anti-Graffiti coating system used shall carry a **guaranteed "Graffiti Removal" life of not less than 3 years from the date of application** for non- sacrificial coatings under normal working condition.
3. The Manufacturer shall demonstrate that the proposed coating system fulfils the claims of

the applied system with respect to coating properties for the particular substrate surfaces.

4. The Anti-Graffiti coating systems shall be applied in accordance with the Manufacturers Published Recommendations. Coatings shall be assessed in accordance with "Method for Assessing the Effectiveness of Anti -graffiti Coatings" as per ASTM- D-6578 and shall achieve a minimum rating of 5 in accordance with the TABLE at 4.2.

4.2 – Effective Ratings for Anti-Graffiti Coatings

Rating	Result
0	No graffiti removed
1	Some graffiti removed but no more than 30%
2	Between 30% and 70% graffiti removed
3	Between 70% and 99% graffiti removed
4	Most graffiti removed with only shadowing remaining
5	Graffiti completely removed

4.3 - GRAFFITI REMOVAL MATERIALS

1. Graffiti removal materials selected by the manufacturer shall be used in accordance with the Manufacturer's Published Recommendations and Material Safety Data Sheets.

2. Chemical graffiti removers shall fulfill the requirements given by the Manufacturer.

3. The remover shall be able to fulfill the claims of the Manufacturer with respect to removal properties for the particular surfaces on which it is designed to be used.

4. The graffiti remover shall be applied in accordance with the Manufacturer's Published Recommendations. Removal shall be assessed in accordance with "Method for Assessing the Effectiveness of Graffiti Removers" and shall achieve a minimum rating of 5 in accordance with the scale detailed in TABLE 4.2

4.4.- SUBSTRATE SURFACE PREPARATION

1. The surface to be treated shall be prepared in accordance with Manufacturer's Published Recommendation for the Anti-Graffiti coating system.

2. All dust, dirt, grease and oil contaminants, including remnants of curing membranes, and any other surface contaminants shall be removed by non-destructive means followed by water washing & drying.

3. In case of new surfaces, the surface is prepared by roughening by P-220 grade emery paper followed by P- 400 or P-600 emery paper to smoothen the surface followed by wiping with Silicone cleaner.

4. In case of already coated surfaces either with PU paints or with Nano Metal Primer, the surface is to be slightly smoothened with P- 600 followed by wiping with silicon cleaner before applying with Anti-Graffiti coating.

5. Where a clear Anti-Graffiti coating system is specified, the substrate shall be free of all graffiti, graffiti shadows, paints or any other surface contaminants which would be visible through the coating unless the substrate or steel work is intentionally painted.

4.5. APPLICATIONS

Anti-graffiti coatings shall NOT be applied under the following conditions:

a) the site of work is exposed to a wind speed exceeding 20 km/Hr;

b) where wind borne debris may contaminate the uncured surface of the freshly applied coating;

c) When the ambient temperature exceeds 45^0C or is below 15^0C;

d) When the Relative Humidity exceeds 85%;

e) When there is any chance of rain spatter, or run off, including leakage through deck joints, contaminating the surface and adversely effecting the adhesion to the substrate;

f) where the surface temperature of the substrate is less than 3°C above the dew point or exceeds 45°C; or

g) Where the substrate surface is wet or damp.

h) The applicator shall ensure that the coated works are protected from adverse conditions, dust and debris during the curing period of the coating system.

5. PROPERTIES

5.1. **The coating system shall be a Polysilazane based UV-resistant for the guaranteed life of Minimum 3 years from the date of application.** The coating shall be impermeable to Chlorides, Carbon Dioxide and water.

5.2. The coating system shall not affect the re-coat ability of the underneath coating system.

5.3. Where a Prime or Tie-Coat is required as part of the Anti-Graffiti system, the Primer or Tie- Coat may be of any colour.

5.4. The finished coating system shall be of uniform thickness, colour, and appearance and shall be free of any defects that may impair the performance or appearance of the coating for the life of the coating.

5.5 The material shall comply with the requirements of this specification specified in TABLE-I.

5.6 Unless otherwise specified the following testing conditions shall apply.

5.6.1 The preparation of steel, tinned and glass panels shall be in accordance with IS: 101(Part.1/ Sec.3)-86 Reaffirmed 2012 or its latest version.

5.6.2 All the tests shall be conducted at room temperature $(27\pm 2)^0$C and a Relative Humidity at (65 ± 5) %, in a well ventilated chamber free from draughts and dust. The temperature of the surface to be painted must be at least 3^0C above the dew point to prevent moisture condensation.

