
To:
All Project Implementing Agencies (PIA)
DDUGJY Scheme
DISCOM(s)/SEB(s)/CPSU(s)/Power Department(s)

Subject: Stage inspection by PIA during manufacturing of Power transformers and Distribution Transformers

Ref: 1. REC Lr No.REC/DDUGJY/QA/2065 dt 29.06.2017
    2. REC Lr No.REC/DDUGJY/QA/2087 dt 11.07.2017

As per the technical specification mentioned under Clause 6.1.1, Section-I, Volume-III of SBD, the core used for manufacturing of Distribution transformer shall be either prime quality CRGO or Amorphous core.

However, for manufacturing of Power Transformer, the core used shall only from high grade non-ageing Cold Rolled Grain Oriented (CRGO) Silicon steel as per technical specification mentioned under Clause No. 7.5.2 & 7.5.3 Volume-III under Section-I of SBD.

This is for your kind information please. The relevant pages of the Standard Bidding Document (SBD) are attached herewith.

Thank you,

Yours faithfully,
(G S BHATI)
Executive Director (Q&FM)

Copy for kind information to:

1. The CMD/MD/Directors/Chief Engineer, PIA, DDGUJY Scheme
2. Sr. CPM/CPM, Regional Office(s) and Project Offices
3. DDGUJY web portal

Regional
and
State
Offices
Training Centre
: Hyderabad, Kolkata, Mumbai, Panchkula & Lucknow
: Bangalore, Bhopal, Hubbaneswar, Chennai, Guwahati, Jaipur, Jammu, Patna, Ranchi, Shillong, Shimla,
: Thiruvananthapuram & Vadodara
: Dehradun, Raipur
: Central Institute for Rural Electrification (CIRE), Hyderabad.
7.2.2 Tank shall be designed to permit lifting by crane or jacks of the complete transformer assembly filed with oil. Suitable lugs and bossed shall be provided for this purpose.

7.2.3 All breams, flanges, lifting lugs, braces and permanent parts attached to the tank shall be welded and where practicable, they shall be double welded.

7.2.4 The main tank body of the transformer, excluding tap changing compartments and radiators, shall be capable of withstandling pressure of 760mm of Hg.

7.2.5 Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.

7.2.6 Gaskets of nitrile rubber or equivalent shall be used to ensure perfect oil tightness. All gaskets shall be closed design (without open ends) and shall be of one piece only. Rubber gaskets used for flange type connections of the various oil compartments, shall be laid in grooves or in groove- equivalent sections on bolt sides of the gasket, throughout their total length. Care shall be taken to secure uniformly distributed mechanical strength over the gaskets and retains throughout the total length. Gaskets of neoprene and/or any kind of impregnated/bonded core or cork only which can easily be damaged by over-pressing are not acceptable. Use of hemp as gasket material is also not acceptable.

7.2.7 Suitable guides shall be provided for positioning the various parts during assembly or dismantling. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection of any sediment.

7.3 Tank Cover

The transformer top shall be provided with a detachable tank cover with bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. The surface of the cover shall be suitable sloped so that it does not retain rain water.

7.4 UNDER CARRIAGE

7.4.1 The transformer tank filled with oil shall be supported on steel structure with detachable plain rollers. Suitable channels for movement of roller with transformer shall be space accordingly, roller wheels shall be provided with suitable rollers bearings, which will resist rust and corrosion and shall be equipped with fittings for lubrication.

7.5 CORE Used for Manufacturing of Power Transformer (PTR)

7.5.1 Each lamination shall be insulated such that it will not deteriorate due to mechanical pressure and the action of hot transformer oil.

7.5.2 The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to HIB grade with lamination thickness not more than 0.23mm to 0.27mm or better ([Quoted grade and type shall be used]). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall not be more than 1.69 Tesla. The Bidder shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s) and different thickness (s) are not allowed to be used in any manner or under any circumstances.

[CRGO steel for core shall be purchased only from the approved vendors, list of which is available at http://apps.powergridindia.com/ims/ComponentList/Power-transformer%20upto%20420%20kV-CH%20List.pdf]
7.5.3 The bidder should offer the core for inspection starting from the destination port to enable Employer for deputing inspecting officers for detail verification as given below and approval by the Employer during the manufacturing stage. Bidder’s call notice for the purpose should be accompanied with the following documents as applicable as a proof towards use of prime core material: The core coils, if found suitable, are to be sealed with proper seals which shall be opened in presence of the inspecting officers during core cutting at the manufacturer’s or it’s sub-vendor’s premises as per approved design drawing.

a) Purchase Order No. & Date.
b) Invoice of the supplier
c) Mills test certificate
d) Packing list
e) Bill of lading
f) Bill of entry certificate to customs

Core material shall be directly procured either from the manufacturer or through their accredited marketing organization of repute, but not through any agent.

Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

7.5.4 The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulating coating resistant to the action of hot oil.

7.5.5 The insulation structure for the core to bolts and core to clamp plates, shall be such as to withstand 2000 V DC voltage for one minute.

7.5.6 The completed core and coil shall be so assembled that the axis and the plane of the outer surface of the core assemble shall not deviate from the vertical plane by more than 25mm.

7.5.7 All steel sections used for supporting the core shall be thoroughly shot or sand blasted, after cutting, drilling and welding.

7.5.8 The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.

7.5.9 The core clamping structure shall be designed to minimize eddy current loss.

7.5.10 The framework and clamping arrangements shall be securely earthed.

7.5.11 The core shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength.

7.5.12 Oil ducts shall be provided, where necessary, to ensure adequate cooling inside the core. The welding structure and major insulation shall not obstruct the free flow of oil through such ducts.

7.5.13 The design of magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earth clamping structure and production of flux component at right angle to the plane of the lamination, which may cause local heating.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>11 kV Distribution Transformers</th>
<th>33 kV Distribution Transformers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>System voltage (Max.)</td>
<td>12 kV</td>
<td>36 kV</td>
</tr>
<tr>
<td>2</td>
<td>Rated Voltage (HV)</td>
<td>11 kV</td>
<td>33 kV</td>
</tr>
<tr>
<td>3</td>
<td>Rated Voltage (LV)</td>
<td>433 - 250 V*</td>
<td>433 - 250 V*</td>
</tr>
<tr>
<td>4</td>
<td>Frequency</td>
<td>50 Hz +/- 5%*</td>
<td>50 Hz +/- 5%*</td>
</tr>
<tr>
<td>5</td>
<td>No. of Phases</td>
<td>Three</td>
<td>Three</td>
</tr>
<tr>
<td>6</td>
<td>Connection HV</td>
<td>Delta</td>
<td>Delta</td>
</tr>
<tr>
<td>7</td>
<td>Connection LV</td>
<td>Star (Neutral brought out)</td>
<td>Star (Neutral brought out)</td>
</tr>
<tr>
<td>8</td>
<td>Vector group</td>
<td>Dyn-11</td>
<td>Dyn-11</td>
</tr>
<tr>
<td>9</td>
<td>Type of cooling</td>
<td>ONAN</td>
<td>ONAN</td>
</tr>
</tbody>
</table>

Audible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers shall be as below (NEMA Standards):

<table>
<thead>
<tr>
<th>kVA rating</th>
<th>Audible sound levels (decibels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50</td>
<td>48</td>
</tr>
<tr>
<td>51-100</td>
<td>51</td>
</tr>
<tr>
<td>101-300</td>
<td>55</td>
</tr>
<tr>
<td>301-500</td>
<td>56</td>
</tr>
<tr>
<td>750</td>
<td>57</td>
</tr>
<tr>
<td>1000</td>
<td>58</td>
</tr>
<tr>
<td>1500</td>
<td>60</td>
</tr>
<tr>
<td>2000</td>
<td>61</td>
</tr>
<tr>
<td>2500</td>
<td>62</td>
</tr>
</tbody>
</table>

**TECHNICAL REQUIREMENTS:**

6.1.1 **CORE MATERIAL**

6.1.2.1 The core shall be stack / wound type of high grade Cold Rolled Grain Oriented or Amorphous Core annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with
continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

6.1.2.2 The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage. CRGO steel for core shall be purchased only from the approved vendors, list of which is available at http://apps.powergridindia.com/ims/ComponentList/Pow-erformer%20upto%20420%20kV-CM%20List.pdf

6.1.2.3 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. The bidder shall furnish necessary design data in support of this situation.

6.1.2.4 No-load current up to 200kVA shall not exceed 3% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.

or

No-load current above 200kVA and upto 2500kVA shall not exceed 2% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% of full load current.

6.1.2.5 Please refer to “Check-list for Inspection of Prime quality CRGO for Transformers” attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

7 WINDINGS:

(i) Material:

7.1.1 HV and LV windings shall be wound from Super Enamel covered /Double Paper covered Aluminum / Electrolytic Copper conductor.

7.1.2 LV winding shall be such that neutral formation will be at top.

7.1.3 The winding construction of single HV coil wound over LV coil is preferable.

7.1.4 Inter layer insulation shall be Nomex / Epoxy dotted Kraft Paper.

7.1.5 Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted.

7.1.6 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP Schedule 1).

