

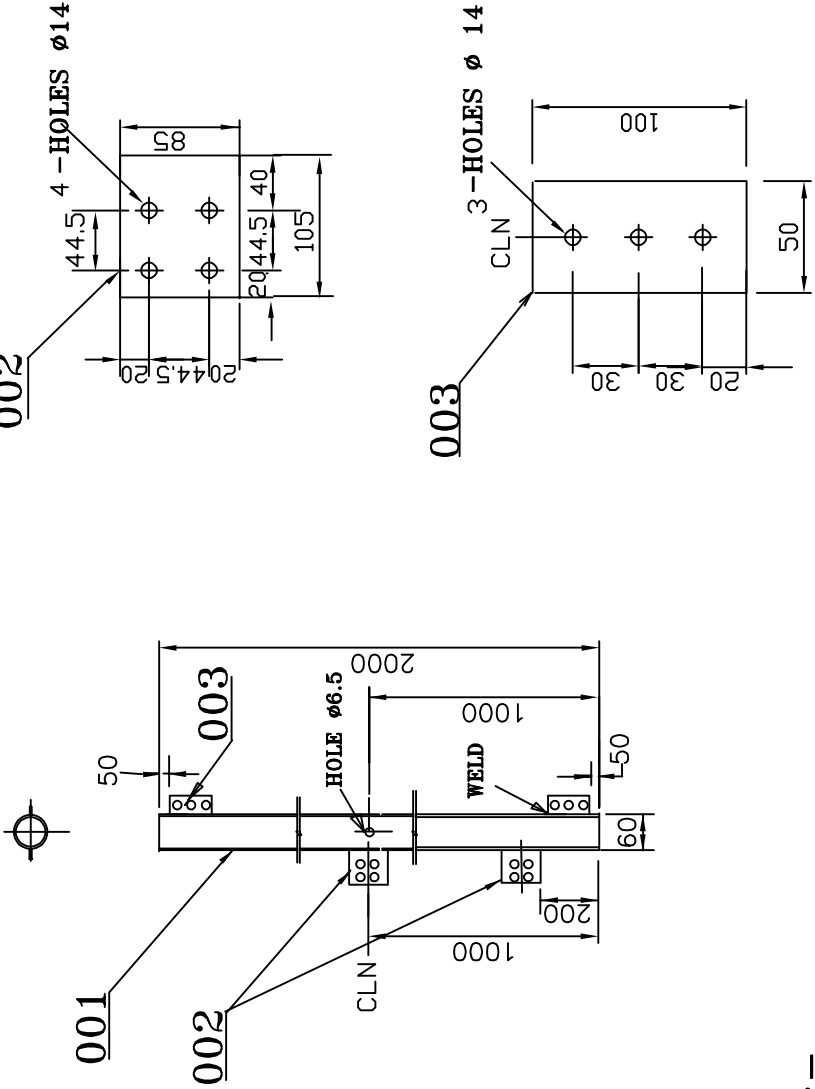


FIRST ANGLE PROJECTION

(ALL DIMENSIONS IN mm)

|                                 |         |                     |      |                               |                     |      |                        |
|---------------------------------|---------|---------------------|------|-------------------------------|---------------------|------|------------------------|
| REV.                            | DATE    | ALTERED             | REV. | DATE                          | ALTERED             | Sd/- | ADDITIONAL INFORMATION |
| 02                              | 5.10.07 | CHECKED<br>APPROVED | 01   | 1.7.07                        | CHECKED<br>APPROVED | Sd/- |                        |
| ITEM-002 QTY WAS 001            |         |                     |      | DRG. MODIFIED                 |                     |      |                        |
| TOTAL WT.5.47 KGS. WAS 5.3 KGS. |         |                     |      | STATUS OF DRAWING             |                     |      |                        |
|                                 |         |                     |      | DISTRIBUTION CPE -1 TAXTCB>-1 |                     |      |                        |
|                                 |         |                     |      | DF PRINTS CPM-1 QCCTCB>-1     |                     |      |                        |

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IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.



NOTE: -

ALL SHARP EDGES SHALL BE GRINDED

|      |     |   |              |      |
|------|-----|---|--------------|------|
| 002  | 003 | ALUMINIUM PLATE<br>10 TK. X 50 X 100.     | AA 12317     | 136  |
| 002  | 002 | ALUMINIUM PLATE<br>10 TK. X 105 X 85 IG.. | AA 12317     | 001  |
| 001  | 001 | ALUMINIUM TUBE<br>60 O/D X 5THK. X 2000   | AA 12331     | 250  |
|      |     | REMARKS                                   | MATL. CODE   | 001  |
|      |     | ITEM NO.                                  | MATL. SPECN. | 4.70 |
|      |     | DESCRIPTION                               | UNIT         | 001  |
| QTY. |     |   | UNIT WT.     |      |
|      |     |   | QTY          |      |

