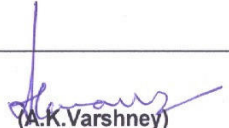


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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company	<u>PROCESS FOR STANDARD AIR DRYING PAINT FINISH FOR TRACTION MACHINES</u> (THIS SPEC.SUPERSEEDS SPEC. NO. BP0674184)					
	1. <u>GENERAL:</u> This standard details the process to be followed to provide the standard paint finish for traction motors, traction generators/alternators, motor generators, motor alternators & ECC Auxiliary machines. The finishing of the outer surfaces of the field coils and armature, including commutators and creepage surfaces, is covered by the appropriate Insulation Process Specifications where a special finish is required, it will be called for on the appropriate drawings and specification sheets.					
	2. <u>MATERIALS:</u> 2.1 <u>Materials Required:</u> (The materials shall be used after ensuring that material TC's is as per the requirement of paint specification & expiry date of paint is not crossed.)					
	2.1.1 Anti Corrosive priming paint to AA56101 (Red). 2.1.2 Epoxy primer paint to AA56109. 2.1.3 Epoxide primer paint to AA56105. 2.1.4 High Quality full Glossy Out Door Finishing paint to AA56126 (Traffic Green/Black). 2.1.5 Polyurethane finishing paint to AA56142. 2.1.6 Paint to AA56128 (Aluminum). 2.1.7 Chemical resistant epoxide finishing paint to AA56131. 2.1.8 Oil Resistant Air Drying Synthetic Enamel to AA56132 (Jasmine Yellow shade). 2.1.9 Epoxy Red Gel Coat (Base, Hardner & Diluent) to BP27476 or Anti Tracking Red Insulating Varnish to BP 27599 or Bectol Red- Prop of M/s Dr Beck & Co.Pune. 2.1.10 Etch Primer to AA56103.					
Revision : 03 Date: 18.01.14		Distribution TXM TAM TGM/TNX QTM TME	Qty. 1 1 1 1 2	Approved :  (A.K.Varshney) Prepared  (R.Chaudhry) Checked:  (M.Verma) Date: 18.01.14		

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED It must not be used directly or indirectly in any way detrimental to the interest of the company	2.1.11 Grey Insulating Enamel to BP 27595. 2.1.12 White Spirit Gr. 145/205 to AA56701. 2.1.13 Xylole-Industrial Solvent Grade to AA56703. 2.1.14 Special Thinner for Epoxy Red Gel Coat/MEK. 2.1.15 Derusting Solution (hydrochloric acid/sulphuric acid) to BP0690086. 2.2 <u>Consistency of Materials at normal shop temperature in cup No.4 of IS:3944:</u> <table><tr><th>Paint</th><th>Thinner</th><th>Applicant</th><th>Consistency in Seconds to 27⁰ C</th></tr><tr><td>AA56101 (Red)</td><td>White spirit</td><td>Spray</td><td>30±27 sec</td></tr><tr><td>AA56126 (Traffic Green / Black / Light Grey)</td><td>-do-</td><td>-do-</td><td>-do-</td></tr><tr><td>AA56128 (Aluminum)</td><td>-do-</td><td>-do-</td><td>-do-</td></tr><tr><td>AA56142</td><td>As recommended by supplier</td><td>-do-</td><td>-do-</td></tr><tr><td>AA56131</td><td>-do-</td><td>-do-</td><td>-do-</td></tr><tr><td>AA56132(Jasmine Yellow)</td><td>White Spirit</td><td>-do-</td><td>-do-</td></tr><tr><td>BP25795</td><td>Xylole</td><td>-do-</td><td>-do-</td></tr><tr><td>BP27476/ BP2799 Becktol Red.</td><td>Special Thinner/ MEK</td><td>-do-</td><td>30 – 40 secs</td></tr></table>			Paint	Thinner	Applicant	Consistency in Seconds to 27 ⁰ C	AA56101 (Red)	White spirit	Spray	30±27 sec	AA56126 (Traffic Green / Black / Light Grey)	-do-	-do-	-do-	AA56128 (Aluminum)	-do-	-do-	-do-	AA56142	As recommended by supplier	-do-	-do-	AA56131	-do-	-do-	-do-	AA56132(Jasmine Yellow)	White Spirit	-do-	-do-	BP25795	Xylole	-do-	-do-	BP27476/ BP2799 Becktol Red.	Special Thinner/ MEK	-do-	30 – 40 secs
	Paint	Thinner	Applicant	Consistency in Seconds to 27 ⁰ C																																			
	AA56101 (Red)	White spirit	Spray	30±27 sec																																			
	AA56126 (Traffic Green / Black / Light Grey)	-do-	-do-	-do-																																			
	AA56128 (Aluminum)	-do-	-do-	-do-																																			
	AA56142	As recommended by supplier	-do-	-do-																																			
	AA56131	-do-	-do-	-do-																																			
	AA56132(Jasmine Yellow)	White Spirit	-do-	-do-																																			
	BP25795	Xylole	-do-	-do-																																			
	BP27476/ BP2799 Becktol Red.	Special Thinner/ MEK	-do-	30 – 40 secs																																			
For application by spray, the paints shall be obtained ready for use or thinned down to the flow time shown on the chart when measured at the shop temperature. The consistency of the paint require adjustment, the appropriate thinner given in the above chart shall be used.																																							



2.3 Compatibility chart for Primer Paint & Finish Paint:

Primer Paint	Finish Paint
AA56101	AA56126 / AA56128
AA56105	AA56131
AA56109	AA56142

For achieving better quality of painting, the combinations of primer paint & finish paint as mentioned in above table shall be used.

2.4 MIXING OF PAINTS:

2.4.1 Before application, any skin formed on the paint in the tin shall be carefully removed, any settled pigment broken up and loosened, and the paint shall be thoroughly stirred to ensure complete and uniform mixing of the constituents. Care shall be taken to avoid air entry into the paint whilst stirring.

2.4.2 AA56103/ AA56105/ AA56109 PRIMER:

AA56103/AA56105/ AA56109 primer as supplied consists of two separate ingredients Viz primer base and accelerator. Shortly before use mix together primer base and accelerator in the proportion 1:1 by volume or as recommended by supplier, care being taken not to entrain air while mixing. It is important that only small quantity of primer which can be consumed within 4 hours can be mixed. Further thinning of the paint prepared as above is not required for application by spraying.

2.4.3 EPOXY RED GEL COAT (BP27476):

This consist of 3 parts viz Epoxy red gel coat, Hardner EH411 and Diluent C. These to be mixed in the ratio 100:40:10 by weight. Should the consistency of the paint require adjustment the same to be done by using special Thinner/MEK.

3. APPLICATION :

A complete paint (as per Table 1, 2, 3 & 4) should be applied so that the equipment has a well finished appearance & adequate protection against corrosion. It is important that each coat of paint is completely dry before the next is applied. **The paint shall be applied by spraying only.**