7.1.7 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

7.1.8 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

8 TAPPING RANGES AND METHODS:

8.1.1 No tapping shall be provided for distribution transformers up to 100 kVA rating.

8.1.2 The tapping shall be as per provisions of IS: 1180 Part-I (2014).

8.1.3 Tap changing shall be carried out by means of an externally operated self-position switch and when the transformer is in de-energised condition. Switch position No.1 shall correspond
Annexure - A

Check-list for Inspection of Prime quality CRGO for Transformers

During inspection of PRIME CRGO, the following points needs to be checked by the Transformer manufacturer.
Utility's inspector shall verify all these points during inspection:-

iii) In case PRIME CRGO cutting is at works of Transformer Manufacturer:

Review of documents:

- Purchase Order (unpriced) to PRIME CRGO supplier/Authorised Agency
- Manufacturer's test certificate
- Invoice of the Supplier
- Packing List
- Bill of Lading
- Bill of Entry Certificate by Customs Deptt.
- Reconciliation Statement as per format below
- Certificate of Origin
- BIS Certification

Format for Reconciliation/Traceability records

- Packing List No./date /Quantity of PRIME CRGO received
- Name of Manufacturer
- Manufacturer test certificate No./date

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Details of package/job</th>
<th>Drawing Reference</th>
<th>Quantity Involved</th>
<th>Cumulative Quantity Consumed</th>
<th>Balance stock</th>
</tr>
</thead>
</table>

1. Inspection of PRIME CRGO Coils:

- PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils
- Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).
- Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.
- ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.
Inspection Clearance Report would be issued after this inspection

3. **Inspection of PRIME CRGO laminations:** Transformer manufacturer will maintain records for traceability of laminations to prime CRGO coils and burr/bow on laminations shall be measured. Utility can review these records on surveillance basis.

4. **Inspection at the time of core building:**
   Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in A.2.2 above.

   Above tests shall be witnessed by Utility. In case testing facilities are not available at Manufacturer's work, the sample(s) sealed by Utility to be sent to approved labs for testing.

**Inspection Clearance Report would be issued after this inspection**

(iii) In case PRIME CRGO cutting is at Sub-vendor of Transformer Manufacturer:
Review of documents:

- Purchase Order (unpriced) to PRIME CRGO supplier/ Authorised Agency
- Purchase Order (unpriced) to Core Cutter
- Manufacturer test certificate
- Invoice of the Supplier
- Packing List
- Bill of Lading
- Bill of Entry Certificate by Customs Deptt.
- Reconciliation Statement as per format below
  - Certificate of origin
  - BIS Certification

**Format for Traceability records as below:**

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Name of Customer</th>
<th>Details of package/job</th>
<th>Drawing Reference</th>
<th>Quantity Involved</th>
<th>Cumulative Quantity Consumed</th>
<th>Balance stock</th>
<th>Dispatch Details</th>
</tr>
</thead>
</table>

1. Inspection of PRIME CRGO Coils:

**PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils**

**Visual Inspection of PRIME CRGO Coils offered as per packing list** (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

**ISI logo sticker on packed mother coil and ISI logo in Material TC.**

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla, thickness depending on the
grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

**Inspection Clearance Report would be issued after this inspection**

3 **Inspection of PRIME CRGO laminations:**

Transformer manufacturer representative will inspect laminations and issue their internal Inspection Clearance Report. Inspection will comprise of review of traceability to prime CRGO coils, visual Inspection of PRIME CRGO laminations and record of burr/bow. After clearance given by transformer manufacturer, Utility will issue an Inspection Clearance Report after record review. If so desired by Utility, their representative may also join transformer manufacturer representative during this inspection.

**Inspection Clearance Report would be issued after this inspection**

viii) **Inspection at the time of core building:**

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in B.2.2.

**Inspection Clearance Report would be issued after this inspection**

**NOTE :-**

a) Transformer Manufacturer to ensure that PRIME CRGO is procured from POWERGRID approved vendors and CRGO manufacturer should have valid BIS Certificate for respective offered Grade.

14.3 Transformer Manufacturer should also involve themselves for ensuring the quality of CRGO laminations at their Core Cutter’s works. They should visit the works of their Core cutter and carry out necessary checks.

**c) General**

If a surveillance sample is drawn and sent to TPL (if testing facility not available with the manufacturer), the Transformer manufacturer can continue manufacturing at their own risk and cost pending TPL test report on PRIME CRGO sample drawn. Decision for acceptance of PRIME CRGO shall be based upon report of the sample drawn.

**These checks shall be read in-conjunction with approved Quality Plan, specification as a whole and conditions of contract.**

**Sampling Plan (PRIME CRGO)**

33 / 11 kV

- 1st transformer and subsequently at random 10% of Transformers (min. 1) offered for inspection.

DTs and other ratings

- 1st transformer and subsequently at random 2% of Transformers (min. 1) offered for inspection.

**NOTE :-** One sample for each lot of CRGO shall be drawn on surveillance basis.

CRGO has to be procured only from POWERGRID approved vendors. List of such vendors is available at the following website. Since the list is dynamic in nature, the site may be checked from time to time to see the list of approved vendors.

http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf