

1583256/2023/HEP-SWM20961



PRODUCT STANDARD

SWITCHGEAR ENGINEERING DIVISION

SG 12702 REV.07

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EPOXY BONDED GLASS FIBRE OPERATING RODS

1. GENERAL:

Epoxy bonded glass fibre operating rods to drg No. 25191000505 - PVTI / PVTB, 25211001627 - VM /BVM, 25213030533-PVN 36, 25213030600-PVN 36, 25217001506 & 25217001574-PVN 12/12A, 25213040501- PMVN 12 are used as links for transmission of mechanical motion and energy from the spring operating mechanism to the VCB pole. As the spring operating mechanism is at earth potential and the VCB poles are at live potential, the electrical clearances are critical. Hence the mechanical and electrical properties of these operating rods are of high importance.

2. MATERIAL:

Operating rod :- Epoxy bonded glass fibre laminated & Discs sheet to BP22483.

Inserts :- High tensile brass to specification AA12117.
:- SS rod to specification AA10721


3. GUIDELINES FOR MANUFACTURING :-

- i. The operating rods shall be manufactured out of rectangular Epoxy bonded glass fibre laminates and disc sheet.
- ii. The boring operation at the two ends of the rods shall be concentric to the OD of the rod within limits specified on drawings.
- iii. The HT brass inserts or SS inserts shall be fixed at the two ends of the rod by suitable epoxide resin based adhesive providing the required pull strength as specified in para 5B(ii) c.

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REV.	07	PRINTS TO :-		APPROVED -		
ALTD.	M.A.KHAN	SWM (PLNG)	1	R.K.SHUKLA		
APPD.	D.K.DIKSHIT	QCX (SCR)	1	PREPARED	ISSUED	DATE
DATE.	05.05.2009	PD & D	1	D.SAHA	S.M.M	4-3-95

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		Following points may be noted:		
		<ul style="list-style-type: none">- The supplier may decide the outer finish of the inserts to obtain the desired pull strength. The sketch 'X' and 'Y' of inserts shown on drawings are for reference only.- Best glued strengths are obtained, if the surface to be glued are mechanically roughened, in addition, thorough degreasing is recommended. Touching of surfaces to be glued, with fingers, is to be avoided.- The adhesive to be used shall not initiate any corrosion.		
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 interest of Co.		iv. The fixing (anchoring) of inserts in the rods shall be carried out carefully so that it is within the circular run-out tolerance (radial) as specified on drawings.		
		v. The operating rods shall be given a final finishing coat of clear anti-tracking varnish to corporate standard AA27517.		
		vi. Circular discs wherever shown on drawings shall be fixed on the operating rod using suitable adhesive. As these discs are for increasing the electrical creepage distance, no cavity or voids shall exist at the jointing sections.		
		4 <u>QA PLAN</u>		
		QA Plan shall be submitted along with offer & got approved .This shall include tests & measurements on raw material , semi finished and finished products, details of manufacturing process followed including tools, jigs & fixtures /gauges used at different stages to ensure quality of end product.		
		5. <u>TEST REQUIREMENTS AND ACCEPTANCE CRITERIA:</u>		
		A. Suppliers inspection and test report as per SlNo.B(ii) and detailed dimensional report as per drawing shall be furnished along with the lot supplies.		
		B. Checks at BHEL.		
		i) <u>VISUAL CHECKS:</u>		
		All (100%) operating rods shall be free from splits/cracks.		



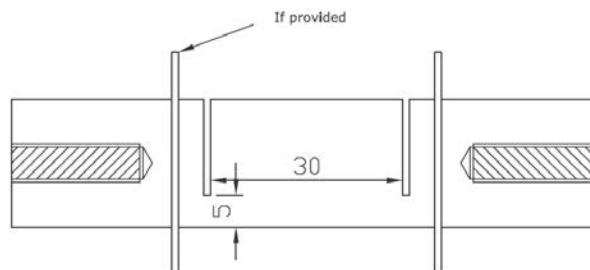
ii) Sampling plan for the following checks/tests shall be as per Level S-2, AQL-0.65 Double sampling plan to IS2500.EL).

a) DIMENSIONAL CHECKS:

The circular run-out-radial tolerance shall be within limits specified on drawings. It shall be checked using fixture mentioned on the drawings. Inserts shall be perpendicular as marked in drawings.

b) ELECTRICAL TESTS:

For testing at BHEL works, supplier shall send 03 nos of operating rod cut to 30mm size using Saw/parting tool as shown below along with each lot. These rods shall be covered in polythene packet and packed in separate box marked samples for testing. This box shall be kept inside the lot package.



