



भारत सरकार-रेल मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

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सं० आर.डी.एस.ओ./पी.ई./एस.पी.ई.सी./टी.एल./0021-2005 (संशो. 3) with Amendment No. 1
RDSO Specification No. RDSO/PE/SPEC/TL/0021/2005 (REV '3') with Amendment No. 1

TECHNICAL SPECIFICATION FOR BRUSHLESS DC RAILWAY CARRIAGE FAN
(SENSORLESS)

S.N.	Date of rev./amd t.	No. of pages	REV.	Reasons for revision/ amendment
1.	18.12.00	13	'0'	First issue
2.	30.11.05	13	1	To incorporate new material for blades in line with conventional fan, modify various clauses based on the experience gathered during prototype testing of various make BLDC Fans. To include environmental tests as per IEC-60571 (1998-02) and vibration tests as per IEC-61373(1999).
3.	00.03.12	12+4	2	To improve the reliability by removing sensor magnet and hall sensor including standardization.
4.	20.11.15	12+3	3	To delete sensor magnet type BLDC fan related content, adding standardization related content and for improvement in maintainability & reliability.
5.	27.04.16	11+3	Amendment No.1	To incorporate latest revision of drawing and correction in parameters in Rev.'3' for improvement in maintainability & reliability.

अनुमोदित
APPROVED

Nasim
27.04.16
कार्यकारी निदेशक/पी.एस. एवं ई.एम.यू.
Executive Director / PS & EMU

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TECHNICAL SPECIFICATION FOR BRUSHLESS DC RAILWAY CARRIAGE FAN**0.0 FORWARD:**

Previously, 110Vdc fixed and swiveling type fans of different sweeps having commutation with the help of carbon brushes were being used in self-generating coaches and dc EMUs. Maintenance and replacement of carbon brushes & their holders including maintenance of commutator of these fans had been great concern to Indian Railways in addition to its low efficiency, reliability and excess noise. In order to reduce maintenance cost, weight, operational cost and to enhance efficiency, reliability, service life and aesthetic of these fans implementing the latest state of art technology in this field, this specification for brushless DC railway carriage fan has been prepared for guidance of manufacturers for their design and development.

Specification is now revised for deleting sensor magnet type BLDC fan related content, adding standardization related content and for improvement in maintainability & reliability.

1.0 REFERENCE TO VARIOUS SPECIFICATIONS:

The latest following standards shall be referred to:-

Standards	Description
IS:6680	Specification for Railway Carriage Fans
RDSO Spec No. ELRS/SPEC/SI/0015-Oct-2001	Reliability of Electronics used in rolling stock application
IEC 60571	Electronic Equipment used on Rail vehicles
IEC 60571-1	Electronic equipment used on rail vehicles Part 1: General requirements and tests for electronics equipment
IS: 616	Safety requirements for mains operated electronics or related apparatus for household and similar general use
IEC 61373	Railway applications –Rolling stock Equipment –Shock & Vibration tests

2.0 SCOPE :

- 2.1** This specification covers the requirements of design, manufacture, testing and supply of 400mm sweep BLDC railway carriage fans for rolling stock application complete in all respect suitable for input voltage of 110V DC system.
- 2.2** Electronic controller card shall be used as power devices in the inverter. The inverter shall have control and protections with a single controller board for power supply, protection; sinusoidal generation etc. and gate driver card shall be provided closer to the power devices. The detailed specification for devices used shall be given / submitted before offering for witnessing the prototype testing.
- 2.3** Input to the unit will be fed through battery bank of 110V dc in parallel with alternator, rectifier cum regulator. The unit shall be suitable for operating voltage available as input i.e. 90V to 140V DC with 15% ripple. There may be surges in input supply with peak value of approximately 350V. However it is advised that the firm may measure the harmonic distortion and Surges in the Coach before designing the BLDC fan. The over voltage trip shall be set between 150V to 155V DC.