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company		4. <u>SURFACE PREPARATION & CHECKING OF SURFACE FINISH (BEFORE PRIMER PAINTING):</u> 4.1 SHOT/SAND BLASTING: The jobs shall be shot/sand blasted as per the requirement mentioned in respective drawing/purchase order/QAP. 4.2 DRESSING AND GRINDING: All flame-cut edges, welds and any major imperfections on the work shall be dressed, by grinding as to leave no sharp edges or protrusions. 4.3 DEGREASING: The surfaces shall be degreased where necessary using white spirit to AA56701 with brush or clean dry cloth. 4.4 REMOVE OF RUST FROM STEEL SURFACES: Before painting, the whole surface to be painted shall be free from rust and scale. If rust is present, it shall be removed as follows : 4.4.1 LIGHT RUST : If a thin film of very light rust exists on the work, it shall be removed by means of "Derusting Solution" (hydrochloric acid/sulphuric acid) to BP0690086. After degreasing as in Clause 4.3 above, Derusting solution (2.1.14) shall be applied in a thin film, using a brush or swab and left for 10-15 minutes. At the end of this period and before it has dried, it shall be wiped off with a clean, dry cloth and the surface examined. If any red rust is still visible, further similar application shall be made until the surface exhibits a grey colour only. The surface shall then be allowed to dry, and be brushed down with a clean, dry brush before painting. 4.4.2 HEAVIER LOCALIZED RUST: If rusting has occurred locally but to such an extent that some pitting, with hard rust flakes is exhibited, the rust shall first be removed using either emery cloth, steel scratch brush, or a portable power tool with abrasive wheel. The affected surface shall then be treated as in Clause 4.4.1 above. 4.4.3 WIDE SPREAD RUST: To remove wide spread rust, the job shall be shot/sand blasted so as to produce a clean, grey metallic surface.	

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company	4.4.4 MILL SCALE:			
	The thick hard mill scale formed on hot-rolled steel cannot be removed by light shot blasting, although the appearance after so treating gives the impression of a uniform clean metal surface. If heavy shot-blasting cannot be applied to material carrying such scale, it shall either be “weathered” for removal followed by treatment as in Clause 4.4.3 above or pickled. If the steel is painted within six hours of pickling and drying, shot blasting will not be required before painting.			
	4.5 REMOVAL OF OLD PAINT (BEFORE PAINTING OF REPAIRED JOBS):			
	i) For removal of old paint, air/electrically operated sander machine with air circular sander paper shall be used. Circular emery paper shall be used as under: • Paper roughness count 40/60 for coarser removal. • Paper roughness count 80 for finer removal. ii) By applying sander, it must be ensured that all previous coats of paint including primer are fully removed and bare metal is visible. iii) If rust be present, the sander may be applied for a longer duration such that white metal is visible. iv) Being stubborn putty may take a little longer to get removed. Removal of putty is absolutely must, as proper adhesion over the putty is simply not possible and if left on the surface, it will result in peeling off the paint over above the putty in future. v) Clean the job by using pressurized air and cotton rag.			
4.6 CHECKING OF SURFACE FINISH:				
The surface finish of the components based on its manufacturing process shall be as per IS: 3073.				
5. <u>PAINTING OF TRACTION MACHINE COMPONENTS:</u>				
After carrying out surface preparation as per clause 4.0 of this specification, the painting of traction machines components shall be carried out as given below:-				

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED It must not be used directly or indirectly in any way detrimental to the interest of the company		5.1 APPLICATION OF PRIMER PAINT: 5.1.1 STEEL COMPONENTS (CASTINGS/FABRICATIONS): 5.1.1.1 All steel castings and fabrications shall be painted with two coats of priming paint as detailed below. 5.1.1.2 The surface of castings/fabrications shall be prepared as per CL.4.4.3. 5.1.1.3 Redoxide zinc chromate priming paint/epoxide primer paint from any of the reputed paint manufacturers like Shalimar, Garware, Jenson & Nicholson, Goodlass, Nerolac, Alkali chemicals, Bombay paints, Asian shall be used. The paint shall be applied by spraying only. The viscosity of the priming paint shall be as per Cl.2.2. After the application of first coat of appropriate compatible primer by spray, second coat of primer paint shall be applied only by spraying after 24 hours of first coat to create smooth and uniform adherence surface. Thereafter, again after 24 hours of drying of 2nd coat of primer, two coats of finish paint shall be applied. 2nd coat of finish paint shall be applied only after proper drying of 1st coat i.e. minimum 24 hours to give glossy smooth finish. The components shall be allowed to dry for at least 24 hours before handling. In raining/winter season, 24 hours drying time may be insufficient to completely dry the paint. In such cases, drying time of paint can be maintained by increasing the temperature of the incoming air or by heating the components in oven. 5.1.2 PRIMING OF FINISHED COMPONENTS: 5.1.2.1 COMPONENTS AND SURFACES NOT TO BE PRIMED: As general rule priming will not be applied to any components within the machine frame. Any exception not mentioned herein will be called for on the drawing. In particular, priming paint will not be applied to any of the following components: - Surface of castings in contact with oil or grease. - Light alloy and glass fibre components. - Pole laminations. - Machined surfaces of the components*. - Surfaces subsequently insulated or to be bonded with epoxy or other resins. - Surfaces or rotating parts. - Brush gear. *Note: The machined surfaces of the components shall be protected with TRP (temporary rust preventive).	



