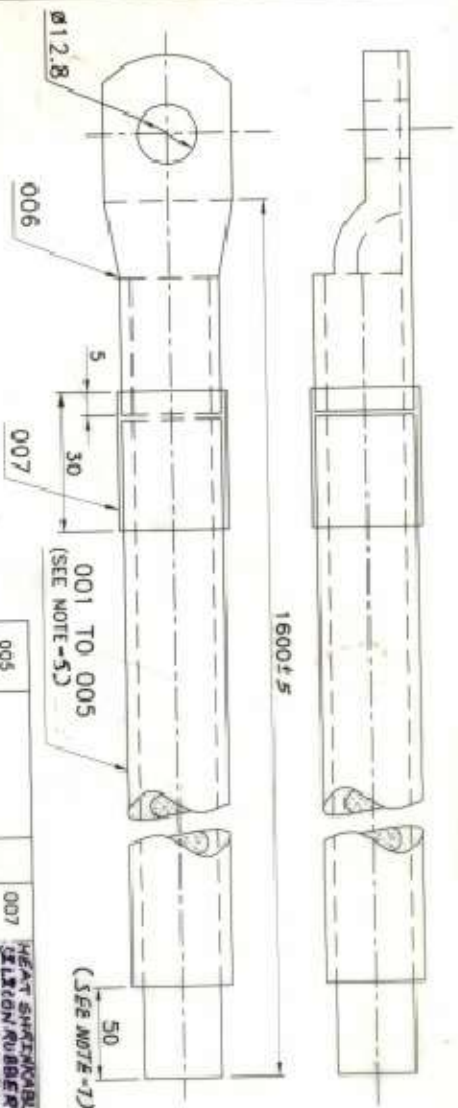


FIRST ANGLE PROJECTION

100 08 21 637 E NO. 080



NOTES:-

1. TERMINAL IS TO BE TINNED AFTER CRIMPING & DRILLING.
2. ALL SILICONE RUBBER INSULATED CHLOROSULPHONATED POLYETHYLENE SHEATHED SINGLE CORE FLEXIBLE THINNED COPPER GABLE (1500 VOLT GRADE) 50 MM 756/0-55-TO BP-28585.
3. CABLES ITEM 001 TO 005 ARE TO BE MARKED AS 'A', 'AA', 'V', 'F', & 'E' RESPECTIVELY, BY LETTER PUNCH ON CRIMPED FLATS.
4. ITEMS 001 TO 005 COMPRISING ONE OF IT, 006.
5. CABLE LEADS 001 TO 005 TO BE 150 SQ MM FLUOROCABLE/EQUIVALENT FLUORO ELASTOMERIC CABLE AS PER HITACHI SPEC. NO. E0028 BY RDSO APPROVED PART 1 (RECORD) VENDORS.
6. FOR ACCEPTANCE OF CABLE LEAD REFER SPEC. NO. TM08393.
7. HOT DIP TINUING TO BE CARRIED OUT ON BARE CABLE.
8. TOLERANCE ON UNIFORMIZED DIMS. TO BE ±0.5

HEAT SHINKABLE
SILICONE RUBBER TUBES
GABLE (AS PER SPEC.)

VAR. NO.	REMARKS	VAR. ITEM NO.	DESCRIPTION	STD.	DRAWING NO.	IT. NO.	MATL. CODE	MATL. SPECN.	UNIT	W.T.	QTY.	UNIT	W.T.	QTY.
005	SEE NOTES	007	HEAT SHINKABLE SILICONE RUBBER TUBES GABLE (AS PER SPEC.)						KG.	0.01				
005	SEE NOTES	006	TERMINAL		3439/028006	001			KG.	0.18				
001	SEE NOTES	005	EARTHING CABLE 'E'											
001	SEE NOTES	004	CABLE 'FF'											
001	SEE NOTES	003	CABLE 'V'											
001	SEE NOTES	002	CABLE 'AA'											
001	SEE NOTES	001	CABLE 'A'											

TME/A4-8078
REF. DRG. NO.

REV.	DATE	ALTERED BY	CHECKED BY	APPROVED BY	REV.	DATE	ALTERED BY	CHECKED BY	APPROVED BY
05	15.03.21				04	24.6.20			

NOTE 9 DELETED.