|               |  |                           |  |                      |                              |                                    |
|---------------|--|---------------------------|--|----------------------|------------------------------|------------------------------------|
| SIGN. & DATE  | भारत हेवी इलेक्ट्रिकल्स लिमिटेड<br>भोपाल<br>BHARAT HEAVY ELECTRICALS LTD.<br>BHO PAL | व्यक्ति<br>DRN.           | नाम  | हस्ताक्षर            | दि. DATE                     | वेरि की<br>संख्या<br>NO.OF<br>VAR. |
|               |  | उपपत<br>SCALE<br>NTS      | भारत हेवी इलेक्ट्रिकल्स लिमिटेड<br>भोपाल<br>BHARAT HEAVY ELECTRICALS LTD.<br>BHO PAL | Sd/-                 | 15.5.01                      | 01                                 |
|               |  | विवरण<br>DEPT. CPE<br>कोड | भारत हेवी इलेक्ट्रिकल्स लिमिटेड<br>भोपाल<br>BHARAT HEAVY ELECTRICALS LTD.<br>BHO PAL | Sd/-                 | 15.5.01                      | 01                                 |
|               |  | विवरण<br>DEPT. CPE<br>कोड | भारत हेवी इलेक्ट्रिकल्स लिमिटेड<br>भोपाल<br>BHARAT HEAVY ELECTRICALS LTD.<br>BHO PAL | Sd/-                 | 15.5.01                      | 01                                 |
| INVENTORY NO. | शीर्षक /TITLE<br>BUS TUBE (ø60)  | उपपत<br>SCALE<br>NTS      | भारत हेवी इलेक्ट्रिकल्स लिमिटेड<br>भोपाल<br>BHARAT HEAVY ELECTRICALS LTD.<br>BHO PAL | मद क.<br>ITEM NO.    | पुन.<br>REV.                 | 003                                |
|               |  |                           |  | 4 601 10 00214       | 02                           |                                    |
|               |  |                           |  | पृष्ठ सं. SHT. NO.01 | पृष्ठों की सं. NO. OF SHT.01 |                                    |

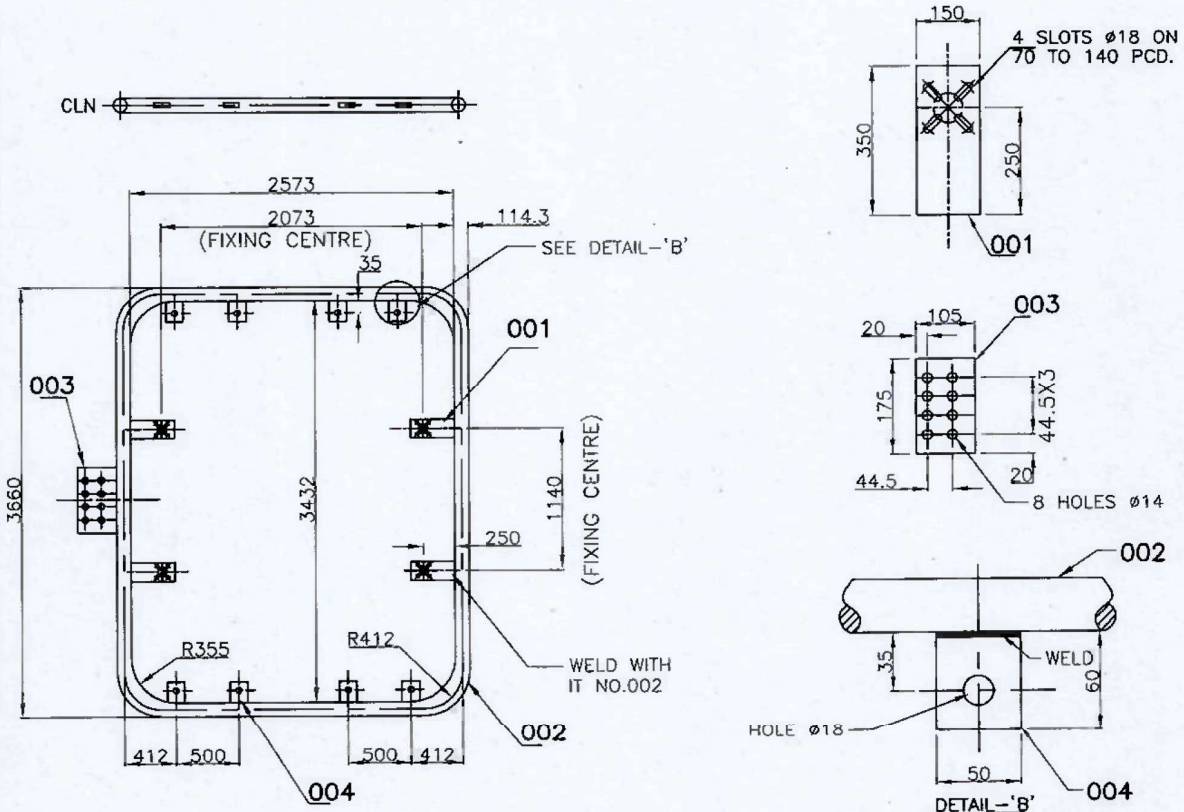


## FIRST ANGLE PROJECTION

(ALL DIMENSIONS IN mm)

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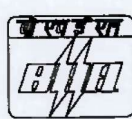
| REV. | DATE | ALTERED  | REV.                      | DATE     | ALTERED  | ADDITIONAL INFORMATION                 |
|------|------|----------|---------------------------|----------|----------|--|
|      |      | CHECKED  |                           |          | CHECKED  |  |
|      |      | APPROVED |                           |          | APPROVED |  |
|      |      |          | 01                        | 02-01-26 |          | STATUS OF DRAWING PR                   |
|      |      |          | Total Weight was 70.78 Kg |          |          | DISTRIBUTION OF PRINTS CPE-1 CUSTOMER- |



| REF. DRG. NO. | VAR QTY.         | REMARKS | ITEM NO.                                      | DESCRIPTION  | UNIT | MATL. CODE | MATL. SPECN. | UNIT WT. | QTY |
|---------------|------------------|---------|---|--------------|------|------------|--------------|----------|-----|
| 008           | WELD WITH IT.002 | 004     | ALLUMINIUM PLATE<br>10 TK X 50 X 60 LG        | AA 12317     | KG   | .081       |              | 001      |     |
| 001           | WELD WITH IT.002 | 003     | ALLUMINIUM PLATE<br>10 TK X 105 X 175 LG      | AA 12317     | KG   | .50        |              | 001      |     |
| 001           |                  | 002     | ALLUMINIUM TUBE<br>114.3 O/D X 5TK X 11758 LG | AA 12331     | KG   | 54.53      |              | 001      |     |
| 004           | WELD WITH IT.002 | 001     | ALLUMINIUM PLATE<br>10 TK X 150 X 350 LG      | AA 12317     | KG   | 1.41       |              | 001      |     |
|               |                  |         |   | MATL. CODE   | A/C  | UNIT       |              |          |     |
|               |                  |         |   | MATL. SPECN. |      |            |              |          |     |

SIGN. &amp; DATE

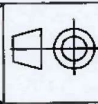
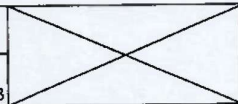
INVENTORY NO.



भारत हेवी इलेक्ट्रिकल्स लिमिटेड  
भोपाल  
BHARAT HEAVY ELECTRICALS LTD.  
BHOPAL

| नाम           | NAME     | हस्ता. SIGN | दि. DATE | वेरि की संख्या NO. OF VAR. |
|---------------|----------|-------------|----------|----------------------------|
| बनाया DRN.    | P.K.PAUL | -Sd-        |          |                            |
| जांचा CKD.    | APY/TSK  | -Sd-        |          |                            |
| स्वीकृत APPD. | M.KURRE  | -Sd-        |          |                            |

विभाग DEPT.CPE  
कोड CODE-408



उत्पात SCALE  
NTS

भारत के.ग. WEIGHT(K.G.)  
62 ±2

उसे. ड्रॉइंग का संदर्भ REF.TO ASSY.DRG.

मद क. ITEM NO.

मद संख्या NO.OF ITEM  
004

शीर्षक /TITLE

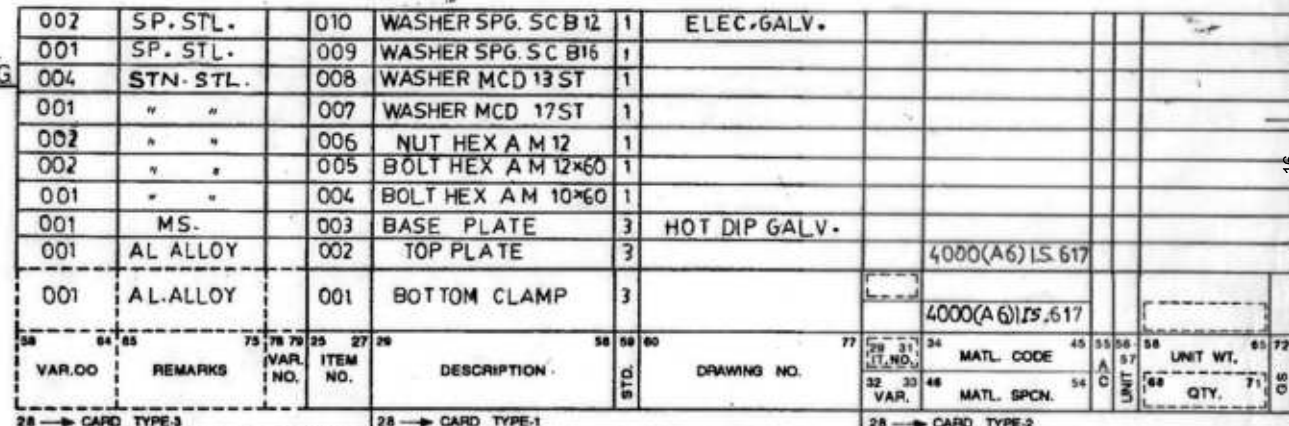
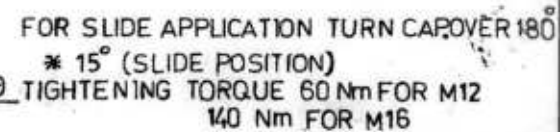
CORONA PROTECTOR Ø114.3  
FOR 16 UNIT RACK

ड्रॉइंग क्र. DRAWING NO.  
4 601 10 00248

पृष्ठ क्र. SHT. NO.01 पृष्ठों की सं. NO. OF SHT.01

पुन. REV.  
01

REF. DRG. NO.



1. ALL SHARP CORNERS WILL BE ROUNDED OFF
2. RATED VOLTAGE-400 K.V.
3. FOREQUIP. POST INSULATOR OF 76 PCD
4. BUS SUPPORT TO BE CORONA FREE UP TO 320KV.

|                                |      |      |                     |         |          |                        |         |          |
|--------------------------------|------|------|---------------------|---------|----------|------------------------|---------|----------|
| REV                            | DATE | ALT. | REV                 | DATE    | ALTERED  | REV.                   | DATE    | ALTERED  |
| 03                             | 05   | APPD | 02                  | 28-8-98 | CHECKED  | 01                     | 3-11-97 | CHECKED  |
|                                |      |      |                     |         | APPROVED |                        |         | APPROVED |
| 4-HOLES Ø14<br>WAS 2-HOLES Ø14 |      |      | 2 HOLES Ø 14 ADDED. |         |          | ZONE DRG RETRACED ONLY |         |          |


|                   |   |
|-------------------|---|
| STATUS OF DRAWING | B |
|-------------------|---|

**DISTRIBUTION OF PRINTS**  
O.C.I.  
C.F.M - 2  
G.C. (T.C.B) - 1  
T.R.A (T.C.B) - 1

उत्पाद का प्रकार या  
ग्राहक/परियोजना का नाम  
TYPE OF PRODUCT OR  
NAME OF CUSTOMER/PROJECT



भारत हेवी इलेक्ट्रिकल्स लिमिटेड  
भोपाल  
BHARAT HEAVY ELECTRICALS LTD.  
BHOPAL

|   |  |   |   |   |                               |                              |
|---|--|---|---|---|-------------------------------|------------------------------|
| भाग<br>DEPT./C.P.E.   | अव. ड्रा. नाम की सेवा<br>UNTOL. DMS. GR. | चक्र<br>SCALE   | आ त्रि. क.<br>WEIGHT/K.G.                 | आ. ड्रा. का सं. /<br>REF. TO ASSY. DRG. | सं. क.<br>ITEM NO.            | सं. संख्या<br>NO. OF<br>ITEM |
| कोड 408<br>CODE   | N  |  N.T.S | 20 (APPX)                                 | -                                       | -                             | 010                          |
| शीर्षक/TITLE<br>BUS SUPPORT CLAMP FOR<br>60 MM.O.D. A.L. PIPE |  |   | ड्रा. सं. / DRAWING NO.<br>3 601 10 00098 |   | सं./REV<br>03                 |                              |
|   |  |   | ड्रा. सं./SHT.No. 01                      |   | ड्रा. की सं. / NO. OF SHT. 01 |                              |

**A3 SIZE**



## MANUFACTURING QUALITY PLAN

| Sr. No. | Components/ Operation & Description or Test | Type of check | Quantum of check/ Sampling With basis | Reference Document for Testing | Acceptance Norms | Format of records | Applicable Codes |   |   |   |   |   | Remarks |
|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

## SECTION: RAW MATERIAL INSPECTION

|        |   |  |  |  |      |   |   |   |   |  |  |   |  |
|--------|---|--|--|--|------|---|---|---|---|--|--|---|--|
| 1.1    | STAINLESS STEEL SHEET   |  |  |  |      |   |   |   |   |  |  | E |  |
| 1.1.1. | Visual & Dimensional checks   |  | One sample per lot for each size                                       | BHEL Specn. CPE/PS/8018/04 /Electrical specn. / POWERGRID Specn.         | CMTC | B | K | P | W |  |  | N | Surveillance check by PowerGrid for review of BHEL records/Mfr. TC |
|        | a) Visual check   |  | --DO--   | Free from defects No. damage.  |      | B | K | P | W |  |  | N | -DO-   |
|        | b) Thickness  |  | --DO--   | CPE/PS/8018/04 /   |      | B | K | P | W |  |  | N | -DO-   |
|        | c) Width  |  | --DO--   | CPE/PS/8018/04 /   |      | B | K | P | W |  |  | N | -DO-   |
|        | d) Length   |  | --DO--   | --DO--   |      | B | K | P | W |  |  | N | -DO-   |
|        | e) Straightness (Camber)  |  | --DO--   | --DO--   |      | B | K | P | W |  |  | N | -DO-   |
|        | f) Flatness   |  | --DO--   | --DO--   |      | B | K | P | W |  |  | N | -DO-   |
| 1.1.2  | Check for   |  |  |  |      |   |   |   |   |  |  |   |  |
|        | a) Chemical composition   |  | --DO--   | --DO--   |      | B | K | P | W |  |  | N | -DO-   |
|        | b) Mechanical properties.   |  | --DO--   | --DO--   |      | B | K | P | W |  |  | N | -DO-   |
|        | c) Surface finish   |  | --DO--   | --DO--   |      | B | K | P | W |  |  | N | -DO-   |
| 1.2    | HAZY POLYPROPYLENE FILM   |  |  |  |      |   |   |   |   |  |  | E |  |
| 1.2.1  | Visual & Dimensional checks   |  |  |  | CMTC | B | K | P | W |  |  | N |  |
| a)     | Visual check & classification of rolls for thickness balancing ( To be done during element winding stage when rolls are unpacked) |  | IS:2500 AQL= 4%<br>Lot Size 2 to 90 3<br>91 to 280 13<br>281 to 500 20 | BHEL Specn. BP22861 / BHEL Electrical specn. POWERGRID Specn. No. damage |      | B | K | P | W |  |  | N | Surveillance check by PowerGrid for review of BHEL records/Mfr. TC |
| b)     | Width   |  | One sample   | --DO--<br>Film Width Tol.<br>Upto 150 +0.75mm<br>>150 +1.50mm            |      | B | K | P | W |  |  | N | -DO-   |
| c)     | Thickness by weight method  |  | One sample per lot for each size.                                      | --DO--<br>Tol. $\pm$ 6%  |      | B | K | P | W |  |  | N | -DO-   |



## MANUFACTURING QUALITY PLAN

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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|       |  |  |   |  |  |  |   |   |   |   |  |   |   |
|-------|--|--|---|--|--|--|---|---|---|---|--|---|---|
| d)    | Camber   |  |   | -DO -<br>Max.3mm for 1.5 meter length  |  |  | B | K | P | W |  | N | -DO-  |
| 1.2.2 | Check for -  |  |   |  |  |  |   |   |   |   |  |   |   |
| a)    | Shrinkage  |  | One sample per lot for each size.                           | -DO -<br>4% Max in MD (Machine Direction) 1.5% Max in CMD (Cross Machine Direction) at 100 deg. C+ -2deg. C for 10 minutes         |  |  | B | K | P | W |  | N | -DO-  |
| b)    | Space Factor   |  | One sample per lot for each size.                           | BHEL Specn. BP22861 /<br>BHEL Electrical specn. /<br>POWERGRID Specn<br>Below 10 micron:6 to10%<br>Above 10 micron:7 to 13%        |  |  | B | K | P | W |  | N | Surveillance check by Power Grid for review of BHEL records/Mfr. TC |
| c)    | Tensile Strength                                       |  | -DO -   | -DO -<br>110 N/mm <sup>2</sup> min. in MD &<br>CMD 140 N/mm <sup>2</sup>   |  |  | B | K | P | W |  | N | -DO-  |
| d)    | MD to CMD ratio of Tensile Strength                    |  | -DO -   | -DO -<br>0.4 to 1.20   |  |  | B | K | P | W |  | N | -DO-  |
| e)    | Elongation at break                                    |  | -DO -   | -DO -<br>40%min.   |  |  | B | K | P | W |  | N | -DO-  |
| f)    | Electrical Properties - Dielectric strength (AC OR DC) |  | One sample per lot for each size.                           | -DO -<br>Thickness BDV(AC)<br>(micron) kV/mm<br>9 to 15 300<br>16 to 18 315<br>Thickness BDV (DC)<br>9 to 11 400<br>12 & above 525 |  |  | B | K | P | W |  | N | Surveillance check by Power Grid for review of BHEL records/Mfr. TC |
|       | Volume Resistivity (Type test)                         |  | One sample for each size. Once in 5 yrs. for every supplier | -DO -<br>1 x 10 <sup>16</sup> ohm cm Min.  |  |  | B | K | P | W |  | N | -DO-  |