5.6.3 For touch-up/patch painting, the material shall be supplied in one litre container.

TABLE-1
SPECIFICATION FOR ANTI GRAFFITI CLEAR COAT:-

SN	Characteristics	Performance required	Test method
1.	Drying Time at (27± 2)˚C , Maximum i)Surface Dry/Touch Dry ii)Hard Dry iii) Recoating Time	 1 Hour. 1-2 Hours below 15 ^{0}C 24 Hours. Within 8 Minutes	IS:101-86 (Part- 3/ Sec- 1), Reaffirmed 2017or its latest version
2.	Finish	Smooth and Glossy	IS : 101-87 (Part -3/ Sec- 4), Reaffirmed 2019 or its latest version
3.	Gloss at 60˚	60-85 on Aluminium panel /Better than original coated gloss	IS : 101-88 (Part 4/Sec-4), Reaffirmed 2017 or its latest version
4.	Flexibility & Adhesion (By Mandrel size 6.25 mm)	No crack should be observed	IS : 101-88 (Part -5/Sec-2), Reaffirmed 2019 or its latest version
5.	Impact Resistance test at Height 100cm (39.37 inch) and weight 2.0 Kg (4.409 pound) on 0.50 mm thick cured panel.	Deformed coating shall be free from cracks	ASTM-D-2794
6.	Adhesion Test (Cross Cut Tape Test)	Coating from none of the squares of the lattice shall be removed. Rate of adhesion shall match to 5B grade	ASTM-D-3359
7.	Consistency/Efflux Time at (27± 2)˚C	Smooth & Uniform, Viscosity less than 5 cps. by Brookfield Viscometer	IS : 101-89 (Part -1 Sec-5), Reaffirmed 2019 or its latest version
8.	Protection against corrosion under conditions of condensation(500 hrs)	No sign of corrosion & No Delamination	IS: 101-88 (Part- 6 /Sec- 1), Reaffirmed 2015 or its latest version
9.	Solvent MEK Rub Test 100 DS	Shall not show any traces on the cloth.	ASTM D-5402
10.	Resistance to 30 % ,w/v (a)Citric acid for 3 Hours (b) Resistance to 5% ,v/v Ammonia for 20 Minutes (c) Resistance to Lubricating oil for 24 Hours. (d) Resistance to Solvents for 20 Minutes. i) Acetone ii) Toluene	No cracking discoloration, blistering, peeling or softening of film. -do- -do- -do- -do-	APPENDIX- III

11.	Mass in Kg/10 litres	10-12		IS : 101-87 (Part -1/ Sec-7),Reaffirmed 2019 or its latest version
12.	Flash Point	Not less than 25˚C		IS: 101-87 (Part- 1/ Sec-6),Reaffirmed 2019 or its latest version
13.	Keeping Property/Shelf Life	1 year		APPENDIX-II
14.	Anti Graffiti test	Graffiti should be completely removed and no marks of EDDING 3000		ASTM D-6578
15.	Identification of Base Material/Resin	Standard Peaks/ Chart should match		By FTIR METHOD. (Clause 3.1 & APPENDIX-V)
16.	Coverage (Spreading Capacity) , Min. , at 1-4 microns DFT, By Spray, Dipping, Roller, Wiping method	50 Sq.mtr./lit@ at 1-4 micron DFT.		APPENDIX-I
17.	Dry Film Thickness per coat, Min., by Wipe/Spray	1-4 micron		APPENDIX-I
18.	Pencil Hardness	4-6 H		ASTM –D- 3363
19.	Volume Solid,%	20-60		APPENDIX-I
20.	Durability Tests (i)Accelerated Weathering test 4 hrs. QUV and 4 hrs. Condensations alternatively, temp. 50 ˚C(750 Hours) (ii) Xenon test for 2000 Hours.	Rating scale Chalking Checking Cracking Flaking Blistering Peeling Spotting Gloss	0-10 10 10 10 10 10 10 10 Gloss retention shall not be less than 80% of the original	APPENDIX-IV & ASTM-G-154 DIN- 53387

TABLE - 2
DETAILS OF PREPARING PAINTED PANELS FOR ANTI-GRAFFITI CLEARCOAT

SN	Test	Type of metal panel	Size in mm	Painting detail	D.F.T	Method of application	Duration of air drying before commencement of test	Special instructions
1.	Drying Time	S.S.	150X 100X 1.25	One coat of anti-graffiti clear coat	1-4 microns	By suitable spray, wiping technique	-	-
2.	Finish	-do-	-do-	-do-	-do-	-do-	48 hrs.	-
3.	Dry Film Thickness	-do-	-do-	-do-	-do-	-do-	24 hrs.	-
4.	PAC TEST	-do-	-do-	-do-	-do-	-do-	7 days	Prepare and paint both sides of the panels
5.	Flexibility & Adhesion	-do-	150X 50X0 .315	-do-	-do-	-do-	7 days	-
6.	Impact Test	-do-	150X 100X 0.50	-do-	-do-	-do-	7 days	Coat only one side of the panel & coated side must be exposed to indentation
7.	Gloss	Al/SS	150X 100X 1.25	-do-	-	-do-	24 hrs.	Anti-graffiti clear coat shall be applied over already painted panel then gloss will be measured.
8.	Accelerated tests Resistance to Citric acid Resistance to Oil Resistance to Ammonia Resistance to Solvents	 SS Tin MS SS	150X 100X 1.25 150X 50X o.315 150X 100X 1.25 150X 100X 1.25	 -do- --do— --do-- -do-	1-4 microns --do-- --do-- --do--	-do- -do- -do-- -do-	7 days -do- --do-- -do--	Prepare and paint both sides of the panels -do- --do— -do--
9.	Durability Test : Accelerated weathering test	S.S.	150 X75 X1.2 5	do	--do--	-do-	-do-	Prepare and paint both sides of the panels

