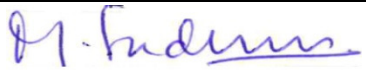







**BEML
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**MRS1 Project
Painting Specification**

Approved	01.06.2020	Sudharshan M	
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REVISION DETAILS

REV. NO.	PAGE	DETAILS		DATE
		FROM	TO	
0	All	First issued		18.03.2020
1	All	Document updated with incorporating Hitachi comments. Sec-3, 7, 8 ,9 , 11 & 12 updated . Also, painting details of other substrates have been added in the document.		06.01.2020



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1. INTRODUCTION

This document describes the painting specification to be followed for painting of under frame, bogie frame & bogie equipments, GFRP Interior panels of both saloon and cab, electrical equipments, doors, exterior cab mask and cab skirt of Driving Motor Car (DMC), Motor car (MC) and Trailer car (TC) for MRS1 Project.

2. TRAIN CONFIGURATION


The basic train configuration of MRS1 project consists of two Driving Motor cars (DMC) cars, two Trailer cars (TC) and two Motor cars (MC).

The train configuration of 6 car formation will be: DMC-TC-MC-MC-TC-DMC

3. APPLICABLE STANDARDS & NORMS

Sl No.	Standard/Code	Title
1	EN 45545	Railway Applications - Fire Protection on railway vehicles
2	BS 3900 E2	Methods of test for paints-Scratch test
3	BS AU 148-15	Methods of test for motor vehicle paints. Resistance to chipping
4	BS 3900 E7	Methods of test for paints- Resistance to impact
5	ASTM D 4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
6	ASTM D 3359	Standard Test Methods for Measuring Adhesion by Tape Test
7	BS EN ISO 2813	Paints and varnishes — Determination of gloss value at 20°, 60° and 85°
8	ASTM D 3363	Standard Test Method for Film Hardness by Pencil Test1
9	ASTM D 6578	Standard Practice for Determination of Graffiti Resistance
10	ISO 2812-1	Paints and varnishes - Determination of resistance to liquids - Part 1: Immersion in liquids other than water.
11	ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
12	ISO 8501	Preparation of steel substrates before application of Paints and related products
13	IS 13183-91	Aluminium Paint, Heat Resistant - Specification
14	IS 1573-1986	Specification for Electroplated coatings of Zinc on Iron and Steel

Table-1: Applicable Standards and Norms

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4. Reference Documents

Sl No.	Doc Id	Title
1	GR/TD/4297	Technical Specification of Carbody Structure
2	GR/TD/4313	System Description of Bogies
3	GR/TD/4781	Detailed description of Bogies
4	GR/TD/4374	System Description of Interior
5	GR/TD/4373	Industrial Design for Car Exterior

5. ABBREVIATIONS

ERTS : Employer's Requirement Technical Specification

ERGS : Employer's Requirement General Specification

DMC : Driving Motor Car

TC : Trailer Car

MC : Motor Car

PDR : Preliminary Design Review

PFDR : Pre Final Design Review

FDR : Final Design Review

6. DESIGN CRITERIA

The painting system on the equipment will comply with Clause 4.4.9, 5.3.6, 14.1.4 and 14.19 of ERTS.

ERTS Clause No.	Description	Compliance	Para no., reference of document where compliance is demonstrated	Remarks
4.4.9	Non-stainless steel surfaces below the floor of the carbody shall be primed with epoxy coating and then finish painted with two coats of an approved polyurethane paint.	Complied.	Covered in Section: 7 and 8 of this document.	
5.3.6	Adequate corrosion protection shall be provided. A corrosion protection control programme for the bogie shall be submitted. This shall comprise of paint protection system of external surfaces.	Complied.	Will be covered in doc no: GR/TD/4306.	



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	The internal areas of the frame shall be completely sealed to avoid moisture ingress after the internal surfaces are protected from corrosion by suitable corrosion resistance substance or any other alternative measure. The corrosion protection plan shall be submitted and got approved during detail design.				
14.1.4	Welding, painting and crimping are considered as special processes. Contractor shall ensure process qualification and validation for these processes and records of the same shall be maintained for scrutiny and review by the Engineer.	Complied.			
14.19	Painting				
14.19.1	All painting processes shall be proven in railway applications, and suitable for the climate of this project, and shall be subject to review. Such processes shall include surface preparation suitable for the material, corrosion preventative priming and high durability finish. Exterior stainless steel, aluminium or their alloys shall not be painted. Bogies shall be treated with primer and an internationally accepted painting system. All steel which will be hidden, except stainless steel, shall be treated with primer and an accepted rust preventative before being concealed. The treatment of copper bearing structural steel shall be subject to acceptance by the Engineer.	Complied.	Covered in Appendix <u>A.D.E</u> of this document.		
14.19.2	Employer expects painting of the equipment/ sub-assemblies as per best International practices. Contractor shall submit the guaranteed life cycles for the paint application for different equipment and sub-assemblies for Engineer's review during design stage.	Complied.			