|       |  |  |  |   |      |   |   |   |   |  |   |   |
|-------|--|--|--|---|------|---|---|---|---|--|---|---|
| h)    | Dielectric Constant at 50 Hz ( Type test )   |  | -DO -  | -DO -<br>2.2 to 2.3   |      | B | K | P | W |  | N | Surveillance check by Power Grid for review of BHEL records/Mfr. TC |
| i)    | Power Factor at 100 deg. C at 50 Hz ( Type test )                                  |  | -DO -  | -DO -<br>0.09% max  |      | B | K | P | W |  | N | -DO-  |
| j)    | Material Identification ( Type test )  |  | -DO -  | -DO -<br>Should be polypropylene  |      | B | K | P | W |  | N | -DO-  |
| 1.3   | ALUMINIUM FOIL HIGH PURITY   |  |  |   | CMTC |   |   |   |   |  | E |   |
| 1.3.1 | Visual & dimensional checks  |  |  |   |      | B | K | P | W |  | N | Dent free/Rinse free foil to be used                                |
| a)    | Visual checks -  |  | Lot Sample size Size<br>2 to 90 - 5<br>91 to 280 - 13<br>281 to 500 - 20 | BHEL specn. BP12399<br>POWERGRID Specn. No.<br>damage                             |      | B | K | P | W |  | N | Surveillance check by PowerGrid for review of BHEL records/Mfr. TC  |
| b)    | Width  |  | --DO--   | +0.4 mm   |      | B | K | P | W |  | N | -DO-  |
| c)    | Thickness  |  | One sample per lot for each size.  | --DO--<br>+ 10% of normal thickness   |      | B | K | P | W |  | N | -DO-  |
| 1.3.2 | Check for -  |  |  |   |      |   |   |   |   |  |   | Surveillance check by Power Grid for review of BHEL records/Mfr. TC |
| a)    | Chemical composition<br>i)Aluminum<br>ii)Total impurities including iron & silicon |  | One sample per lot for each size.  | BHEL spec. BP12399<br>POWERGRID Specn.<br>99.35% Min (Al)<br>0.65% max. (balance) |      | B | K | P | W |  | N |   |



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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|       |                                     |                   |   |  |  |  |   |   |   |   |  |   |   |
|-------|-------------------------------------|-------------------|---|--|--|--|---|---|---|---|--|---|---|
| b)    | Wettability                         |                   | -DO-  | -DO-<br>Shall be wettable  |  |  | B | K | P | W |  | N | -DO-  |
| c)    | Covering Capacity                   |                   | -DO-  | BHEL Elect. Spec.<br>Thk<br>Sqm/Kg.<br>4.5 micron 73-87<br>5 micron 66-80<br>5.5 micron 60-73<br>6 micron 55-66<br>10 micron 3.3-40<br>BHEL spec. BP12399<br>POWERGRID Specn |  |  | B | K | P | W |  | N | -DO-  |
| d)    | Tensile strength                    |                   | -DO-  | BHEL spec. BP12399<br>POWER GRID Specn.<br>2.8g/micron/mm width (min)  |  |  | B | K | P | W |  | N | -DO-  |
| 1.4   | CAPACITOR OIL(PXE/JARYLEC)          |                   |   |  |  |  |   |   |   |   |  | E |   |
| 1.4.1 | Check for -                         |                   | As per IS : 6835 for sampling electrical tests<br>No. of sample drums per in lot size<br>Upto 5 2<br>6 to 20 3<br>21 to 50 4<br>51 to 100 5<br>For other tests<br>One composite sample per lot. | BHEL Product Std. CR 90105 / POWERGRID Spec.   |  |  | B | K | P | W |  | N | Surveillance check by Powergrid for review of BHEL records / Mfr. TC. |
| a)    | Flash Point                         | Physical Analysis | -do-  | 145°C min. as per Annex. C of IS 13067 or 140°C min as per IS 1448 Part 21   |  |  | B | K | P | W |  | N | -do-  |
| b)    | Kinematic Viscosity at 37.8 deg. C. | -do-              | -do-  | 3.3 to 5.3 cST (IS : 1448 Part 25)   |  |  | B | K | P | W |  | N |   |