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3.0 OPERATING POWER SUPPLY:

The fan shall be suitable for working from the power supply described as under:-
 Rated Voltage : 110 V DC; Voltage range: 90- 140V DC

4.0 DESIGN AND GENERAL CONSTRUCTIONAL FEATURES :

- 4.1** The motor of the fan shall be permanent magnet type, light in weight and small in size without field winding, brushes and commutator. The permanent magnet shall be fitted on the rotor in such a manner that it should not get disengaged. It is desirable that the magnet shall be embedded in slots. Deep drawn design for fan body made from MS sheet shall conform to RDSO drg. No. RDSO/PE/SK/TL/0025-2002 (Rev.0). Motor body shall be of aluminum alloy LM-6. Details of mounting of fan to coach ceiling are as under.

PCD : 108 mm; No. of holes: 3 at equal distance; Hole diameter: 9 mm

For fixing of fan guard, extension of fan motor body collar or provision of additional collar shall be used.

4.2 PROPERTIES FOR PERMANENT MAGNET:-

The permanent magnet to be used on the fan shall have the following properties:

- Value of coercive force shall be advised after designing the fan.
- Hardness of the magnet shall not exceed 700 HV.
- It shall have smooth ground surface.
- It shall meet the requirement of clause 8.7 of this specification.
- Magnetism of rotor magnet shall have 1350-1750 Gauss.

4.3 BLADES:-

Fan blades shall conform to RDSO drg. No. RDSO/PE/SK/TL/0108-2008 (ALT.1) (Rev.0) or latest and shall be easily replaceable / interchangeable. M/s. Paras Plastic, Mumbai / M/s. Qumex Mould, Kolkata make blades shall be used. Any other source of blade with prior approval of RDSO shall be used.

4.4 ELECTRONIC CONTROLLER:

Electronic components used in electronic controller or elsewhere in fans shall be as under:

SN	Item	Technical Requirements
i.	IC (Integrated Circuits)	Industrial Grade
ii.	Electrolytic capacitors	Maximum permissible temperature shall not be less than 105°C (Mill grade/Industrial grade).
iii.	Paper/polyester capacitors	Maximum permissible temperature shall not be less than 85°C
iv.	Resistors	Preferably made of metal film of adequate rating
v.	Switching devices transistors, MOSFETs and IGBTs etc	Minimum junction temperature of 150°C
vi.	Devices thermal margin at the ambient of 55°C	Minimum 20°C
vii.	Material for printed circuit board	Copper clad glass epoxy of grade FR-4 or superior

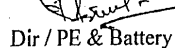
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- 4.4.1** The manufacturer shall develop Brushless DC fan using Digital Signal Processer (DSP) or microcontroller based PCB.
- 4.4.1** The Controller Card shall be used with three phase output voltage with provision of 6 nos. mounting holes as per RDSO drawing No. RDSO/PE/SK/TL/0153-2011 (Rev.1)-Sheet 1 of 3 (or latest).
- 4.4.2** PCB shall be fixed on the motor body only either on three inner holes or on three outer holes.
- 4.4.3** Assembled PCB shall be given a conformal coating to enable them for functioning under adverse environmental conditions. Soft or hard potting under any circumstances may not be acceptable. PCB will be suitable for satisfactory performance without any soft/hard potting.
- 4.4.4** Use of Surface Mounted Devices (SMD) shall be preferred to the maximum possible extent.
- 4.4.5** No hand soldering shall be allowed. Only automatic wave soldering / reflow soldering is acceptable.
- 4.4.6** The connection for 3 phase supply, wires shall be connected on the PCB through male/female connector of Wago make (Part No. 734-233 & 734-203) or Paras make (Part No. HDRPCBMC 3.8/3 & CAGEPCBMC 3.8/3) and DC supply wires (0.5 mtrs) shall be soldered on the location shown in the RDSO drawing No. RDSO/PE/SK/TL/0153-2011 (Rev.1) – Sheet 1 of 3 (ALT.1) or latest for PCB. Thin walled flexible elastomeric cables with multi-strand copper conductors suitable for continuous operation at 120°C and having halogen free insulation and sheath shall be used.
- 4.4.7** The Connector for 3 phase shall be provided as per RDSO drawing No. RDSO/PE/SK/TL/0153-2011 (Rev.1) – Sheet 1 of 3 (ALT.1) or latest. It shall be compulsory in order to ensure correct configuration of R, Y, B at the output. It will ensure interchangeability of PCB.
- 4.4.8** PCB dust cover shall be so mounted on the motor body such that it will be possible to remove the dust cover without dismounting the fan from the coach. It will ensure replacement of PCB without dismounting of fan from coach.

