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**10.10.2 Performance tests which has to be verified/compared after completion of shock & vibration tests are as under:**

1.	Visual inspection and dimensional checks
2.	Measurement of winding resistance
3.	Measurement of voltage ratio and check of voltage vector relationship
4.	Measurement of impedance voltage/short circuit impedance and load loss at 75 deg.C
5.	Measurement of NO load loss and current at 75 deg.C
6.	Measurement of insulation resistance
7.	Measurement of acoustic noise level

These tests shall be witnessed by RDSO representative at firm's premises or can be conducted in NABL accredited laboratory.

#### 10.11 Commissioning tests:

10.11.1 The supplier will associate during commissioning of their initial few transformers.

#### 10.12 Visual Examination Test:

10.12.1 Overall dimensions and mounting arrangements shall be verified as per the approved drawings. The dimensions of assemblies and sub-assemblies and constructional detail shall be checked to ensure that these are consistent with sound engineering practices. In addition to the above, the following shall also be verified during the test:

1. Terminal arrangement as per approved drawings.
2. Provision of metric fasteners & its tightness
3. Marking and danger notice plate
4. Weight verification only one in each sample lot
5. Size and type of crimping sockets
6. Earthing terminals and
7. Lifting arrangement
8. Bill of material etc. as per approved RDSO design document.

#### 10.13 Dielectric test

The dielectric tests shall be conducted on transformer completely assembled as in service, at ambient temperature. Each winding of the transformer shall be subjected to a high voltage value of 5KV (RMS) at 50 Hz for one minute. This test shall be conducted after the temperature rise test

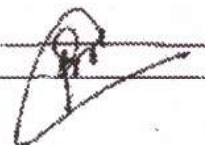
#### 10.14 Vibration & Shock tests

Vibration & Shock tests shall be got carried out by the manufacturer from NABL approved recognized laboratory as per IEC 61373 under the category 1 class B, Location D as given in figure C.1 to above IEC. Test severity and frequency range for functional random vibration tests shall be as per clause 8.1 of above IEC; however the frequency range from 5 Hz to 70 Hz may be accepted till the facilities for frequency range from 5 Hz to 150 Hz at NABL accredited lab is developed. Transformers shall be kept in energized conditions at no load during the test.

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Table 1,2&3 and figure 2&6 of IEC-61373 shall be followed for the test conditions.

After completion of the test, the performance test as given in clause 10.10.2 to this specification shall be repeated. The value of the test results should fall within the tolerance limit specified in IS: 2026 (Pt-1) when compared with the test results carried out before shock & vibration tests.

#### 10.15 Fire retardant test for terminal board.

10.15.1 A test piece of terminal board of transformer measuring about 150 x 25 mm cut from terminal board sheet shall be subjected to the luminous flame, preferably supplied by a Bunsen burner. The specimen shall be held with the flat side up at an angle of 45 deg. to the horizontal as shown in Fig.1. The flame shall be of 25 mm in width across the tips.

10.15.2 The flame shall be applied to the specimen at the lower end for 30 seconds and removed for 30 seconds and then applied again to the same end for the second period of 30 seconds and then removed again. This test shall be carried out with the decorative surface facing up-ward and also the decorative surface facing down-wards.

10.15.3 If the test specimen gets ignited, it shall not continue to burn for more than 50 seconds after the flame has been finally removed.

#### 10.16 Water immersion test

10.16.1 The water immersion test shall be done by closing cable entry holes provided on the enclosure.

10.16.2 The test shall be done in accordance to IEC 60529

#### 10.17 Tests on stamping and Core

10.17.1 Following test on stamping and core shall be conducted by NABL accredited laboratory as per IS: 649-1997 & IS: 3024-1997 and test certificates shall be submitted to RDSO. Test results shall be complied with values declared by core material manufacturer.

- a) Specific core loss measurements
- b) Accelerated ageing test
- c) Surface insulation resistivity test
- d) AC permeability, AC magnetization test
- e) Stacking factor
- f) Ductility test

#### 11.0 TECHNICAL DATA:

11.1 The technical information as per Annexure B "Data sheet" complete in all respect should be furnished before development of prototype.

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- 11.2 The manufacturer shall indicate their compliance or other wise against each clause and sub-clause of the technical specification. The manufacturer shall enclose a separate statement for this purpose, if necessary, indicating the Annexure and clause reference and compliance or otherwise.
- 11.3 The manufacturer shall submit complete design details along with necessary calculation.
- 11.4 The manufacturer shall also supply following approved drawings in CAD software and hard copy:
1. Layout drawing showing the important dimensions of transformer showing locations of various components.
  2. Structural frame drawing showing size of various sections used & gauge of stainless steel sheet provided.
  3. Dimensional drawings of each part.
  4. Drawings of mounting details.
  5. Operating Instructions
  6. One set of the followings will be supplied with each transformer.
    - a) Operating and trouble shooting manual
    - b) Parts illustrated catalogue-indicating sources.