6 . PACKING AND MARKING:

6.1 Each container shall be marked with the following:

a) Name of the Material

b) Source of Manufacture

c) Volume of the Material

d) Batch No. or Lot No. in CODE or otherwise and

e) Month & year of Manufacture

f) Shelf Life/ Expiry Date

6.2 For touch up/patch painting, the material shall be supplied in one litre container.

7. INSPECTION

7.1 At the time of initial approval, full testing shall be done.

7.2 In case of Acceptance testing, Inspecting Authority shall draw the sample from the Batch under consideration and tests shall be done as per TABLE-I, except for Long Duration tests as per Sl. No. 8 & 20.

7.3 For Bulk Supply, every third batch or last Batch exceeding 750 litrs shall be tested for all characteristics including long duration test.

APPENDIX- I

PROCEDURE FOR DETEMINING VOLUME SOLIDS PERCENTAGE

1. SCOPE

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

2. SIGNIFICANCE

This method is intended to provide a measure of the volume of dry coating obtainable from a given volume of liquid coating. This volume is considered to be the most equitable means of comparing the coverage (sq. meter 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) Weigh the disc in air. Let it be W1 grams.

iii) Suspend the disc in water and weight 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 grams.

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

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

viii) Dry the disc. in an oven for 3 hours at 105°C and cool.

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

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

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

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

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

Volume of dried coating = V1 – V=(Vd)

xii) Calculate the volume of wet coating as follows:

$$V1 = \frac{W3 - W1}{W \times P}$$ 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 :

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

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

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

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

APPENDIX- II

KEEPING PROPERTIES

When stored under cover in a dry place in the original sealed containers under normal temperature conditions, the material shall retain the properties prescribed in the specification for the stipulated period from the date of manufacture which shall be subsequent to the date of placement of contract. **The film shall give a Guarantee / Warrantee Certificate with effect of above**.

APPENDIX-III

ACCELERATED TESTS

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

a) RESISTANCE TO CITRIC ACID

Immerse ¾th of the panel in 30% citric Acid (w/v) for 3 hours. Remove the panel, wash in running fresh water and allow it to dry for an hour and record the observation.

b) RESISTANCE TO AMMONIA: Immerse ¾th of the panel in 5% Ammonia (v/v) for 20 Minutes. Remove the panel, wash in running fresh water and allow it to dry for an hour and record the observation.

c) RESISTANCE TO OIL

Prepare the panel. Immerse ¾th of the panel in a General Purpose Spindle Oils as mentioned in Clause 3.2 and 4.2, TABLE-1, Medium Viscosity Grade 20 of IS: 493 (part-2)-2019 or its latest version for 24 hours. Remove the panel and wipe the excess oil with a pad of cotton and wash it with mineral turpentine oil (MTO) and allow drying for 30 minutes and recording the observation.

d) RESISTANCE TO SOLVENTS

Test on panel each for resistance to Toluene and Acetone for 20 Minutes respectively. Immerse ¾th of the panel in solvents mentioned above, remove the panel and wipe the area with a clean dry cotton and immediately record the observation

APPENDIX – IV

ACCELERATED TEST FOR DURABILITY

Both sides of the panels must be prepared and painted as per Sl.No.9 of TABLE 2:

a) ACCELERATED WEATHERING TEST

The test is performed according to DIN53387

Test Period : 2000 Hours

Apparatus : Weather-o-Meter, Xenon Arc Lamp with rotating Day/Night device type

Cycle : 3 Min. rainfall, 17 Min. dry period alternatively

Light exposure : UVB 313 light exposure

Temperature : $50^{O}C$

The requirements of this test shall be taken to have been satisfied if performance in respect of the characteristics as noted in IS: 8662-2004 (Second Revision) Reaffirmed-2019 (or corresponding clause of its latest version) is within the limits.

