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PURCHASE SPECIFICATION
GROUP: TRACTION ENGINEERING

P.S NO. : PS4452498

REV. NO: 02

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SPECIFICATION FOR SINE WAVE FILTER INDUCTOR

Code No. TI0668107913

REVISION HISTORY SHEET

REV. NO.	DATE	NATURE OF CHANGE	REASONS	PREPARED BY	APPROVED BY
00	02.04.2014	FIRST ISSUE		David J	Shekar R
01	23.07.2014	SECOND ISSUE		David J	Shekar R
02	12.12.2015	THIRD ISSUE		Venkatesh R	Shekar R

REVISIONS

02

APPROVED BY

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12/12/15

PREPARED BY

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DATE

12.12.2015

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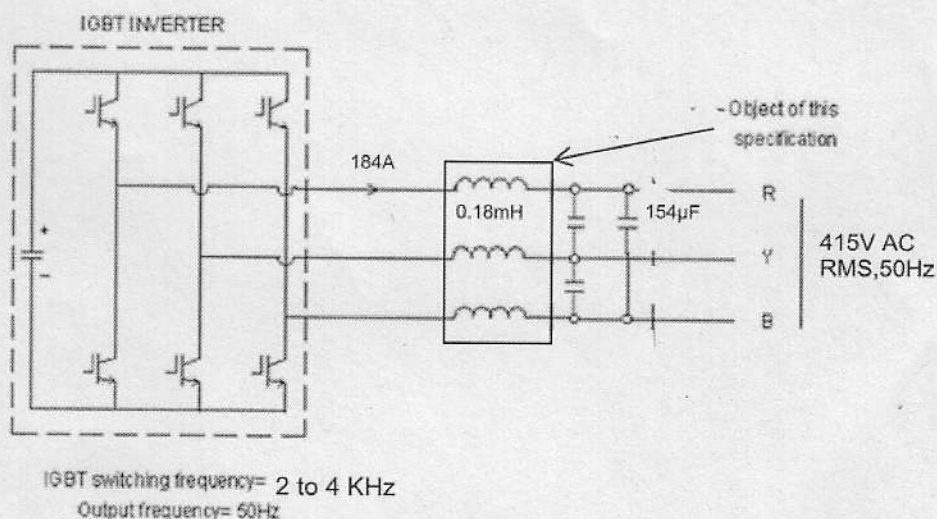
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SPECIFICATION FOR SINEWAVE FILTER INDUCTOR

1.0 Functional requirements:

This document covers specification of a Sine wave filter Inductor, to be used at the output of an IGBT based inverter. The Inductor will be mounted in a cabinet/enclosure and will be used in traction applications for on board mounting. The block diagram is shown below.



2.0 APPLICATION : Sine filter Inductor

3.0 TYPE : Dry Type, Air natural cooling

4.0 REFERENCE STANDARDS:

IEC 60076/ IS5553	Power transformers
IEC 60077-1	Railway applications – electric equipment for rolling stock-part 1.
IEC 60085	Thermal evaluation and classification of electrical insulation
IEC 60146-1-3	Semiconductor converters ... Transformers and reactors
IEC 60310	Traction transformers and inductors
IEC 61287-1	Electronic power converters installed on rolling stock
IEC 61373	Railway applications – Rolling stock equipment –shock and vibration tests
EN50124	Railway Applications - Insulation Coordination Basic Requirements - Clearance And Creepage Distances
IEC60571/EN50155	Operating conditions

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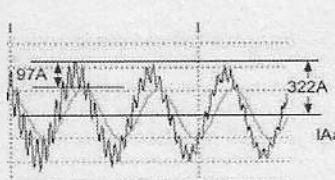
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SPECIFICATION FOR SINEWAVE FILTER INDUCTOR