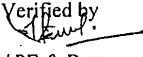
4.5 STAMPINGS:

Laminated core shall be used in the construction of fan motor. The stampings used for laminated yoke and armature core shall be made from electrical steel sheets (see IS: 648, IS: 649 and IS: 3024 with latest amendments if any).

4.6 STATOR:-

Stator used in BLDC fans shall be as under-

No. of phases	3	No. of turns	450-470	Stack outer dia	87 mm
No. of slots	6	Stack length	11.5 ±0.5mm	Stack inner dia	56.2 ±0.2mm

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4.7 ROTOR:

4 pole rotor magnet and shaft used in BLDC fan shall be as per the RDSO drawing No. RDSO/PE/SK/TL/0153-2011 (Rev '1') – sheet 2 of 3 (latest) and sheet 3 of 3 (latest) respectively.

4.8 BEARINGS:

SKF make (6201ZZ) ball bearings, NBC (6201ZZ), FAG (6201ZZ) make bearing shall be used.

4.9 WINDING WIRE AND INSULATION:

The copper polyesterimide enameled round wire of Class 180 conforming to IS specification No.13730 (Part 8) shall be used for winding of the motor.

All the insulating materials used in the motor shall be of ISI quality conforming to the relevant specifications and test conditions specified for class 155 insulating materials.

The fan's motor shall be well treated with the insulating varnish of Class 155 conforming to relevant IS in vacuum pressure impregnation plant to achieve minimum IR value of 20 mega Ω . The curing of varnish shall be done in air circulating oven or as per guidelines issued by varnish manufacturers.

4.10 COLOUR OF FAN BLADE AND BODY:

Complete fan i.e. fan body, fan guard assembly (of mild steel) etc. shall be powder coated with minimum thickness of 60 microns to colour silver metallic finish to HYC 100 of HAWCOPLAST / 95-03014 of MARPOL / 9000622 of Narocoat. However motor body which is made of aluminum does not require any painting. A band of dark green colour of about 20 mm wide shall be applied over the periphery of the fan body near its middle portion as a colour code for sensor less BLDC fan.

4.11 GUARD:

Crashworthy design of fan guard shall conform to ICF drg No. ICF/SK-7-6-158 alt. 'G' Coll-II or latest.

4.12

A connector of fiberglass reinforced plastic manufactured from sheet moulding compound (SMC) of 25% fiberglass contents, self-extinguishing grade, Male connectors 721-603 & Female connectors 721-103 of M/s Wago and similar in Phoenix make Male connectors 1942604 & Female connectors 1942387 shall be provided. The connector shall be mounted in the ceiling of the coach and shall be supplied separately with the fan.

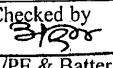
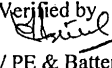
4.13 GENERAL:

Any more information required, if any, for design, construction and test - IS: 6680 shall be referred to. However, still, if any, clarification is required, RDSO shall be contacted while development. For any deviation while development, firm shall obtain RDSO's approval.

5.0 PERFORMANCE REQUIREMENTS:

The fan shall be light weight and energy efficient with maximum air delivery at rated voltage and shall confirm the following parameters:-

SN	Parameter	Unit	Value
a.	Minimum air delivery	Cubic meter per	60

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b.	Max. input power	watt	32
c.	Maximum weight	Kg	7
d.	Min. service value	Cubic meter /min/watt	2
e.	Noise level (maximum)	dBA	55

6.0 MARKING:

6.1 Each fan shall be indelibly marked with the following-

Type of fan	Size of fan	Rated and voltage range	Input voltage watts	RPM	Sl.No	Month & year of manufacture
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6.2 An oval shape rectangular plate of size 50 mm x 30 mm fixed by two screws or rivets shall be provided on the fan body for marking of Railway Code initials and serial Number separately.