NOTE 10 & 11 ADDED.
NOTE 5 DELETED.

ADDITIONAL INFORMATION
STATUS OF DRAWING:
DISTRIBUTION OF PRINTS:
TME-1
TME-3
TME-4



TITLE OF PRODUCT OR NAME OF CUSTOMER/PROJECT
BHARAT HEAVY ELECTRICALS LTD.
BHOVAL

TM 4303 AZ/BY

REV.	DATE	ALTERED BY	CHECKED BY	APPROVED BY
05	04/04/18			

NOTE 3 WAS NOT ON.

NOTE 8 WAS NOT ON.
DIM 1600±5 WAS 1600.

NOTE 7 ADDED.
NOTE 6 ADDED.

OUTGOING CABLE LEADS

3 439 12 80 001

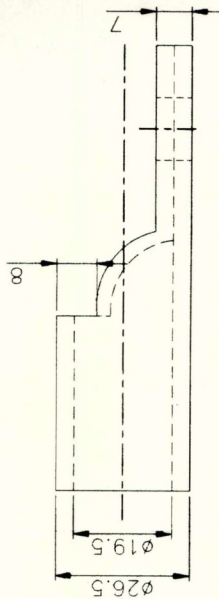
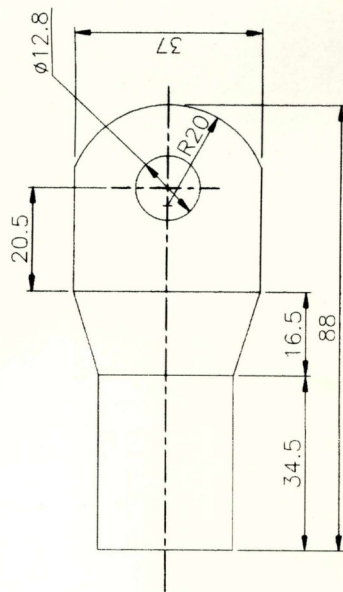
05

(ALL DIMENSIONS ARE IN MM)

TOOL LIST

IT. NO.	TOOL NO.	DESCRIPTION
	1574523	CRIMPING TOOL

DRG. NO. 34393028006



NOTES: -

1. THE TERMINALS ARE TO BE BRIGHT ANNEALED AT 300°C FOR 45 MINUTES AND WATER QUENCHED AFTER WARDS. THE HARDNESS OF TERMINALS AFTER ANNEALING SHOULD NOT BE MORE THAN 60 HV.
2. TERMINAL TO BE DIP TINNED TO 0.013 TK MINIMUM AFTER ANNEALING.
3. TOLERANCE ON UNTOLERATED DIMS. TO BE ± 0.1 EXCEPT HOLE SIZE.

		SEE NOTES		001		TERMINAL HIGH COND CPR. TUBE 26.5 0/DX3.5TKX88								BP12082																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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[illegible]

The characteristics of the wire shall be given in Table 1.

Item	Characteristics	Test Method
1. Construction	To be complied with clause 3 and the attached table	Clause 5 in JIS C 3005
2. Conductor resistance	Not exceeding the value in the attached table	Clause 6 in JIS C 3005
3. Dielectric strength	Capable of withstanding the test voltage given in the attached table.	Clause 8 (1) in JIS C 3005
4. Insulation resistance	Not less than the value in the attached table	Clause 9.1 in JIS C 3005
5. Surface leakage resistance	Not less than the value in the attached table	Clause 16 in JIS C 3005
6. Insulation material		
	Tensile strength	Not less than 1.0 kg/mm ²
	Elongation	Not less than 250%
	Ageing Tensile resist- strength	Not less than 80% of the value before ageing
		Elongation
Oil resisting	Ageing Tensile resist- strength	Not less than 60% of the value before ageing
		Clause 20 in JIS C 3005 (Ageing condition : 120°C x 18 hr)
		Clause 28 in JIS C 3005 (by Horizontal method)
7. Flame retardant	To be naturally extinguished within 15 minute.	