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5.2 APPLICATION OF FINISH PAINT:

The paint specification, colour and number of coats required for various components are as given below:-

Table no.	Component details
1	Finishing paint non-rotating parts of traction machines.
2	Finishing paint for rotating parts of traction machines.
3	Finishing paint for miscellaneous equipments.
4	Final finish paint/colour to be applied on traction machines.

The paint finishes shall be applied after degreasing by wiping surfaces using a rag soaked in white spirit to AA56701. In normal shop conditions, a period of 24 hours shall be allowed for air drying of paints. Finish paints are to be applied by means of spraying. Epoxy red gel coat is applied by means of brushing only.

6. APPLICATION OF FINAL TOUCHING COAT OF FINISH PAINT AFTER ASSEMBLY (INSIDE BHEL):

In case of any removal/damage to painted surfaces during processing (machining/handling) of the component, the final touching coat of finish paint as per table no. 4 shall be applied on the traction machines (inside BHEL) which are in completely assembled condition & ready for dispatch. The paint shall be applied by spraying.

Note: For the exterior surfaces of the traction machines subjected to VPI process, the final touching coat of finish paint shall be applied after removal of the varnish (in hot condition) by means of wiping with cloth.

7. INSPECTION FOR PROCESS CONTROL:

- 7.1** Quality Control Inspector shall visually inspect the finished components (as per clause 5.0) for various paint film defects such as gloss, uniformity of shade, wrinkles, orange peel effect, blistering etc.
Condition of surface of the components (prepared as per clause 4) before application of 1st coat of primer shall be ensured by BHEL/BHEL authorised third party inspecting agency at supplier's works.

7.2 THICKNESS :

7.2.1 TWO COATS PRIMER:

35-60 microns by suitable measuring gauges.

7.2.2 OVERALL PAINT THICKNESS AFTER TWO COATS FINISHING PAINT (SPECIFIED COLOUR):

70-120 microns with high spots of 150 microns by suitable measuring gauge.



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TABLE NO. 1

FINISHING PAINT FOR NON-ROTATING PARTS OF TRACTION MACHINES

Part	Traction Motors		Other Machines	
	Paint	Coats	Paint	Coats
Exterior surfaces of machines including gearcase	AA56126 (Black)	2	AA56126 (Traffic Green)	2
	AA56126 (Traffic Green)	2	AA56126 (Light Grey)	2
	AA56142 (Light Grey)	2	-do-	2
Interior Surface of machines	AA56126 (Traffic Green)	2	-do-	2
	AA56131	2		
Surface in contact with Lubricant	AA56132 (Jasmine Yellow)	2	AA56132 (Jasmine Yellow)	2
		2		2
Terminal Box Interiors	BP27476/ BP27599 Becktol Red.	2	BP 27595	2
Field coils & Connections : See appropriate Insulation Sketch/CIT064				
Brush gear and brush : Plant Standard BP0674183 to be followed				
Gear Insulators				

NOTES:

1. Light alloy & glass fibre cover and other readily detachable parts in the traction machines shall not be painted.
2. If required, interior surface of frames and poles may be finished with the Red Gel coat for adjacent coils, cable etc.
3. Epoxy bonded components must not be painted prior to bonding.