6.3 Brand name (if different from firm's name) shall not be used anywhere on the fans, packing, letters, documents etc.

7.0 TESTS:

Tests are classified as:-

- Prototype test
- Type test
- Acceptance test
- Routine test.

7.1 Prototype Test

Prototype test is conducted on the first unit developed by the firm as per the relevant specification.

7.2 Type Test

Type tests shall be carried out to prove confirmation with the requirement of specification and general quality/design features of the unit. In case of any change in Bill of Material or design of unit, complete type test shall be repeated.

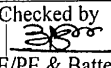
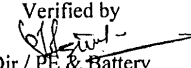
If any sample fails in any of the type tests, fresh samples shall be taken and tested. If sample again fails in that test, the whole lot shall be rejected.

7.3 Acceptance Tests:

These tests are carried out by an inspecting authority at the manufacturer's premises on samples taken from a lot for the purpose of acceptance of a lot. Acceptance tests shall not be carried out from particular fan from the lot on which type tests have already been conducted.

7.4 Routine Tests:

These tests shall be performed by the manufacturer on each fan and the results shall be submitted to the inspecting agency, prior to offering the lot for acceptance test.

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7.5 TESTS SCHEME:

S. No	Test description	Prototype test	Type test	Routine test	Acceptance test	Remarks/ Clause ref.
1.	2.	3.	4.	5.	6.	7.
1.	Visual inspection	Y	Y	Y	Y	Clause 8.1
2	Running of fan at max voltage i.e. 140V.	Y	Y	Y	Y	Clause 8.2
3.	Starting test	Y	Y	Y	Y	Clause 8.3
4.	Speed test	Y	Y	Y	Y	Clause 8.4
5.	Electrical In put test	Y	Y	Y	Y	Clause 8.5
6.	Input overvoltage test	Y	Y	Y	Y	Clause 8.6
7.	Heating test on permanent magnet	Y	Y	-	-	Clause 8.7
8.	Reverse polarity test	Y	Y	Y	Y	Clause 8.8
9.	Locked rotor test	Y	Y	-	Y	Clause 8.9
10.	Temperature rise test	Y	Y	-	-	Clause 8.10
11.	Insulation resistance test	Y	Y	Y	Y	Clause 8.11
12.	Dielectric test	Y	Y	-	Y	Clause 8.12
13.	Air delivery test	Y	Y	1 in every 500 th	Y	Clause 8.13
14	Endurance Test	Y	Y	-	-	Clause 8.14
15.	Noise level test	Y	Y	-	Y	Clause 8.15
16.	Test on complete electronic devices:	Y	-	-	-	Clause 8.16
	A. Voltage surge test	Y	-	-	-	
	B. Dry heat test	Y	-	-	-	
	C. Damp heat test	Y	-	-	-	
	D. Burn-in test	Y	-	-	-	
17.	Vibration and shock test	Y	-	-	-	Clause 8.17

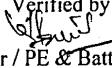
Y denotes 'test to be conducted'

NOTE:

1. Prototype tests shall be carried out by RDSO on five samples of BLDC fans of the same type selected from the lot available at the premises of the manufacturers. One fan shall be used for endurance tests after carrying out all tests except tests mentioned at clause 8.10.
2. In respect of tests for which testing facility is not available with the manufacturer, the same may be carried out at NABL accredited test lab/ Govt. approved lab and test reports shall be submitted to RDSO.

8.0 METHOD OF TESTS:**8.1 VISUAL INSPECTION:**

All components shall be visually examined for finish, Guard, blade and fan motor body shall be verified for their dimensions and material specification. The manufacturer shall furnish test report of Aluminum motor body, permanent magnet, blade, stamping, stator core & stator copper conductor materials as specified in Clause 4.1, 4.2, 4.3, 4.5 & 4.9 respectively and thickness of powder coating of complete fan shall be as per Clause 4.10

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8.2 RUNNING OF FAN AT MAXIMUM VOLTAGE:

Before starting testing on BLDC fan, the fan shall be run at maximum voltage in voltage range i.e. at 140V for at least one hour.

8.3 STARTING TEST:

The fan shall be capable of starting from rest at ≤ 75 volts.

8.4 SPEED TEST:

The fan manufacturer shall furnish the actual speed at specified rated voltage or voltages specified in various tests such as temperature rise etc. and it is desirable that constant speed is maintained within the input voltage range i.e. 90V to 110V.

8.5 ELECTRICAL INPUT TEST:

The electrical input in watts to the fan shall be determined by running the fan at rated voltage. However input watts at other voltages i.e. 90, 100, 120, 130 and 140 V shall also be recorded for reference purpose during prototype test.

8.6 INPUT VOLTAGE PROTECTION:

8.6.1 Input over voltage protection shall be provided in the circuit so that whenever input voltage increased between 150V to 155V, the fan shall trip and whenever the voltage comes down between 145V to 140V, the fan shall start automatically.

8.6.2 Input under voltage protection shall be provided in the circuit so that whenever input voltage decreased below 65V, the fan shall trip and whenever the voltage comes ≤ 75 V, the fan shall start automatically.

Capability to withstand input of 200V DC without any damage to any part of the BLDC fan for two minute shall also be provided. This shall be tested for 30 minutes during type test and for 2 minutes during routine and acceptance test.

8.7 HEATING TEST ON PERMANENT MAGNET:

Before starting of the test, magnetism of the magnet shall be measured with the help of flux meter. The rotor with magnet fixed shall be heated up at 120°C for 3 hrs continuously. After that, it shall be removed from the oven and cooled to the room temperature. The flux of the magnet shall be measured again. The difference in these two-recorded values i.e. before and after heating shall not vary by more than 5%.

8.8 REVERSE POLARITY TEST:

The fan shall be run with the correct polarity at 110V i.e. rated voltage and then shall be disconnected from the supply and reconnected with reverse polarity as quickly as possible. The supply shall be maintained in the reverse direction for duration sufficient to reach steady speed at rated voltage.

The above test for running the fan with correct and reverse polarity shall be conducted for twenty-five cycles.

Fan shall run in the same direction irrespective of the supply polarity.

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8.9 LOCKED ROTOR TEST:

This test shall be conducted after heating test of the magnet and reverse polarity test. The fans shall be subjected to the highest value of the voltage range i.e. 140V for one hour with the rotor in the locked conditions providing external means to arrest the rotation of fan. The fan under this condition shall draw no appreciable current. After the removal of the lock condition, the fan shall either start automatically or on switching OFF and ON the power supply.

Thereafter, the performance test i.e Power input and air delivery tests shall be repeated in accordance with Clause 8.5 & 8.13 respectively. There shall be no appreciable variation from initial performance test values.

Note: During acceptance test, air delivery test shall be conducted on one fan before locked rotor test and on all the fans (sampled) after locked rotor test.

8.10 TEMPERATURE RISE TEST:

The temperature rise test shall be conducted on four fans at an ambient temperature not exceeding 55°C and at maximum voltage (i.e. 140 V) for sufficient time to achieve thermal stabilization of all parts of fan and motor.

The permissible temperature rise shall not exceed the limits given in Table below:-

S.N.	Item	Rise in ° C	Method
1	Insulated windings of motor	65	R
2	Accessible external surface, metallic	30	T
3	Bearings	35	T

R - Resistance method

T - Thermometer method

8.11 INSULATION RESISTANCE:

IR shall be measured immediately after temperature rise test on 4 fans and after endurance test on 5th fan.

The insulation resistance measured with 500 Volt megger between the live parts and the frame shall not be less than 200 mega Ω . There shall not be an appreciable change in the IR values obtained before and after dielectric test.

8.12 DI-ELECTRIC TEST:

Immediately after insulation resistance test, an AC voltage of 1.72 kV rms (1500 + 2 x rated voltage) of sine wave form of 50 Hz shall be applied for one minute between the live parts and frame. There shall not be any kind of break down, flashover or tripping of supply.