SYN		REVISIONS		DATE	REV'D	CHK'D	INVG	ATTN

Table 2 1,500V Fluonlex Insulated Wire (WFM2)

Conductor			Thick. of Insulation	Dia. of Finished wire	Tolerance of overall diam.	Conductor Resistance (20°C)	Test Voltage (V/1 min.)	Insulation Resistance (20°C)	Surface Leakage Resistance (MΩ)
Nominal Sectional Area (mm ²)	Construction No./Dia. of Wire (mm)	Dia. of Conductor (mm)	(mm)	(mm)	(mm)	(Ω/km)	(V/1 min.)	(MΩ/km)	(MΩ)
250	61/77/0.26	22.6	3.0	28.8	±1.2	0.0804	5,400	900	50
200	37/102/0.26	20.2	3.0	26.4	±1.1	0.0991	5,400	1,000	60
150	37/76/0.26	17.5	2.5	22.7	±1.0	0.133	5,400	900	70
100	37/51/0.26	14.4	2.5	19.6	±0.9	0.198	5,400	1,000	80
80	19/79/0.26	12.7	2.5	17.9	±0.9	0.249	5,400	1,000	90
50	19/50/0.26	10.2	2.5	15.4	±0.8	0.394	5,400	1,000	100

DWG. M. Makiwaka 86.10.23		CHKD.		APPD. O. Kawai 86.10.23	
MATERIAL SPEC.					
Hitachi, Ltd. Tokyo Japan					
HITACHI WORKS DWG. No. 10W702-362					
SH. No.		SH. 3		OF 3	



PLANT PURCHASING SPECIFICATION BHOPAL

BP 59698

Rev. No.03

PAGE 1 OF 3

**SUPERSEDES
BP 59698 Rev.02**

HEAT SHRINKABLE SILICON RUBBER TUBE

1. General :

This specification governs the quality of Heat Shrinkable Silicon Rubber Tube, which can be shrunk uniformly by application of heat at temperature of 120 deg.C and above.

2. APPLICATION :

Used for covering exposed portion of flexible lead wires and packing of connections in traction machines.

3. COMPLIANCE WITH NATIONAL STANDARDS :

There is no Indian Standard covering this material.

4. DIMENSIONS AND TOLERANCES :

Sizes shall be stated on the order/drawing. However the preferred dimensions and tolerances shall be as follow :

O.D. of Conductor For Covering (mm)	Before Heat Shrinking (As Recd-Nom)	After Heat Shrinking without Conductor		
	I.D. (mm)	I.D. (mm)	Thickness (mm)	
13 - 19	22	11	2.0	+0.3 -0.4
17 - 24	28	14	1.3	+0.3 -0.4
20 - 30	34	17	2.0	+0.3 -0.4

5. FREEDOM FROM DEFECTS:

The tube shall be smooth and free from porosity, breaks and other visible defects.

Revision :
Reviewed & brought up to date.

Issued by :

**STANDARDS AND MATERIALS GROUP
TECHNICAL SERVICES DEPARTMENT**

Rev. 03

Date : 05.03.2022

Date of first Issue : Dec' 1990



TSD 6207 A

**PLANT PURCHASING SPECIFICATION
BHOPAL**

BP 59698

Rev. No.03

PAGE 2 OF 3

6. IDENTIFICATION:

The material, when identified by infra-red spectrometer or by any other convenient method, shall be silicone rubber.

7. TEST METHOD :

As stated against each clause. 5 metre long sample of the tube shall be supplied for testing and approval.

8. PROPERTIES:

8.1 Specific Gravity

1.23, Nom, when tested by any conventional method.

8.2 Tensile Strength (IS : 3400, Part I) (Dumb – bell Method Type1)

5 N/mm² Min.

8.3 Elongation (IS : 3400, Part I,) (Dumb – bell Method Type 1)

300%, Min.

8.4 Breakdown Voltage IS: 2584

25 kV/mm, Min.

8.5 Resistivity IS : 3396

2×10^5 ohm – cm, Min.

9. KEEPING PROPERTIES :

When stored in a covered area under normal storage condition, the material shall not show any sign of deterioration like hair line cracks, swelling, porosity, flow lines, etc. for a period of 36 months from the date of manufacture which shall be subsequent to the date of placing the order.

The expiry date shall be marked clearly on every metre of the tube.



TSD 6207 A

**PLANT PURCHASING SPECIFICATION
BHOPAL**

BP 59698

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10. TEST CERTIFICATE :

Unless otherwise stated, three copies of test certificate shall be supplied giving the following information :

In addition, the supplier shall ensure to enclose one copy of Test Certificate along with their dispatch document to facilitate quick clearance of the material.

BP 59698 (Rev. 03): Heat Shrinkable Silicon Rubber Tube

BHEL Order No.

Supplier's Name & Trade Mark, if any,

Date of manufacture and expiry.

Test results of clauses 6 & 8 as well as spring hardness & tear strength as detailed below.

Spring Hardness : 70 + 5 Hs (By any international method)
- 7

Tear Strength : 2.5 kg / cm, Min. (BS 903 Part A3).

11. PACKING & MARKING :

Material shall be suitably packed in continuous rolls of 100 metres to prevent damage from contamination and handling during transit.

Each package shall be legibly marked with the following information :

BP 59698 : Heat Shrinkable Silicon Rubber Tube

BHEL Order No.


Manufacturer's / Supplier's Name & Trade Mark, if any


Date of manufacture and expiry.

Batch No.

Size

Quantity

		 PRODUCT STANDARD TME DIVISION, BHOPAL	TM 08393												
			PAGE 01 OF 02												
TME/2011		<u>GUIDELINES FOR PROCUREMENT OF FLUONLEX/FLUOROELASTOMERIC CABLE BY CABLE LEAD MANUFACTURES</u>													
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 the interest of the company	1.0 Scope														
	1.1 This specification covers the guidelines for procurement of Fluonlex/Fluoroelastomeric cable from cable manufacturers by cable lead vendors for traction machines cable leads & brush gear connectors.														
	1.2 This specification is being issued because cable is a critical item and due control shall be exercised by cable lead manufacturers in procuring cable from cable manufactures and documents in this respect shall be submitted to BHEL. Cable should have cable manufacturer's identification mark alongwith size and manufacturing date of cable after every 500-800mm length.														
	2.0 Instructions for cable procurement :														
	Vendors of cable leads must comply with the following instructions while procuring the Fluonlex/Fluoroelastomeric cable from original cable manufacturers :														
	2.1 Cable shall be as per specification called in enquiry / drawing.														
	2.2 Cable shall be purchased from RDSO / BHEL approved sources only and copy of approval of RDSO / BHEL shall be submitted in offer itself.														
	2.3 Name of cable manufacturer should be clearly mentioned in offer itself.														
	2.4 Complete type test results of the tests conducted at original cable manufacturer's works witnessed by BHEL representative. Alternatively test certificate by NABL approved lab shall be submitted with first supply.														
	2.5 For acceptance of regular lots:														
a. Cable lead supplier shall submit complete test results or acceptance test results mentioned in the respective specification mentioned in the drg/enquiry from original cable manufacturer's works.															
b. After receipt of lot in BHEL, 2 nos. of cable leads will be subjected to following tests for acceptance of lot:															
<table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Tests</th> <th>Requirement</th> <th>Test Method</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Insulation Resistance</td> <td>30GΩ (Min.)</td> <td>As per Appendix-1</td> </tr> <tr> <td>2</td> <td>Dielectric Strength Test</td> <td>Should pass at 80% of value mentioned in the reference specification</td> <td>As per Appendix-2</td> </tr> </tbody> </table>				Sl. No.	Tests	Requirement	Test Method	1	Insulation Resistance	30GΩ (Min.)	As per Appendix-1	2	Dielectric Strength Test	Should pass at 80% of value mentioned in the reference specification	As per Appendix-2
Sl. No.	Tests	Requirement	Test Method												
1	Insulation Resistance	30GΩ (Min.)	As per Appendix-1												
2	Dielectric Strength Test	Should pass at 80% of value mentioned in the reference specification	As per Appendix-2												
Revision Details: As per revision sheet		Distribution	Qty.	Approved S. P. Singh Sr.DGM/TME											
Rev. No.	Date of Rev	Reaffirmed Year	TME TXM TXN QMX	1 1 1 2											
04	31.12.12	Feb 2022	Prepared P. Telang Dy. Mgr/ TME	Checked V.Rawtiya DGM/TME											
			Dt. of 1st Issue												