TYPICAL SKETCH OF OPERATING ROD

- i) 30 mm long rod piece (minimum 3 Nos.) cut from sample should withstand 60 kV for 5 minutes in oil after preconditioning at 90 deg C per lot.
- ii) The finished product shall be subjected to water absorption test for 24 hrs and after cleaning with non-fibrous paper within 3 minutes time HV test shall be carried out. Samples shall withstand 95kV (rms) for 1 min for PVTI/PVTB, 70kV(rms) for PVN36 And 35kV(rms) for VM/BVM/PVN12 & 12A. If any of the above tests fails, Subsequent test shall not be conducted and lot shall be rejected.
- iii) The operating rod shall with stand power frequency voltage of 75 kV for one minute in air when applied across the threaded inserts. Correction factor for voltage if applicable may be applied. (For 25211001627-001, two pieces of SMC sheet as per sketch

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No. SKETCH/SWE/OPTG ROD/001 drawn below, to be used on both sides during test to avoid surface tracking. For other items no such SMC sheet will be used during testing).

- c) MECHANICAL TESTS: The operating rod shall be tested for pull test at the threaded inserts till rupture and the load value 'F' shall be > 3000 kgf. Refer respective drgs for exact value to be tested on different items.
Material to drg no. 25213040501 shall withstand 1500 kgf.

6. IDENTIFICATION MARKINGS FOR TRACEABILITY

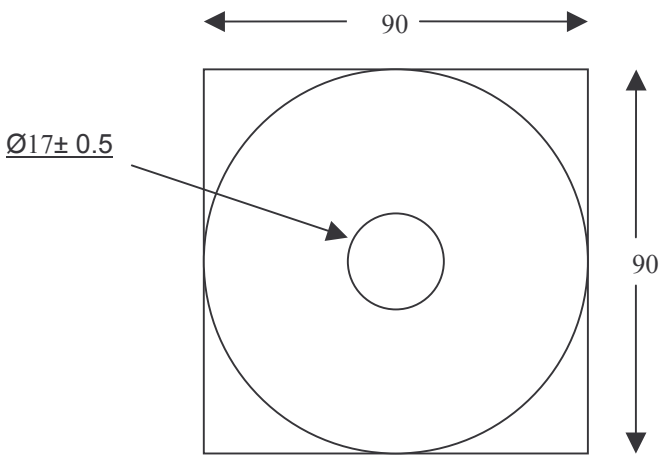
Each operating rod shall have following markings at locations (*) shown on the drawings:

- Suppliers name or logo
- Month and year of manufacturing

The markings shall be long lasting and should not affect the electrical properties.

7. PACKING

Components shall be properly packed to prevent mechanical damage during transit.



SKETCH/SWE/OPTG ROD/001



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SUPERSEDES
BP 22483 Rev 06

EPOXY BONDED GLASS FABRIC BASE LAMINATED SHEET & COMPONENTS

1. **GENERAL:**
This specification governs the quality of laminated sheet made from layers of plain woven glass fabric (non-alkaline glass type E) having suitable silane/volan finish with excellent mechanical and electrical properties using thermosetting epoxy resin as the bonding medium. The material shall have temperature index of at least 155.