8.13 AIR DELIVERY TEST:

This test shall be conducted as per Clause No.19.2 of IS: 6680. This test shall be conducted at 90 volts, 110 volts and at 140 Volts during prototype test. In any case, air delivery shall not be less than 10% of air delivery at rated voltage.

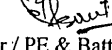
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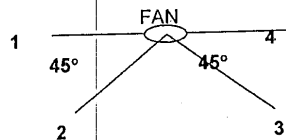

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8.14 ENDURANCE TEST:

The complete carriage fan with electronic controller shall be tested at rated voltage i.e. 110V DC continuous for 120 hrs at 55°C temperature. The temperature shall be maintained within $\pm 3^\circ\text{C}$. The air delivery and power input test shall be carried out immediately after completion of 120 hrs. The fan shall meet the air delivery, power consumption, and service value requirements given in Clause 5.0 of the specification.

8.15 NOISE LEVEL MEASUREMENT:

Noise level of the complete fan with guard in position shall be measured at a distance of 3 times of impeller diameter at 4 points on a spherical distribution around the fan as shown in the following diagram and the average value obtained shall not exceed the value specified in Clause 5.0 of the specification when measured on A weighing scale. The measurements shall be done in a reasonably echo free acoustic chamber.

**8.16 ENVIRONMENTAL TEST ON COMPLETE ELECTRONIC DEVICES:**

These tests shall be conducted on the complete electronic devices such as card, electronic controllers used for commutation in the Carriage Fans as per the standard specified against each test.

- | | |
|-----------------------|--|
| i) Voltage surge test | - IEC 60571 |
| ii) Dry Heat test * | - IEC 60571 |
| iii) Damp Heat test | - IEC 60571 |
| iv) Burn-in test | - RDSO Spec No. ELRS/
SPEC/SI/0015-Oct-2001 |

* However, dry heat test shall be conducted at 80°C.

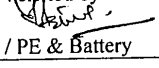
8.17 VIBRATION AND SHOCK TEST:

The test shall be conducted in accordance with the relevant clauses of IEC 61373 for category 1- Class A. No mechanical damage or deterioration in performance shall occur as a result of these tests.

9.0 SAMPLING PLAN FOR ACCEPTANCE TEST:

Sampling plan for fans for conducting acceptance tests shall be as per the following:-

SN	Lot size (In nos.)	Sampling quantity (in Nos.)
1	1-100	5
2	101-500	10
3	501-1000	15
4	Above 1000	20

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However, for air delivery, service value and noise level tests, 2 fans for lot size up to 100, 4 fans for 101 to 200, 6 nos. for lot size of above 200, will be selected at random from the lot."

10.0 DEVIATIONS:

Any deviation to this specification proposed by the manufacturer, aimed to improve upon the performance, utility and reliability/efficiency of the equipment shall be given due consideration, provided full particulars of the deviations with justification are furnished.

11.0 INFRINGEMENT OF PATENT RIGHT:

Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, used of components in design/development/manufacturing of Brushless dc fan and/or any other factor, which may cause such dispute. The responsibility to settle any such issue will rest with the manufacturer.

12.0 TECHNICAL INFORMATION:

The manufacturers shall supply the following technical information in respect of Brushless DC fan during prototype test.

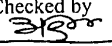
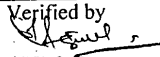
I	Rated speed in rev / min
II	Air delivery & service value at rated voltage i.e. 110 V DC
III	Blades and their detailed drawing with material specification along with the test report
IV	Class and details of winding insulation & insulating varnish
V	Type, make and life etc. of bearings
VI	Instructions for lubrication of bearings
VII	Details of magnet characteristics
VIII	Weight of fan
IX	Drawings showing the overall dimensions of the fan including Motor unit with mounting dimensions
X	Drawings showing full particulars of the rotor and stator windings including dimensions, shape, size, section and weight of copper wire used
XI	Technical details with drawing/schematic of electronic controller card
XII	Aluminum Motor body Test Certificate from the OEM.
XIII	Stator Copper Test Certificate from the OEM.
XIV	Stator Core Steel Test Certificate from the OEM.