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TABLE-2
FINISHING PAINT FOR ROTATING PART OF TRACTION MACHINES

Part	Paint	Coats	Remarks
Steel Fans: 1) TM4601, TM4603	AA56126 (Traffic Green)	2	-
2) AG3101, AG2702, TA10102	AA56126 (Light Grey)	2	
Alloy Fans	AA56126	2	Balance weights shall also be painted with 2 coats of AA56126 (Traffic Green)

TABLE-3
FINISHING PAINT FOR MISCELLANEOUS EQUIPMENT

Equipment	Part	Paint	Coats
Eddy Current Clutch and gear boxes surface	Steel surfaces	AA56126 (Traffic Green)	2
	Coil	See Insulation Spec.	-
	Interior of gear box	AA56132	2

TABLE-4

Type of machine	Paint/Colour
TM4906AZ	AA56126(Black)
TM4907BZ	-do-
TM4603AZ	-do-
HS15250A	-do-
TM3701AZ	-do-
TM5002AZ	IS:51994 (Light grey) (631 export) & Black for WDP2
TM4303CZ/BY & TM4303DY	Traffic Green for CZ/BY (EMU & MEMU application) & Black for DY (DEMU application)
TM4601AZ	AA56126(Traffic Green)
ECC9005/2/M	-do-

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Type of Machine	Paint/Colour
TG10919AY	AA56126(Light Grey)**
TG10931AZ/M	-do-
AG51/M	-do-
AG3101	-do-
AG2513AZ/M	-do-
AG2501AZ/M	-do-
AG2702AZ/AX/BX/BY	-do-
GB12A/M	-do-
GB13A/M	-do-
MA3501AZ	-do-
TG4302AZ	-do-
TAO-659	-do-
TA10102 & TA10106	-do-
BM2101AZ	AA56128 (Aluminium)
DY3423/M	-do-
MG51BX/CW	AA56126(Black)
AG903CW	-do-
AG1404AZ	-do-

(**) - For the component drawings in which painting as per specification AA56125 is called, the paint to specification AA56126 shall be considered in place of AA56125.

8. ADHESION BY TAPE TEST:

This test is carried out by applying & removing pressure sensitive adhesive tape over cuts made in the paint film to ensure that adhesion of paint film to metallic substrate is adequate.

The test shall be carried out generally in line with ASTM D 3359 except that Transparent Pressure Sensitive Adhesive Tape of 25mm width, shall conform to IS: 2880 or should bear ISI Mark.

Method A of ASTM D 3359 shall be followed in case thickness of film is greater than 125 microns & acceptance criterion shall be "4A", Viz. trace peeling or removal along inclusions, and method B of ASTM D 3359 shall be followed when thickness of paint film is between 50 to 125 microns and acceptance criterion shall be "4B", Viz. small flakes of the coating are detached at intersections, less than 5% of the area is affected.



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Annexure-I

Acceptance criteria for Painting of Traction Machines

The acceptance criteria for the check points, which are to be ensured during painting of Traction Machines as per the requirements of specification TM94217, are as given below. The supplier to furnish below mentioned check points for each component in the format as per annexure-II along with consignment.

1) Checking of Painting Material:

Sl. no.	To be checked	Acceptance criteria
i.	Expiry date of primer paint.	Primer paint shall be within expiry date.
ii.	Expiry date of finish paint.	Paint shall be within expiry date.
iii.	Verification of supplier's TC as per paint specification.	Painting material shall be used only after verification of TC.