b) ALTERNATE METHOD

The test may also be carried out as per ASTM-G-154

Test Period : 750 Hours

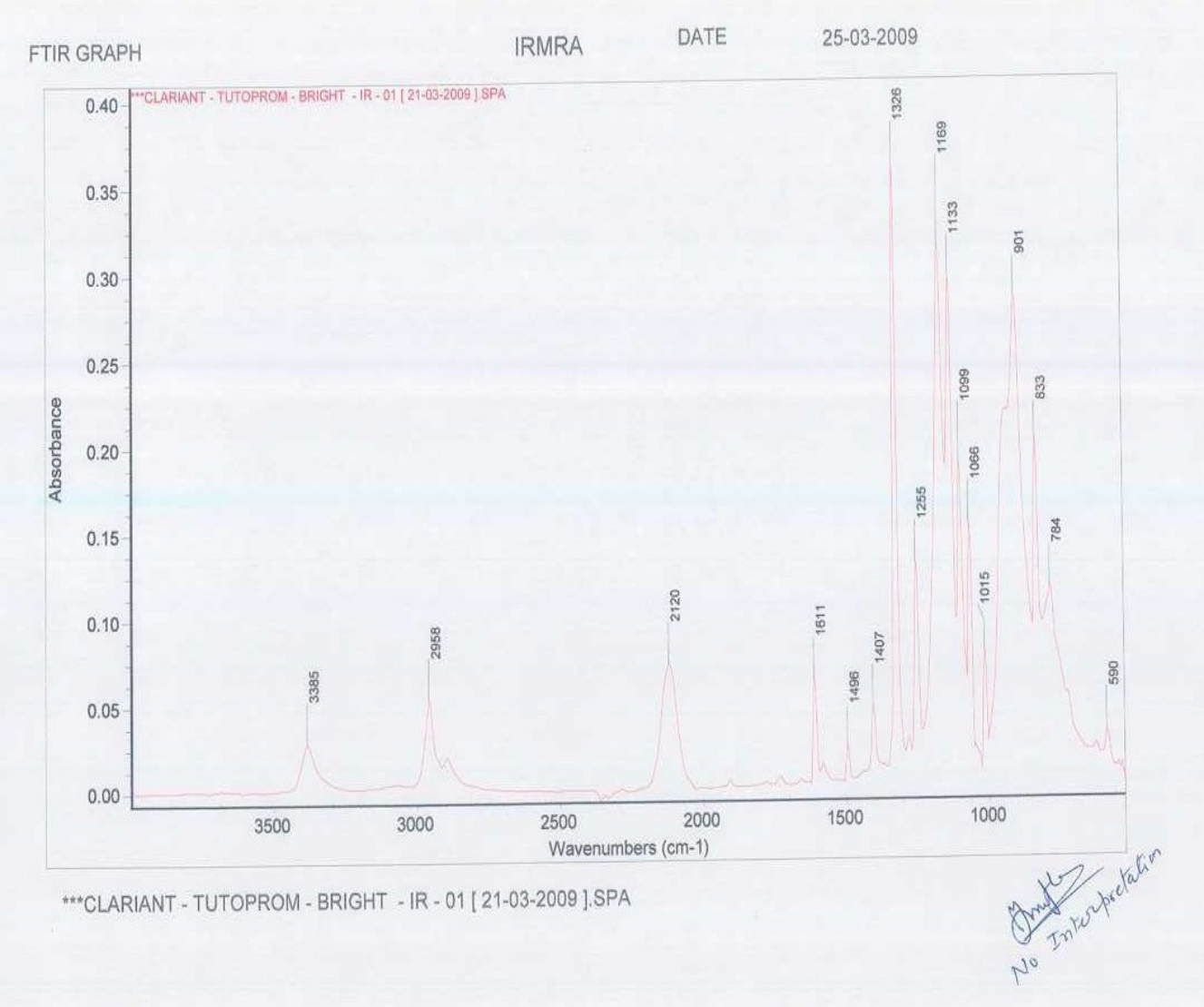
Apparatus : Operating Light and Water-Exposure Apparatus (Fluorescent UV-Condensation Type)

Cycle : 4 Hrs. U.V. Light from UV-B lamps with a peak emission @ 313 nm. and 4 Hours Condensation alternatively.

Temperature : $50^{O}C$

The requirements of this test shall be taken to have been satisfied if performance in respect of the characteristics as noted in of IS: 8662-2004 (Second Revision) Reaffirmed-2019 (or corresponding clause of its latest version) is within the limits.

APPENDIX – V


FTIR GRAPH
IRMRA
DATE
25-03-2009
***CLARIANT - TUTOPROM - BRIGHT - IR - 01 [21-03-2009].SPA
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0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)
3385
2958
2120
1611
1496
1407
1326
1255
1169
1133
1099
1066
1015
901
833
784
590
***CLARIANT - TUTOPROM - BRIGHT - IR - 01 [21-03-2009].SPA
No Interpretation