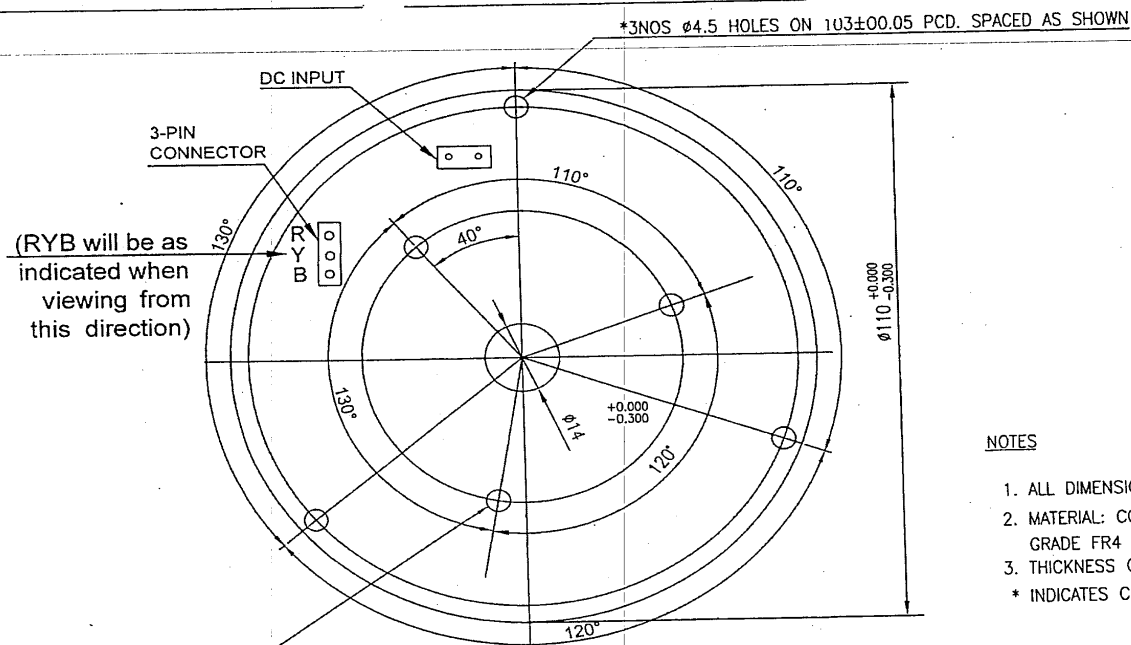
13.0 INFRASTRUCTURE & ESSENTIAL TESTING EQUIPMENTS:

In respect of machinery and plant considered essential for the manufacture of quality and reliable product, essential testing / measuring equipments and eligibility criteria etc., the manufacturer shall fulfill the requirements of STR No. RDSO/PE/STR/TL/0016-2005 (Rev. '0') or latest, issued by RDSO for BLDC fan.

14.0 Quality storage / packing of fan components & fan:

Quality storage to be ensured for all the bought out components and internally manufactured components.

Prepared by  JE/PE	Checked by  ADE/PE & Battery	Verified by  Dir / PE & Battery
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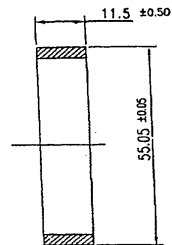
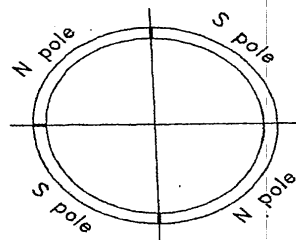
NOTES

1. ALL DIMENSIONS ARE IN mm.
 2. MATERIAL: COPPER CLAD GLASS EPOXY GRADE FR4 OR SUPERIOR.
 3. THICKNESS OF PCB : 1.6mm MIN.
- * INDICATES CRITICAL DIMS. ONLY.