5.0 ENVIRONMENTAL CONDITIONS:

- 5.1 Ambient Temperature : 55°C
- 5.2 Maximum Temperature : 70°C (when locomotive standing dead under sun)
55°C (when locomotive working)
47°C Nominal
- 5.3 Relative Humidity : IEC60571
up to 95% any moisture condensation during operation shall not lead any damage Or failure
Yearly average $\leq 75\%$ Rel. Humidity
- 5.4 Altitude : up to 1200 m above mean sea level
- 5.5 Atmosphere during hot weather: Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6mg/cub meter.
- 5.5 Air Pollution : The equipment shall be designed to work in coastal area in humidity and salt laden Corrosive atmosphere. The maximum values will be as follows
(a) Maximum pH Value : 8.5
(b) Sulphate : 7mg/liter
(c) Maximum concentrate of chlorine:6mg/liter
(d) Maximum conductivity:130 μ Siemens
- 5.6 Climate : Tropical, Hot and humid Climate

6.0 ELECTRICAL REQUIREMENTS

Issue	Unit	Min	Nom	Max	Notes
Output power	kVA		132.5	265	265kVA during 5 sec At nominal output voltage
Output voltage	V	0	415	436	Maximum voltage = 415 + 5%
L	uH		180		Total 3 x 180
Inom	Arms		184	194	286Arms during 5 sec
Ripple	%	50			Peak peak
L_Linearity (10%)	Apeak	322			up this current the inductance must be in a tolerance +/-10% 50% of 194 = 97App $\Rightarrow$ 48.5Apeak
					194Aac gives 194.SQRTT(2)/2 = 274Apeak Max peak current: 274+48.5 = 322A
asymmetry	%			10	
Frequency	Hz	25	50	53	continuously
Fs	kHz		2	4	Switching frequency of the inverter
Udc	Vdc		700		DC-link voltage.

Noise Level Max: 75db

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SPECIFICATION FOR SINEWAVE FILTER INDUCTOR

7.0 CONSTRUCTION

7.1 Core:

7.1.1 Electrical steel should be CRGO with grade of M4 or better along with test certificate.

7.1.2 The inductor is open type, the inductor shall be compact.

7.2 Winding: Windings to be of electrolytic Grade copper conductor

7.3 Cooling Type:

7.2.1. Supplier shall indicate if additional cooling is required and the required airflow.

7.2.2 Suitable temperature sensor shall be incorporated for the winding where maximum HOTSPOT is Anticipated and the method of temperature measurement shall be indicated in the offer.

7.4 Insulation: Class H All windings to be uniformly insulated. Neutral point of secondary windings to be insulated to full line voltage. Should meet the requirement as per IS2026 /IEC 60076
Insulation Voltage 2500 Vrms – Test voltage 50Hz/1min
Pollution degree: PD3A as of EN50124

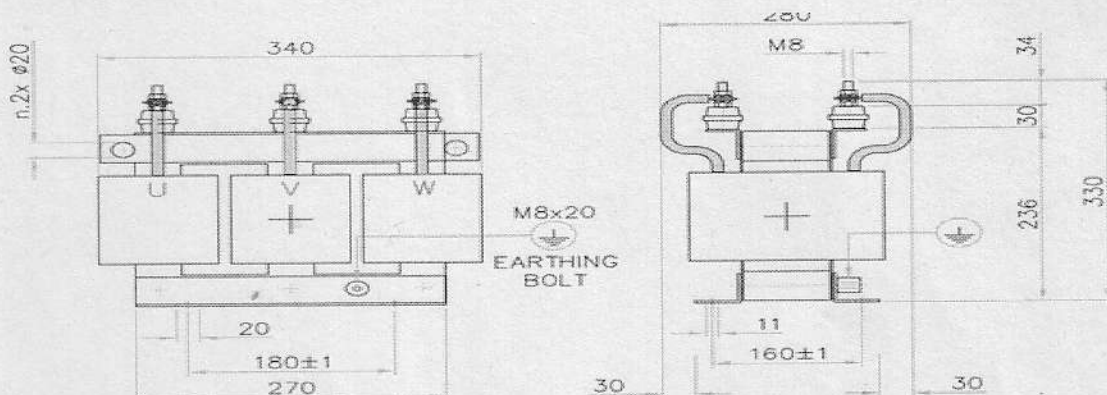
7.5 Impregnation:

Inductor assembly impregnated under vacuum with epoxy based resin for achieving high hygroscopic acid & Alkali resistant insulation. The complete winding should have smooth finish after impregnation to ensure high Mechanical strength. Thickness of the resin should be uniform. The insulation should be self-extinguish type.