Note : Whenever the components are ordered the supplier shall ensure that length of the components shall be in longitudinal direction of sheet only.
2. **APPLICATION:**
The insulating material is used for support rod, operating rod and other parts of electrical machines, where high mechanical and electrical properties are required.
3. **COMPLIANCE WITH NATIONAL STANDARD:**
There is no National/ International standard covering this type of material.
4. **DIMENSIONS AND TOLERANCES:**
Shall be stated on the order or drawing accompanying the order.
5. **FINISH :**
The surface of the components shall be even, smooth, free from visible defects like blisters, loose fibers, resin concentration, delamination, wrinkles, local deformation and dents.
6. **TEST METHODS :**
Unless otherwise specified the tests shall be conducted in accordance with the relevant methods of Corporate Standard AA 085 17 01.
7. **SAMPLE FOR TEST :**
Three sheets of size 300x300x3mm and two sheets of size 300x300x10mm prepared from the same batch, shall be supplied for testing and approval. Longitudinal direction shall be clearly marked on test samples.

Revision :
Reviewed & up-dated

Issued by : 
**STANDARDS AND MATERIALS GROUP
TECHNICAL SERVICES DEPTMENT**

Rev. 07

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Date of first Issue: October 1989



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8. PHYSICAL PROPERTIES :

8.1 Specific Gravity : 1.85 – 1.95

8.2 Glass Content : 65 - 71 %.

9 MECHANICAL PROPERTIES :

9.1 Tensile Strength in Longitudinal Direction : 350 N/mm², Min.

(For Sheet 1.5 mm tk and above)

9.2 Cross Breaking Strength :

9.2.1 As Received Condition : 350 N/mm², Min.

9.2.2 After Heating at 155 ± 3°C for 60 ± 5 minutes and tested at 155 ± 3°C.

The reduction shall not be more than 50% of the value in as received condition.

9.3 Impact Strength in Longitudinal Direction : 200 KJ/m², Min. Flat wise

9.4 Notched – Impact Strength in Longitudinal Direction : 150 KJ/m², Min. Flat wise

Test shall be carried out on 10mm tk. Sheet as per AA 085 17 01 except that test specimen will have U- notch of width 2 ± 0.2 mm & depth shall be 1/3 of thickness of sheet under test. Radius at corners & bottom of the notch shall be less than 0.2 mm.

9.5 Machinability (for sheets 3.0 mm and above) :

The sheets shall be capable of being sawn, milled, drilled and tapped with a M 3.5 tap and shall be capable of being shaped in a shaping machine without showing any sign of cracking or chipping.

10.0 ELECTRICAL PROPERTIES :

10.1 Electrical Strength (Proof) in oil at 90 ± 2 °C :

10.1.1 Flatwise : 40 kV for 1 Minute. Test shall be carried out on 3 mm thick sheet.

10.1.2 Edgewise : 60kV for 1 Minute

Test shall be carried out on sheets/ components above 3 mm thick.

10.2 Comparative Tracking Index : 420, Min.

10.3 Breakdown Strength – Edgewise (After Ageing) :

10.3.1 After ageing at 100 ± 2 °C for 24 ± 0.5 hours : 6.6k V/cm, Min.

10.3.2 After ageing at 100 ± 2 °C for 100 ± 1.0 hours : 6.6k V/cm, Min.



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11 TEST CERTIFICATE :

Unless otherwise specified, three copies of test certificates shall be supplied.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information.

BP 22483 (Rev. 07) : Epoxy Bonded Glass Fabric Base Laminated Sheet & Components
BHEL Order No.

Supplier's Reference :

Batch / Lot No.

Test values obtained/certificate for compliance for clause 5 and 8 to 10.

12 PACKING AND MARKING :

Identification slips shall be pasted suitably on all sheets/Components giving manufacturer's code number/grade. The sheets/Components shall be suitably packed in wooden case lined with water proof paper from inside. Each sheet/Component should be separate from other sheet/Component by a thick paper or card-board. Longitudinal direction shall be clearly marked on each sheet/Components.

Each package shall be marked with the following information :

BP 22483 : Epoxy Bonded Glass Fabric Base Laminated Sheets and Components.

BHEL Order No.

Supplier's Name and Grade

Batch / Lot No.

Thickness, Width and length/Drawing No..

No of sheets/Components.

Net weight and Gross weight.

Test certificate No.