## 12.0 MAINTENANCE MANUAL

- 12.1 The general maintenance requirement for the transformer should be of cleaning of parts and blowing of dust etc. from it. However the firm will submit the recommendations on maintenance requirement of transformer, which should contain periodicity, work content and justification for each maintenance requirement.

## 13.0 INFRINGEMENT OF PATENT RIGHT

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

## 14.0 TRAINING

- 14.1 The manufacturer shall undertake to train, free of cost, the supervisors & staff of the Indian Railways for operation, maintenance, fault finding, repair of offered transformer under guidance of skilled engineers, as and when required by any Zonal Railways.

## 15.0 SERVICE ENGINEERS

- 15.1 The firm shall provide service engineers free of cost to watch performance of the equipment in service periodically and also carry necessary repairs or replacement under warranty obligations. The necessary spares needed for replacement during service should be available with the service engineers at all possible places where these coaches are maintained.

Prepared by *Amey*  
ADE/EL/7.1.108/DOC

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**16.0 CARTEL FORMATION**

16.1 The firms shall submit a declaration in this regard as per enclosed annexure C.

**17.0 ENCLOSURE**

- |  |  |
|--|--|
| i) The over all dimensions, construction and mounting of the transformer | RCF Drawing No. CC71216 Alt-b with latest alteration |
| ii) Terminal board for 9KVA/15KVA transformer                            | RCF drawing No. CC71073 with latest alteration       |
| iii) Fire retardant test   | Figure 1   |
| iv) Bill of Material   | Annexure - A   |
| v) Data sheet  | Annexure - B   |
| vi) Declaration against cartel formation                                 | Annexure - C   |

Prepared by *[Signature]* ADE/EL/108

Checked by *[Signature]*

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ANNEXURE - A to  
Specification No. RDSO/PE/SPEC/TL/ 0158 - 2010 (Rev.0)

**ACCEPTABLE MAKE AND SPECIFICATION OF THE MATERIAL USED IN  
9/15 KVA TRANSFORMER**

S.No	Description of the material	Nos.	Make	Specification
1.	Anti vibration mountings (loose supply)	4	Resistoflex / Dunlop/ Metallistic or any other make with prior approval of RDSO	
2.	Super enameled copper round/rectangular winding wire	As required	As per latest vendor list of RDSO available at web site <a href="http://www.rdsso.gov.in">www.rdsso.gov.in</a>	IS: 13730, Pt 13 - 93/ IS: 13730, Pt 29
3.	Connecting lead	As required	As per latest vendor list of RDSO available at web site <a href="http://www.rdsso.gov.in">www.rdsso.gov.in</a>	IS: 6195
4.	Epoxy resin	As required	FT 2005/500EK	Dr BECK
5.	Grommet/PG coupler	10	PMA or any other make with prior approval of RDSO	
6.	CRGO grade M27	As required	M/s POSCO(Korea), M/s NIPPON STEEL Corporation (Japan), M/s THYSSCENKRUPP(INDIA) or any other make with prior approval of RDSO.	IS: 3024 of 0.27 mm thickness
7.	SRBGF material		Make to be submitted by the firm at the time of design approval.	IS:10192-1982 with EP3 grade
8.	Enclosure	01	-	SS 304, 2.0 mm thick
9.	Terminal Board	01	Any make approved by RDSO	As per clause No. 8.10
10.	Crimping socket/lug	As required	Dowells or any other make approved by RDSO	

- Note:**
1. All the materials should have fire retardant property.
  2. Firm should have test records of all raw material used in their transformer.
  3. Firm will submit the purchase bills of raw materials from approved sources as above.