Table - 2: Compliance Matrix for Related ERTS Clauses

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7. GENERAL

The paint system adopted is that of M/s.KCC, which has been used in all BEML Metro projects and has been proven in Metro Rail application.

Painting will be carried out under covered shed and protected from air, dust and moisture. All painted surfaces will match and display a uniformity of colour throughout its Service Life and shall be easily cleanable with general cleaning agents.

The paint system will meet Fire safety requirement of EN 45545 Part 1 to 7 (Category 4-A, Hazard level HL3) for both Interior and Exterior applications.

8. PROCEDURE OF COATING SYSTEM

The following coating systems shall be followed for the metallic substrates viz., Stainless Steel, Mild Steel, Aluminium or Glass fiber Reinforced Plastic (GFRP).

SYSTEM 1

The system shall be applied to the metallic substrates like Mild Steel and aluminium. Please refer Appendix- A.

SYSTEM 2

The system shall be applied to the GFRP, Other laminate and Aluminium substrates used for interior panels.. Please refer Appendix-B

SYSTEM 3


The system will be applied to the exterior of GFRP Cab Mask & Cab Skirt. Please refer Appendix - C

SYSTEM 4

Painting of internal surfaces of bogie frame. Please Refer Appendix - D

SYSTEM 5

Anti-drumming compound will be applied to the under floor i.e. under the keystone plate of car body. At the interference area with bolster, center-sill, cross beam, etc., this system shall be applied to only accessible area. Mask the under frame areas like cross beam member, jack pad, centre pivot area etc by using masking tape except keystone plate area.

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Please refer Appendix E - For Painting procedure & Appendix F for Insonastic AQ NF data sheet for more detailed technical description.

Note: The primer and finish coating shall be applied on exposed mild steel area below floor level. The accessible parts of under floor shall be provided with anti-drumming and noise suppression paint. Unless otherwise noted, all colors of finish coat below floor level shall have a semi gloss, NCS 8500N colour, except the following:


- ◆ Application of primer only: Bolster closed area (hollow area), air bag contact plate and coupler mounting plate and coupler mounting hole.
- ◆ No application of primer and finish: Earth pad, mounting plate for centre pivot, mounting plate for anti-roll bar, plate on air bag, end face of end sill etc.
- ◆ One coat of finish paint shall be applied on bogie after complete assembly.

9. SPECIFICATION OF COATING THICKNESS

Case of the specified average: Mean thickness (Nominal value). This value is mandatory subjected to a tolerance.

In this case, an arithmetic thickness is to be complied with.

TABLE OF PAINTING PRODUCTS AS PER THE RULE OF THE SPECIFIED AVERAGE					
PRODUCTS		Nominal value	Minimum value	Maximum value	Maximum point (Individual points)
System 1	Primer 1	50 µm	40 µm	80 µm	120 µm
	Finish 1	50 µm	40 µm	80 µm	120 µm
System 2	Primer (Aluminium)	30 µm	30 µm	60 µm	90 µm
	Finish (Aluminium)	50 µm	40 µm	80 µm	120 µm
	Primer (GFRP)	50 µm	40 µm	80 µm	120 µm
	Finish (GFRP)	50 µm	40 µm	80 µm	120 µm
System 3	Primer	40 µm	35 µm	70 µm	105 µm
	Finish 1	30 µm	30 µm	60 µm	90 µm
	Finish 2 (Clear Coat)	30 µm	30 µm	60 µm	90 µm
System 4	Finish 1	20 µm	15 µm	30 µm	45 µm


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	Finish 2	20 µm	15 µm	30 µm	45 µm	
System 5	Finish	1000 µm	800 µm	1600 µm	2500 µm	

For the thickness of system 5, the real measurement point will be center of each corrugation.