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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|       |  |                          |   |   |  |      |   |   |   |   |  |   |   |
|-------|--|--------------------------|---|---|--|------|---|---|---|---|--|---|---|
| c)    | Water content  | Chemical Analysis        | -do-  | 50 ppm max.   |  |      | B | K | P | W |  | N | -do-  |
| d)    | Refractive Index (on one batch for every 10 batches of supply)                 | Physical Analysis        | -do-  | 1.56 ± 0.001  |  |      | B | K | P | W |  | N | -do-  |
| e)    | Active Epoxide Content   | Chemical Analysis        | -do-  | 0.7 ± 0.1% by wt.   |  |      | B | K | P | W |  | N | -do-  |
| f)    | Dielectric Strength (BDV) for 2.5 mm gap                                       | Electrochemical analysis | -do-  | 70 kV min.  |  |      | B | K | P | W |  | N | -do-  |
| g)    | Dielectric Constant at 50 / 100 Hz at 90 deg C                                 | -do-                     | -do-  | 2.45 Min.   |  |      | B | K | P | W |  | N | -do-  |
| h)    | Dissipation Factor at 50 / 100 Hz at 90 deg C                                  | Electrochemical analysis | -do-  | 0.1% max.   |  |      | B | K | P | W |  | N | -do-  |
| i)    | Resistivity at 90 deg C  | -do-                     | -do-  | 100 x 10 <sup>12</sup> Ohm cm, min                                |  |      | B | K | P | W |  | N | -do-  |
| j)    | Pour Point (on one batch for every 10 batches of supply)                       | Physical analysis        | -do-  | -24°C min.  |  |      | B | K | P | W |  | N | -do-  |
| k)    | Neutralization value   | Chemical Analysis        | -do-  | IS 13067 / 0.001 mg KOH/gm max.                                   |  |      | B | K | P | W |  | N | -do-  |
| 1.5   | <b>KRAFT INSULATING PAPER</b>  |                          |   |   |  |      |   |   |   |   |  | E |   |
| 1.5.1 | Visual & Dimensional check   |                          |   |   |  | CMTC | B | K | P | W |  | N |   |
| a)    | Visual Check ( to be done when covering wrap of the roll is opened before use) |                          | Lot size 2 to 90 - 5<br>91 to 280 - 13<br>281 to 500 - 20 | BHEL Specn. AA 21110 / POWERGRID Spec. Smooth surface, No. damage |  |      | B | K | P | W |  | N | Surveillance check by PowerGrid for review of BHEL records/Mfr. TC  |
| b)    | Thickness  |                          | -do-  | Tolerance 4 to 10 as per BHEL Specn. AA21110                      |  |      | B | K | P | W |  | N | Surveillance check by Power Grid for review of BHEL records/Mfr. TC |
| c)    | Width  |                          | -do-  | Tolerance ± 5 mm  |  |      | B | K | P | W |  | N |   |
| 1.5.2 | Checks for -   |                          | One sample per lot for each size.                         | BHEL Specn. AA21110 / POWERGRID Spec.                             |  |      |   |   |   |   |  |   |   |



## MANUFACTURING QUALITY PLAN

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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|       |  |  |   |   |  |  |   |   |   |   |  |   |   |
|-------|--|--|---|---|--|--|---|---|---|---|--|---|---|
| a)    | Substance  |  | -DO-  | BHEL Elect. Specn. As per CL 8.1 of BHEL Specn. AA 21110                              |  |  | B | K | P | W |  | N | -DO-  |
| b)    | Apparent Density   |  | -DO-  | 0.8± 0.05 g/cm cube   |  |  | B | K | P | W |  | N | -DO-  |
| c)    | Moisture content   |  | -DO-  | 8% max  |  |  | B | K | P | W |  | N | -DO-  |
| d)    | Water absorption   |  | -DO-  | 10 mm min   |  |  | B | K | P | W |  | N | -DO-  |
| e)    | Air Permeability   |  | -DO-  | 0.2 to 0.5 µ m / PaS  |  |  | B | K | P | W |  | N | -DO-  |
| f)    | Tensile index  |  | -DO-  | 93 Nm/g min. Machine Direction) 35Nm/g min (CROSS DIRECTION)                          |  |  | B | K | P | W |  | N | -DO-  |
| g)    | Tear index   |  | -DO-  | As per cl. 9.3 of BHEL Specn. AA 21110 / BHEL Elect. Specn.                           |  |  | B | K | P | W |  | N | -DO-  |
| h)    | Electric strength in air   |  | One sample per lot for each size.   | Thickness BDV (Micron ) (KV/mm) Min<br>Upto 90 7.5<br>90 to 125 7.0<br>> 125 6.5      |  |  | B | K | P | W |  | N | Surveillance check by Power Grid for review of BHEL records/Mfr. TC |
| i)    | Ash content  |  | -DO-  | 1% max  |  |  | B | K | P | W |  | N | -DO-  |
| j)    | Conductivity   |  | -DO-  | 10 mS/m max   |  |  | B | K | P | W |  | N | -DO-  |
| k)    | pH value   |  | -DO-  | 6 to 8  |  |  | B | K | P | W |  | N | -DO-  |
| l)    | Heat stability (Type test)   |  | -DO-  | Increase in conductivity of aqueous extract 23 mS/M.max                               |  |  | B | K | P | W |  | N | -DO-  |
| 1.6   | PRESS PAPER (If applicable)  |  |   |   |  |  |   |   |   |   |  | E |   |
| 1.6.1 | Visual & Dimensional check   |  |   |   |  |  | B | K | P | W |  | N |   |
|       | Visual Check ( to be done when covering wrap of the roll is opened before use) |  | IS:2500<br>Lot Sample size Size<br>2 to 90 - 3<br>91 to 280 - 13<br>281 to 500 - 20 | BHEL Specn. AA 21103 / POWERGRID Spec.<br>Smooth surface, Unglazed finish, No. damage |  |  | B | K | P | W |  | N | Surveillance check by Power Grid for review of BHEL records/Mfr. TC |