Prepared by *AD/PE-604/DSC*

Checked by 

Annexure -- B to

Specification No. RDSO/PE/SPEC/ TL/ 0158 (Rev.0)-2010

**DATA SHEET (Separate for 9 kVA and 15 kVA)**

1. Name of the manufacturer
2. Rating
  - a) KVA ..... KVA
  - b) Rated Primary voltage ..... V
  - c) Rated Secondary voltage ..... V
  - d) Frequency ..... Hz
  - e) Temperature rise
    - i) Winding by resistance method ..... deg.C
    - ii) Core by thermometer method ..... deg.C
    - iii) Terminals by thermometer method ..... deg.C
3. Number of phases .....
4. Connections
  - i) High Voltage .....
  - ii) Low Voltage .....
  - iii) Vector group .....
5. No load loss at rated voltage & frequency ..... W
6. Load loss at rated current at 75 deg.C ..... W
7. Efficiency at 75 deg.C at unity power factor
  - i) At full load ..... %
  - ii) At three forth load ..... %
  - iii) At half load ..... %
  - iv) At one forth load ..... %
8. No load current at rated voltage & Frequency
9. Over all dimension and weight
  - i) Length ..... mm
  - ii) Width ..... mm
  - iii) Height ..... mm
  - iv) Weight ..... mm
10. IR value
11. Winding resistance
12. Degree of protection
13. Detailed drawing of
  - i) Terminal arrangement .....
  - ii) Marking .....
  - iii) Circuit diagram .....
  - iv) Mounting details .....
14. Class of insulation & its details
  - i) Winding .....
  - ii) Terminal Board .....
15. Winding wire/strip material
16. Current density of conductor
  - i) Primary .....

Prepared by *Asst. Engr. D. C. D. C.*Checked by 

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- ii) Secondary
17. Core details
    - i) Material & grade
    - ii) Thickness
  18. Details of insulator for terminal stud
  19. Details of anti-vibration mounting
    - a. Make
    - b. Drawing No.
    - c. Part No. etc.
  20. Clamping socket's make & size
  21. Make/size of grommet/PG coupler
  22. Heat shrinkable sleeve.

Prepared by *AD/PE/005/DAC* Checked by *[Signature]*

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ANNEXURE – C to  
Specification No. RDSO/PE/SPEC/AC/ 0158 (Rev.0)-2010

### UNDERTAKING AGAINST CARTEL FORMATION

We, ..... hereby, give an undertaking that as a Registered Vendor for manufacture and supply of ..... will not be a part of a cartel with other vendors and will be quoting competitive rates in the tenders invited by the Indian Railways/PUs.

We ..... are aware of the fact that the Registering Authority i.e. RDSO may de-list the name of our firm from the Master List of Approved Vendors if complaint is received about such cartel formation from any of the Railways/Production Units.

Seal and signature  
(Authorized signatory of the firm)

Date:

Place:

Seal:

Prepared by

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ADE/EL/7.1.108/Dec

Checked by

*Handwritten signature*

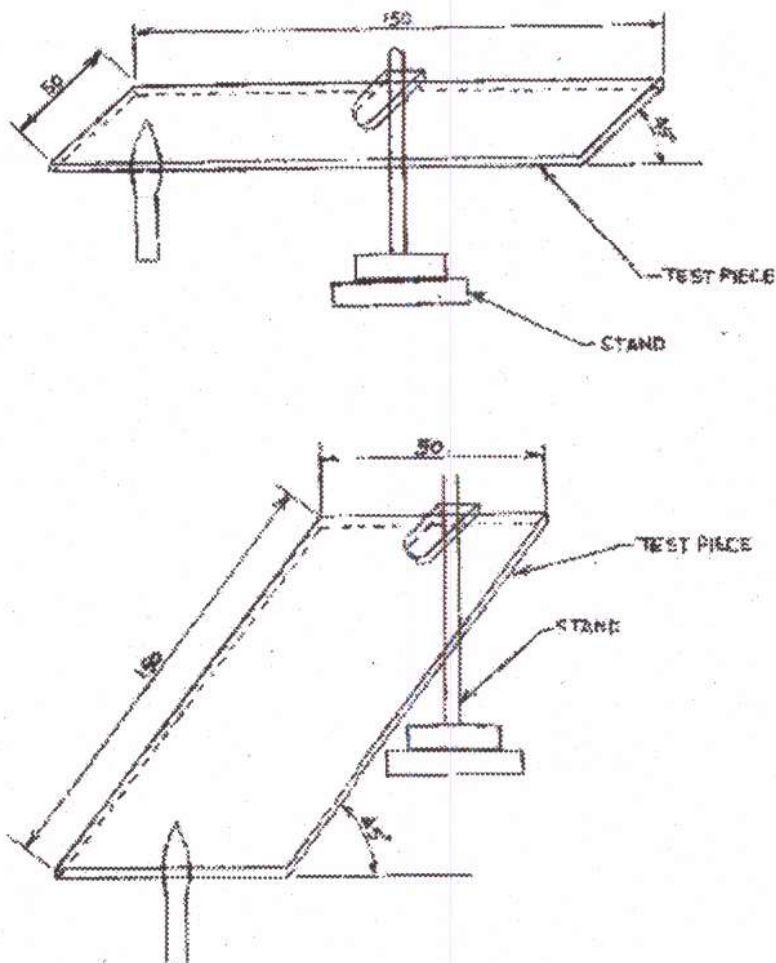
TEST FOR RESISTANCE TO  
SPREAD OF FLAME

FIGURE - 1

Prepared by

ANP/EL/7.1.108/DGL

Checked by