		 PRODUCT STANDARD TME DIVISION, BHOPAL TME /2012	TM 08393 PAGE 02 OF 02
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 the interest of the company		<p>Note: Sample Cable leads sent for tests (above) shall be taken back for assembly in traction machines after passing the above tests.</p> <p>Appendix-1</p> <p>Finished cable lead shall be immersed in tap water at bath temperature less than 30°C for a period of 6 hours. The ends of cable lead during immersion shall be kept above water level. Following this condition period, the insulation resistance shall be measured with 1000V Megger.</p> <p>Appendix-2</p> <p>Specimen of cable lead should be immersed in tap water keeping both ends above water level at bath temperature less than 30°C for a period of 16 hours. Following this condition period, apply test voltage between copper conductor and water.</p> <p>3.0 Packing and Marking :</p> <ul style="list-style-type: none"> ➤ All cable leads shall have their ends sealed with non-hygroscopic sealing materials. ➤ The label /stenciling on the packing shall contain the following information: <ul style="list-style-type: none"> • Reference specification number with revision • Manufacturer's name, brand name or trade mark • Types of cables and voltage grade • Number of cores • Nominal cross-sectional area of the conductor • Approx. gross weight • Month and Year of manufacture • Purchase Order Number <p>4.0 Revision Record:</p> <p>Rev 01: Length of cable sample has been reduced from 6 meter to 1.5 meter and table-1 added.</p> <p>Rev02: In table-1 requirement and test method against Insulation Resistance has been revised. Instead of "as per specification", IR value of Minimum 30GΩ for 1.5 meter cable sample has been called.</p> <p>Rev03: Cable sample called in clause no. 2.5, has been removed as per guidelines of RDSO (refer RDSO letter SD.DFM.Cable.1 dated 23.04.2012).</p> <p>Rev04: a) Title has been changed from "Guidelines for procurement of Cable by cable lead manufacturers" to "Guidelines for procurement of Fluonlex/Fluoroelastomeric Cable by cable lead manufacturers. b) In clause no. 2.5 i.e. For acceptance of regular lots, witnessing of test results from BHEL representative has been withdrawn. c) Conductor Resistance test called in table for acceptance of regular lot has been withdrawn. d) Appendix-2 added.</p>	



PLANT PURCHASING SPECIFICATION BHOPAL

BP 12082

REV NO. 07

PAGE 1 of 3

**SUPERSEDES
BP 12082 Rev 06**

HIGH CONDUCTIVITY COPPER TUBES

1. GENERAL

This specification governs the quality requirements of high conductivity copper tube, up to 125mm outside diameter.

2. APPLICATION :

For use in Traction Motor /Current Transformers.

3. CONDITION OF DELIVERY:

The tube shall be supplied in solid drawn condition in straight lengths.

Ends shall be cut clean and square with the axis of the tube.

4. COMPLIANCE WITH NATIONAL STANDARDS

There is no Indian standard for this material. However assistance has been drawn from IS: 2501/BSEN 13600.

5. DIMENSIONS AND TOLERANCES:

5.1. Sizes

These tubes shall be designated by outside diameter and thickness. The material shall be supplied to the dimensions as specified in purchase order.

The sizes shall be selected from IS 5493.

5.2 Tolerances

The tolerances shall comply with IS: 5493, as detailed below.

5.2.1 Diameter:-

The mean diameter of the tube shall not vary from the specified diameter by more than the amount of tolerance given below. The mean diameter is half the sum of two diameters measured at right angles at any section of the tube.

Revision : Reviewed & Brought up to date.

Issued by :

**STANDARDS AND MATERIALS GROUP
TECHNICAL SERVICES DEPTMENT**

Rev. 07

Date : 12.03.2022

Date of first Issue: Feb. 1984

PLANT PURCHASING SPECIFICATION BHOPAL

BP 12082
REV NO. 07
PAGE 2 of 3

Outside Diameter Specified (mm)	Tolerances Nominal (\pm mm)
Up to 10	0.08
Over 10 to 18	0.10
Over 18 to 32	0.12
Over 32 to 50	0.15
Over 50 to 80	0.20
Over 80 to 125	0.25

5.2.2 Thickness:

The mean thickness of the tube shall not vary from the specified thickness by more than $\pm 12.5\%$ of the specified wall thickness. However total weight of the tubes should not differ by more than $\pm 5\%$ from the nominal dimensions.