2) Surface Preparation (Before Primer Painting):

Sl. no.	Operation	Acceptance criteria
i.	Dressing & grinding of all flame-cut edges, welds & any major imperfections.	No sharp edges or protrusions.
ii.	Degreasing by using white sprite to AA56701 & removal of varnish in wet condition.	Free from grease & varnish.
iii.	Removal of light rust by hydrochloric acid/sulphuric acid to BP0690086 and removal of heavier localized rust by using emery cloth, steel scratch brush or portable power tool with abrasive tool & then applying hydrochloric acid/sulphuric acid.	Surface should exhibit grey colour in place of red rust.
iv.	In case surface is widely rusted to such an extent that pitting with hard rust flakes is exhibited, the surface shall be sand/shot blasted.	Surface should exhibit clean & grey colour in place of red rust.
v.	Visual inspection of condition of surface of components before application of primer paint.	As per the requirement of clause 4.
vi.	Checking of surface finish of the components.	Surface finish shall be as per IS:3073.

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3) Measurement of Primer Paint Thickness (As per AA0674105):

Sl. no.	Description of Paint	Acceptance criteria
i.	Measurement of paint thickness after two coats of primer paint as per clause 2.1.1, 2.1.2 & 2.1.3 of AA0674105.	35-60 microns

4) Inspection for Process Control (After Finish Painting):

Sl. no.	Type of inspection	Acceptance criteria
i.	Visual inspection of finished components for various paint film defects such as gloss, uniformity of shade, wrinkle, orange peel effect, blistering etc.	Free from paint film defects.
ii.	Measurement of total thickness of paint as per clause 2.1.1, 2.1.2 & 2.1.3 of AA0674105.	70-120 microns with high spots of 150 microns

5) Adhesion by Tape Test (As per ASTM D3359):

Sl. no.	Description of Test	Acceptance criteria
i.	Test is carried out by applying & removing pressure sensitive adhesive tape over cuts made in the paint film as per clause 7 of ASTM D3359.	Adequate adhesion of paint film to metallic substrate. Acceptance criteria shall be "4B" of ASTM D3359, viz small flakes of the coating are detached at intersections, less than 5% of the area is affected.

Note: The sample size for quality checking of painting of traction machines should be as per IS: 2500 Part-2, Level 4 and AQL 1% as mentioned below:-

<u>Lot size</u>	<u>Sample size</u>
2 to 8	3
9 to 15	3
16 to 25	4
26 to 50	5
51 to 100	7
101 to 150	10
151 to 300	15
301 to 500	20

Imp.: When sample size equals or exceeds lot size, every item in the lot shall be inspected.



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Annexure-II

Checklist for Painting of Traction Machines

Machine type:

Machine/Component no.:

Date of Painting:

Sl. No.	Check points as per the requirement of annexure-I	Checking Remark (100%TP & 20%QC)
1.	Checking of Painting Material: i. Expiry date of primer paint ii. Expiry date of finish paint iii. Verification of supplier's TC as per paint specification	 (ok/not ok) (ok/not ok) (ok/not ok)
2.	Surface Preparation (Before Primer Painting): i. Visual inspection for absence of sharp edges or protrusions ii. Visual inspection for absence of grease & varnish iii. Visual inspection for absence of light rust iv. Visual inspection for absence of widely spread rust v. Visual inspection for condition of surface as per the requirement of clause 4 vi. Surface finish of the component	 (ok/not ok) (ok/not ok) (ok/not ok) (ok/not ok) (ok/not ok)microns (ok/not ok)
3.	Measurement of Primer Paint Thickness: i. Paint thickness after two coats of primer paint	microns (ok/not ok)
4.	Inspection for Process Control (After Finish Painting): i. Visual inspection of finished component for absence of paint film defects ii. Total thickness of paint	 (ok/not ok)microns (ok/not ok)
5.	Adhesion by Tape Test (As per ASTM D3359): i. Adhesion by tape test	 (ok/not ok)

Abbreviations:-

TP – Task Performer, QC – QTM/BHEL Authorized Quality Inspection Agency

Note: 1) For the components supplied by the supplier in finish painted condition, the supplier to furnish dully filled checklist for each component along with consignment.

2) The acceptance criteria shall be as per annexure-I.

(Task performer's signature)

(QC's signature)

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