7.5 Terminals, markings, and connections: As per IS : 2026 and existing inductor

9.0 MECHANICAL DIMENSION LIMITATION

The inductor dimensions (overall & mounting) shall not exceed the dimensions indicated in the below sketch. is given for guidance only for limiting dimensions



Supplier to prepare detailed drawing & submits to BHEL for approval before commencing manufacturing process

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SPECIFICATION FOR SINEWAVE FILTER INDUCTOR**10.0 TESTS TO BE CONDUCTED AT SUPPLIER'S WORKSPACE**

Three Phase inductor	IEC60310 Clause		
	Type	Routine	Investigative
Preliminary checks	—	10.3.3	
Measurement of winding resistance	—	10.3.4	
Measurement of losses	10.3.5		
Measurement of inductance	10.3.6	10.3.6	
Temperature-rise	10.3.7		
voltage between terminals withstand	10.3.8.1	10.3.8.1	
separate source voltage withstand		10.3.8.2	
full wave impulse voltage withstand	10.3.8.3		
Shock and vibration withstand	10.3.9		

Tolerance – According to IEC-60289**11.0 TEST PROTOCOL**

Supplier shall submit test protocol for Routine & Type tests along with techno-commercial offer. List of tests are as per clause 5.0 of this specification.

12.0 DOCUMENTATION

12.1 Information required along with techno commercial offer without which offer is liable for rejection.

12.2 Supplier shall furnish clause wise confirmation/comments to the technical specification in the Typical format given below. Deviation, if any, shall be clearly brought out indicating the clause Number, original specification, deviation sought with proper technical backup (catalogue, Technical brochure, international standards, calculations etc.
If no deviations required, then supplier shall furnish certificate indicating "NO DEVIATION REQUESTED" and we comply fully with all the technical requirements of this specification no. PS4452498

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SPECIFICATION FOR SINEWAVE FILTER INDUCTOR

- 12.3 Supplier shall take a copy of this specification and sign on each page and submit the signed copy along with offer.
- 12.4 Supplier shall furnish winding material, winding resistance, winding cross section.
- 12.5 Supplier shall furnish the type of core used along with technical details of core.
- 12.6 Information required after the placement of order
- 12.7 Detailed dimensional drawing for BHEL approval
- 12.8 Test protocol for BHEL approval.
- 12.9 Information required along with material supply.
- 12.10 Two sets of Test certificates.
- 12.11 BHEL engineer witnessed Pre inspection report.

13.0 ACCEPTANCE

- 13.1 Dimensions as per approved drawing
- 13.2 Routine test certificate
- 13.3 Type test certificate

14.0 PRE-SHIPMENT INSPECTION

Pre-shipment inspection will be carried out by BHEL engineer as per the approved test protocol. BHEL engineers will witness Routine & Type tests before dispatch.

15.0 RATING PLATE DETAILS

Weather proof Rating Plate (with following information) shall be fixed at a suitable position..

- 15.1 BHEL Specification No.
- 15.2 Rated Inductance
- 15.3 Rated Voltage
- 15.4 Rated Current
- 15.5 Serial number
- 15.6 Month & Year of Manufacture
- 15.7 Total mass
- 15.8 Ambient Temperature
- 15.9 Type of Reactor
- 15.10 IP class
- 15.11 Manufacturer' Name
- 15.12 Insulation level/Insulation Class
- 15.13 Number of Phases
- 15.14 Rated Frequency
- 15.15 Type of Cooling
- 15.16 Thermal class of Insulation

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