5.2.3 Length

The tube ordered in the specified length shall be within the tolerances as specified below:

Specified Length (metres)	Tolerances on Specified Length (mm)
Upto & including 3	+4
Over 3 upto 6	+6
Over 6 upto 10	+8

*Note: Minus tolerances are not permissible.

5.3 Straightness :

For the acceptable straightness of the tubes, the permissible max. deflection shall not exceed 2 mm per meter.

6. MANUFACTURE:

The tubes shall be solid drawn; temper annealed and in no case shall be redrawn from used tubes.

7. FREEDOM FROM DEFECTS:

The tubes shall be round, straight, smooth, clean, uniform in diameter and free from cracks, seams, slivers, scales, deleterious film in the bore and other harmful defects.

The ends shall be cut clean and square with the axis of the tube.

8. CHEMICAL COMPOSITION:

The chemical composition of the material shall be as follows :

Copper including silver : 99.9% Min.

Note: These elements need not be determined when the material supplied confirms with Electrical & Mechanical properties specified in this specification. However, the supplier shall ensure that the composition of material confirms the specified limits.

9. TEST SAMPLES:

One sample per size, per batch, per consignment, shall be selected for test.

10. MECHANICAL PROPERTIES:

10.1 Tensile :

Test pieces when tested in accordance with IS : 1608 shall show a tensile strength of 245N/mm², Min.

10.2 Hardness :

The material when tested in accordance with IS : 1501 shall show a vicker's hardness of 75-90 HV.

11. ELECTRICAL CONDUCTIVITY:

The electrical conductivity of the material when tested at 20°C in the "As Received" condition shall be 97% min. of IACS standard which is equivalent to resistivity of 0.01777 Ohm mm²/ meter max. The material shall be tested in accordance with IS 3635. Alternatively, the eddy current probe method as per ASTM E1004 is also acceptable. Refer Appendix B of IS: 613 for temperature correction factor.

12. TEST CERTIFICATE:

Unless otherwise stated on the order, three copies of the test certificate 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 12082 (Rev. 07) : High conductivity Copper tubes.

BHEL Order No.

Manufacturer's / Supplier's Name.

Size and number of tubes.

Batch No.

Results of Tests: Test results obtained for Electrical and Mechanical Properties and Dimensional tolerances as per this specification.

13. PACKING AND MARKING

The tubes shall be suitably Hessian wrapped and packed to prevent damage during transit. Each package shall bear the following information

BP 12082: High conductivity Copper tubes.

Manufacture/Supplier's Name.

Size and weight of the material.

outgoing cable

Outgoing Cable

SHARAT HEAVY ELECTRICALS LIMITED, BHOPAL
QUALITY ASSURANCE DEPARTMENT
QUALITY ASSURANCE (PANOPI)
QA PLAN NO. QTM/TPM/ENCOR/09/2016 /TPM-001 Cable Lead DT. 16.04.2016 REV 01
REFERENCE: DRG NO. 3439/2009/01

SL. NO.	CHARACTERISTIC	CLASSIFICATION	TYPE OF CHECK	QUANTUM OF CHECK	REF. DOCUMENT	FORMAT OF RECORD	REMARKS
			TP	TP/A			
1.0	Raw Material Test Certificate	A	VR	100%	100%	DRG NO. 3439/2009/01 (Latest revision)	TEST LAB NABL / EQUIVALENT ACCREDITED
2.0	AI dimensions	A	I	100%	5%	DRG NO. 3439/2009/01 (Latest revision)	Supplier to be the raw material consigned with TC, purchase document from TPM/001, TC to be Submitted
3.0	Identification / Vendor Name, PO No. & Item serial no.	A	VR	100%	10%	PO Drawing	Dimensions Report is to be Submitted
4.0	Packaging suitability for transit & storage	B	VR	100%	—	—	Packaging shall be such that during transit components should not damage.

PREPARED BY: *[Signature]*
APPROVED BY: *[Signature]*

Notes:
1) All TR, SR checked by TP, TPM/001 (signed & sealed) as per above OAP requirement shall be submitted to the management.

Abbreviations: C - Check, S - Major VR - Verification, I - Inspection, TP - Test Performer, SR - Shop Record, TR - Test Record, SR - Shop Record.