10. PAINTING METHOD AND COLOURS

Finished colours are defined in the Natural Colour System (NCS) and RAL shades.
The following are the colour shades painted in different regions of MRS1 cars.

		Substrate	Painting System	Finish Color	Gloss level
1. Bogie					
- Bogie frame		Steel	1	NCS 8500N	Semi Gloss
- Internal surfaces of bogie frame		Steel	4	Aluminium	Semi Gloss
2. Under frame					
(a) Bolster Assy, Sill Assy. Center, pad Jacking, Anti Climber & Stiffener		Steel	1	NCS 8500N	Semi Gloss
(b) Beneath key stone plate (Anti-drumming compound)		SUS	5	-	-
(c) Underframe except (a) & (b)		SUS	No painting	Metal colour	-
3. Interior (Saloon)					
- Interior side panels		GFRP	2	RAL9010	Semi Gloss
- End Cubicle panels		GFRP	2	RAL9010	Semi Gloss
- Ceiling end panels		GFRP	2	RAL9010	Semi Gloss
- Ceiling panels		Al honeycomb	2	RAL9010	Semi Gloss
- Return air grille for saloon		Al	2	RAL9010	Semi Gloss
- Duct panels		Al	2	RAL9010	Semi Gloss
- Air diffuser	Line-2-Yellow	Al	2	RAL1021	Semi Gloss
	Line-7- Red	Al	2	RAL3028	Semi Gloss
- Bulkhead panel (Draught screen)		Al	2	RAL9010	Semi Gloss
Infill strip panels		G.F.R.P	2	RAL9010	Semi Gloss
- Door coving & Ceiling coving panels		G.F.R.P	2	RAL9010	Semi Gloss
4. Interior (Driver's Cab)					

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	Substrate	Painting System	Finish Color	Gloss level
- Front panels	G.F.R.P	2	RAL9010	Semi Gloss
-Front upper panels	G.F.R.P	2	RAL9010	Semi Gloss
- Side panels	G.F.R.P	2	RAL9010	Semi Gloss
- Partition wall panel	Al honeycomb	2	RAL9010	Semi Gloss
- Ceiling panel	Al honeycomb	2	RAL9010	Semi Gloss
- Inspection covers (Cab area) in Non-UTO & UTO	G.F.R.P	2	RAL9010	Semi Gloss
- Driver's desk (except operation panels, equipment)	G.F.R.P	2	RAL9010	Semi Gloss
- Auxiliary desk (except equipment)	G.F.R.P	2	RAL9010	Semi Gloss
- Driver's seat frame	Steel	1	Gray NCS 5500N	Semi Gloss
- Partition door	Al honeycomb	2	RAL9016	Semi Gloss

5. Electric Equipment

- Passenger saloon light. DC	Al	2	RAL9010	Semi Gloss
- Gangway light	Al	2	RAL9010	Semi Gloss
- Cab main light	Al	2	RAL9010	Semi Gloss
- Driving Console light	PC	2	RAL9010	Semi Gloss
- Flasher light / Flood light	Al	2	RAL9005	Matt
- Head & Tail light	GRP/PUR cast	2	RAL9005 (Tentative, TBU)	TBD


6. Exterior

-Cab Mask	Blue Zone	G.F.R.P	3	PANTONE 287C	High Gloss
	Black zone	G.F.R.P	3	RAL9005	High Gloss
- Cab Skirt		G.F.R.P	3	PANTONE 287C	High Gloss
- Passenger Door Skin	Exterior	SUS	-	No Painting	-
	Interior	SUS	-	No Painting	-

* Note: SUS – Stainless Steel
Al – Aluminum
High Gloss 80 ±10
Semi Gloss 50±10

11. TOUCH UP & REPAIR PROCEDURES

The damage area and the surrounding area should be cleaned and degreased with

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thinner or acetone.

Any loose, flaking coating of finish coat should be abraded with either 120-240 grade sanding paper using mechanical or manual methods depending on the extent and degree of damage. After the abrading operation, any residual debris and dust must then be removed using vacuum brush. The abraded areas should then be further degreased with acetone.

If the substrate is exposed, apply primer and finish coat as per coating systems. If the substrate is not exposed and primer is intact after abrading, apply only finish coat as per coating systems.

When the repair area is very less, touch up with brush for repair. however when the area is large, spray-coating to be adopted.

11.1. Graffiti Removal

The graffiti made of different markers on painted surface shall be removed as per ASTM D 6578.