Dt.	17-11-2015
D	M KUMAR
C	AKR

STATUS	REV./ALT.	REF NO	DESCRIPTION	APPD BY	DATE
	ALT. 1		DETAILS OF CONNECTORS MENTIONED IN THE SPECN.	DIR, PE & B	17-03-2016
	(Rev.'1')		1 3 NOS SENSOR ON 25.0 PCD PLACED AT 60° APART DELETED 2 RYB DIRECTION INDICATION ADDED	DIR, PE & B	17-11-2015

REF. NO.	PART NO.	DESCRIPTION	DETAIL DRG. NO.	NO. OF	MATL.	SPEC.
REF:-EL/6.5.1/BLDC		400mm SWEEP BLDC FAN PRINTED CIRCUIT BOARD (PCB)	SCALE: NTS	APPROVED BY:-	(FOR DG)	FIRST ISSUED 13.06.12
						SUPERSEDES Rev.'0'
		RDSO/PE/SK/TL/0153-2011(REV.'1')				SUPERSEDED BY Rev.'1'
		(SHEET 1 of 3)				



NOTES:

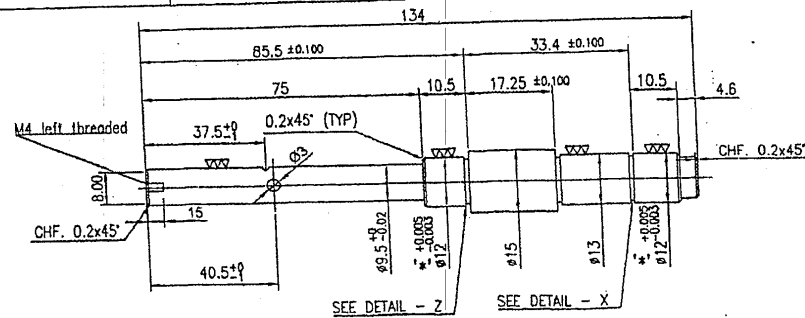
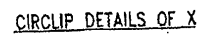
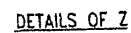
1. ALL DIMS. ARE IN mm.
2. MAGNETIC GAUSS: 1350-1750.

7-11-2015
 V. KUMAR
 AKR

	(Rev.'1')		Magnetic Gauss changed to 1350-1750 from 1300-2000.	DIR. PE & B	7-11-2015
STATUS	REV/ALT.	REF NO	DESCRIPTION	APPD BY	DATE

REF. NO.	PART NO.	DESCRIPTION	DETAIL ORG. NO.	NO. OF	MATL.	SPEC.
REF-EL/4.5.1/BLDC			SCALE: NTS	APPROVED BY:-	(FOR DG)	
400 mm SWEEP BLDC FAN ROTOR MAGNET					FIRST ISSUED 13.06.12	
					SUPERSEDES Rev.'0'	
					SUPERSEDED BY Rev.'1'	

RDSO/PE/SK/TL/0153-2011(REV.'1')
 (SHEET 2 of 3)



1. ALL DIMS. ARE IN mm.
2. COMPONENT SHOULD BE FREE FROM BURRS AND SHARP EDGES.
3. SHAFT TO BE GRIND BETWEEN CENTRES.
4. MATERIAL OF SHAFT: MS-EN8
5. SURFACE ROUGHNESS $\nabla \nabla \nabla - 6.3 \mu m$ $\nabla \nabla \nabla \nabla \nabla - 0.8 \mu m$

* INDICATES CRITICAL DIMENSIONS ONLY.

REF. NO.	PART NO.	DESCRIPTION	DETAIL DRG. NO.	NO. OF	MATL.	SPEC.
REF:ELI/6.5.1/BLDC			SCALE: NTS	APPROVED BY:- (FOR DRG)		
400mm SWEEP BLDC FAN (SHAFT)				FIRST ISSUED : 13.05.12		
				SUPERSEDES : Rev.'0'		
2015	RDSO/PE/SK/TL/0153-2011(REV.'1')			SUPERSEDED BY :		
TE	(SHEET 3 OF 3)			Rev.'1'		