12. PERFORMANCE FOR PAINTS

The paints used will be tested and satisfied for limited fire hazard performance according to the EN 45545 Part 1 to 7 (Category 4-A, Hazard level HL3).


12.1. FIRE PERFORMANCE

The paints will be tested for fire performance as follows.

Requirement set (used for)"	Test method reference	Parameter and unit	Maximum or Minimum	HL3
R1	T02 ISO 5658-2	CFE (kW/m ²)	Minimum	20
	T03.01 ISO 5660-1: 50kW/m ²	MARHE (kW/m ²)	Maximum	60
	T10.01 EN ISO 5659- 2: 50kW/m ²	T10.01 EN ISO 5659-2: 50kW/m ²	Maximum	150
	T10.02 EN ISO 5659-2: 50kW/m ²	VOF ₄ min	Maximum	300
	T11.01 EN ISO 5659-2: 50kW/m ²	CIT _G dimensionless	Maximum	0.75
Fire Propagation				

 NEW FRONTIERS, NEW DREAMS	Painting Specification For MRS1 Project	DRCA No.	MRS1/IE.10.00/M/B008/A1		
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R7 (EX3,EX8)	T02 ISO 5658-2 Lateral Flame Spread	CFE kWm ⁻²	Minimum	20
	T03.01 ISO 5660-1: 50 kWm-2 Heat Content Reaction to fire tests - Heat Release, Smoke Production and Mass loss rate - Part -1 : Heat Release Rate (Cone Calorimeter method)	MARHE kWm ⁻²	Maximum	60
	T10.04 EN ISO 5659-2: 50 kWm-2 Smoke Density	D _s max dimensionless	Maximum	300
	T11.01 EN ISO 5659-2: 50 kWm-2 Toxicity	CIT _G dimensionless	Maximum	1.5
	R9(EX9,EX10)	T03.02 ISO 5660-1: 25 kWm-2 Heat Content Reaction to fire tests - Heat Release, Smoke Production and Mass loss rate - Part -1 : Heat Release Rate (Cone Calorimeter method)	MARHE kWm ⁻²	Maximum
T10.03 EN ISO 5659-2: 25 kWm-2 Smoke Density		D _s max dimensionless	Maximum	300
T11.02 EN ISO 5659-2: 25 kWm-2 Toxicity		CIT _G dimensionless	Maximum	1.5
R17		T02 ISO 5658-2	CFE (kW/m ²)	Minimum
	T03.01 ISO 5660-1: 50kW/m ²	MARHE (kW/m ²)	Maximum	60
	T10.04 EN ISO 5659-2: 50kW/m ²	D _s max dimensionless	Maximum	300
	T11.01 EN ISO 5659-2: 50kW/m ²	CIT _G dimensionless	Maximum	1.5
Requirement set (used for)"	Test method reference	Parameter an d unit	Maximum or Minimum	HL2
R10 (IN1C)	T04 EN ISO 9239-1 Horizontal Flame spread	CFE kWm ⁻²	Minimum	6
	T03.02 ISO 5660-1: 25 kWm-2 Heat Content Reaction to fire tests - Heat Release, Smoke Production	MARHE kWm ⁻²	-	-

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	and Mass loss rate - Part -1 : Heat Release Rate (Cone Calorimeter method)				
	T10.03 EN ISO 5659-2: 25 kWm-2 Smoke Density	D_s max dimensionless	Maximum	300	
	T11.02 EN ISO 5659-2: 25 kWm-2 Toxicity	CIT_G dimensionless	Maximum	0.9	

13. Appendices

- Appendix A : System Recommendation – Protection of metallic substrates
- Appendix B : System Recommendation – Protection of phenolic GFRP & Aluminium Substrates used for Interiors
- Appendix C : System Recommendation – Protection of Exteriors GFRP- Cab Mask, & Cab Skirt
- Appendix D: Painting procedure for Bogie frame internal surfaces
- Appendix E: Painting procedure for anti drumming paint.
- Appendix F: INSONASTIC AQ NF Data Sheet

14. Attachments

- Attachment - 1: Inspection Check sheet for Shot blasting, primer & finish painting of Bogie assembly.
- Attachment - 2: Inspection Check sheet for painting bolster & center sill.
- Attachment - 3: Inspection Check sheet for Anti drumming Paint of Under frame.
- Attachment - 4: NCS Color Code Sheet.