## MANUFACTURING QUALITY PLAN

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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|       |   |                                   |  |  |   |   |   |   |  |   |  |                               |
|-------|---|-----------------------------------|--|--|---|---|---|---|--|---|--|-------------------------------|
| b)    | Thickness   | -do-                              | As per BHEL Specn. AA21103             |  | B | K | P | W |  | N |  | -do-                          |
| c)    | Width   | -do-                              | As per BHEL Specn. AA21103             |  | B | K | P | W |  | N |  | -do-                          |
| 1.6.2 | Checks for -  | One sample per lot for each size. | BHEL Specn. AA21103 /                  |  |   |   |   |   |  |   |  | -DO-                          |
| a)    | Density   | -DO-                              | 1.0 g/cm <sup>3</sup> min.             |  | B | K | P | W |  | N |  | -DO-                          |
| b)    | Moisture content                                      | -DO-                              | 8% max                                 |  | B | K | P | W |  | N |  | -DO-                          |
| c)    | Oil absorption  | -DO-                              | Cl. 8.3 of BHEL spec. AA 21103         |  | B | K | P | W |  | N |  | -DO-                          |
| d)    | Flexibility   | -DO-                              | Cl. 8.4 of BHEL spec. AA 21103         |  | B | K | P | W |  | N |  | -DO-                          |
| e)    | Tensile Strength(m/c direction & cross m/c direction) | -DO-                              | Cl. 9.1 of BHEL spec. AA 21103         |  | B | K | P | W |  | N |  | -DO-                          |
| f)    | Heat Ageing   | -DO-                              | Decrease in bursting strength 60% max. |  | B | K | P | W |  | N |  | -DO-                          |
| g)    | Electric strength (BDV)                               | -DO-                              | Cl. 10.1 of BHEL spec. AA 21103        |  | B | K | P | W |  | N |  | -DO-                          |
| h)    | Ash content   | -DO-                              | 2% max                                 |  | B | K | P | W |  | N |  | -DO-                          |
| i)    | pH value  | -DO-                              | 5.0 to 8.5                             |  | B | K | P | W |  | N |  | -DO-                          |
| j)    | Conductivity  | -DO-                              | 3 mS/m max                             |  | B | K | P | W |  | N |  | -DO-                          |
|       | <b>DISCHARGE RESISTOR</b>                             |                                   |  |  |   |   |   |   |  | N |  |                               |
|       | Visual & Dimensional Check                            | One sample per lot                | BHEL Drg.                              |  | B | K | P | W |  | N |  | Survey and check by POWERGRID |



## MANUFACTURING QUALITY PLAN

| Sr. No. | Components/ Operation & Description or Test | Type of check | Quantum of check<br>Sampling With basis | Reference Document for Testing | Acceptance Norms | Format of records | Applicable Codes |   |   |   |   |   | Remarks |
|---------|---|---------------|---|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |   |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

For review of  
BHEL records  
Mfr. TC

|     |                             |  |                    |  |                     |      |   |   |   |   |  |   |   |
|-----|-----------------------------|--|--------------------|--|---------------------|------|---|---|---|---|--|---|---|
| 1.1 | Resistance                  |  | -DO-               | -DO-   | Tolerance $\pm 5\%$ |      | B | K | P | W |  | N | -DO-  |
| c)  | DC voltage test for 10 sec. |  | -DO-               | BHEL Drawing   |                     |      | B | K | P | W |  | N | -DO-  |
| 1.8 | COPPER FUSE WIRE (TINNED)   |  |                    |  |                     |      |   |   |   |   |  | N |   |
| a)  | Visual & Dimensional Check  |  | One sample per lot | BHEL Specn. CR 90064 /POWER GRID SPECN. Tol. On dia. $\pm 0.02$ mm |                     |      | B | K | P | W |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC |
| b)  | Weight                      |  | -DO-               | BHEL Specn. CR 90064   |                     |      | B | K | P | W |  | N | -DO-  |
| c)  | Thickness of Tin coating    |  | -DO-               | BHEL Specn. CR 90064 , 3 microns min.                              |                     |      | B | K | P | W |  | N | -DO-  |
| d)  | Chemical composition        |  | -DO-               | BHEL Specn. CR 90064   |                     |      | B | K | P | W |  | N | -DO-  |
| e)  | Breaking elongation         |  | One sample per lot | BHEL Specn. CR 90064 min. 20%                                      |                     |      | B | K | P | W |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC |
| f)  | Resistance                  |  | -DO-               | BHEL Specn. CR 90064   |                     |      | B | K | P | W |  | N | -DO-  |
| 1.9 | CAPACITOR BUSHING           |  |                    |  |                     | CMTC |   |   |   |   |  | E |   |
| a)  | Visual Checks               |  | Sample             | BHEL / Supp Drg.   |                     |      | B | K | P | W |  | N | -DO-  |
| b)  | Dimensions                  |  | -DO-               | -DO-   |                     |      | B | K | P | W |  | N | -DO-  |
| c)  | Creepage                    |  | -DO-               | -DO-   |                     |      | B | K | P | W |  | N | -DO-  |





## MANUFACTURING QUALITY PLAN

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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|      |   |  |                                   |                                       |  |  |   |   |   |   |  |   |   |
|------|---|--|-----------------------------------|---------------------------------------|--|--|---|---|---|---|--|---|---|
| d)   | Electrical routine tests  |  | As per IS 5621                    | As per IS 5621                        |  |  | B | K | P | W |  | N | -DO-  |
| e)   | Porosity  |  | -DO-                              | -DO-                                  |  |  | B | K | P | W |  | N | -DO-  |
| f)   | Temp. cycle test  |  | -DO-                              | -DO-                                  |  |  | B | K | P | W |  | N | -DO-  |
| g)   | Leakage test (Air pressure test)  |  | BHEL Drg.                         | BHEL Drg. / Manufacturer's Drg.       |  |  | B | K | P | W |  | N | -DO-  |
| 1.10 | <b>FABRICATED COMPONENTS OF RACK STRUCTURE (GALVANISED / PAINTED AS PER POWERGRID SPECN.)</b>   |  |                                   |                                       |  |  |   |   |   |   |  | N |   |
| a)   | Mechanical & chemical composition of structural steel   |  | Sample as per Drg./Spec./ IS 2062 | BHEL Drg. / BHEL spec: AA10108        |  |  | B | K | P | W |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC |
| b)   | D.P. test on load bearing welds   |  | 100%                              | BHEL Drg.                             |  |  | B | K | P | W |  | N | -DO-  |
| c)   | Visual & dimensional checks   |  | One sample per lot                | BHEL Drg. / BHEL spec: AA10108        |  |  | B | K | P | W |  | N | -DO-  |
| d)   | Checks on galvanizing<br>i) Condition of surface<br>ii) Uniformity of coating (piece test)<br>iii) Wt. of coating / Thickness<br>iv) Adhesion |  | --DO--                            | IS 4759 / IS 2629 / IS 2633 / IS 6745 |  |  | B | K | P | W |  | N |   |
| 1.11 | <b>SOLID CORE INSULATOR (POST INSULATOR)</b>  |  |                                   |                                       |  |  |   |   |   |   |  | E |   |
|      | Visual check  |  | 1% of lot                         | BHEL/Manufacturer's Drg.              |  |  | B | K | P | W |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC |



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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|------------|-------------|------|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2          | 3           | 4    | 5 | 6 |         |
|         | BHEL BHOPAL                                 | Customer      | Vendor Code                           | Item                           | QP. No.:         | Rev. No.          | Rev. Date        | Valid from | Valid up to | Page |   |   |         |
|         |   | POWERGRID     | 23E2 D2                               | H.T CAPACITOR (SERIES&SHUNT)   | CAB 111          | 04                | 14.07.2011       | 01.07.2011 | 30.06.2014  | 10   |   |   |         |

|      |  |  |  |   |  |  |          |          |          |          |  |   |   |
|------|--|--|--|---|--|--|----------|----------|----------|----------|--|---|---|
| b)   | Dimensions   |  | BHEL DWI<br>DWI/QC-<br>TCB/008<br>One sample per lot | -do-  |  |  | B        | K        | P        | W        |  | N | -DO-  |
| c)   | Creepage distance  |  | BHEL DWI<br>DWI/QC-<br>TCB/008<br>One sample per lot | -do-  |  |  | B        | K        | P        | W        |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC   |
| d)   | Temp. cycle test   |  | --DO--   | IS:2544   |  |  | B        | K        | P        | W        |  | N | -DO-  |
| e)   | Mechanical Load test - Bending test  |  | -do-   | IS 2544   |  |  | B        | K        | P        | W        |  | N | -DO-  |
| f)   | Porosity test  |  | --DO--   | --DO--  |  |  | B        | K        | P        | W        |  | N | -DO-  |
| g)   | Checks on galvanizing<br>i) Piece test (Uniformity of coating)<br>ii) Adhesion test<br>iii) Mass of Zinc coating |  | --DO--   | IS 4759 / IS 2629 / IS 2633 / IS 6745               |  |  | B        | K        | P        | W        |  | N | -DO-  |
| 1.12 | STRANDED/ SOLID COPPER CONDUCTOR FOR CAPACITOR BANK(With Insulating Sleeves)                                     |  |  |   |  |  |          |          |          |          |  | N |   |
| a)   | Visual & Dimensional Checks  |  | One sample per lot                                   | BP 12063 /AA 12004 /AA12008                         |  |  | A<br>/ B | J<br>/ K | P<br>/ S | W<br>/ Z |  | Y | Review of BHEL records/ Mfr. TC by POWERGRID at the time of final CIP |
|      | Chemical Composition   |  | --DO--   | BP 12063 /AA 12004 /AA12008<br>99.9% Min. (Cu & Ag) |  |  | B        | K        | P        | W        |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC   |

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मुख्य प्रबंधक (गु.आ.)  
महा आश्वासन-टी.सी.बी.  
बी.एच.ई.एल., भोपाल



## MANUFACTURING QUALITY PLAN

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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|        |   |  |   |  |  |  |        |        |        |        |   |   |  |
|--------|---|--|---|--|--|--|--------|--------|--------|--------|---|---|--|
| c)     | Electrical resistance                               |  | One sample per lot                                  | BP 12063 /AA 12004 /AA12008                  |  |  | B      | K      | P      | W      |   | N | -DO-   |
| 1.13   | <b>HARDWARE</b>                                     |  |   |  |  |  |        |        |        |        | E |   |  |
| 1.13.1 | Visual checks, dimensions & verification of make    |  | Relevant Indian std. /BHEL std. / IS 1367 / IS 2614 | BHEL std. /POWERGRID specn.                  |  |  | B      | K      | P      | W      |   | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC        |
| 1.13.2 | Mechanical & Chemical test                          |  | -do-  | -do-   |  |  | B      | K      | P      | W      |   | N | -DO-   |
| 2      | <b>INPROCESS CHECKS FOR</b>                         |  |   |  |  |  |        |        |        |        |   |   |  |
| 2.1    | <b>BOX FABRICATION</b>                              |  |   |  |  |  |        |        |        |        |   |   |  |
| 2.1.1  | Checks for welding procedure & welder qualification |  | As per WPS-195                                      | ASME Code II/Drg. / WPS-195                  |  |  | A<br>B | J<br>K | P<br>S | W<br>Z |   | Y | <b>POWERGRID approval required</b>   |
| 2.1.2  | Dimensional checks                                  |  | 10% Sample  | BHEL Drg.                                    |  |  | A<br>B | J<br>K | P<br>S | W      |   | N | Surveillance check by POWERGRID for review of BHEL records/Mfr. TC<br>-DO- |
| 2.1.3  | Leak Proof ness test (air pressure)                 |  | 100%  | BHEL spec. 0.7 kg/cm <sup>2</sup> for 1 min. |  |  | A<br>B | J<br>K | P<br>S | W      |   | N | -DO-   |
| 2.1.4  | D.P.Test  |  | 100%  | As per BHEL Spec.                            |  |  | A<br>B | J<br>K | P<br>S | W      |   | N | -DO-   |



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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|       |  |  |                    |                                   |  |  |       |       |       |       |  |   |   |
|-------|--|--|--------------------|-----------------------------------|--|--|-------|-------|-------|-------|--|---|---|
| 2.1.5 | Visual Checks for cleaning surface from inside & outside |  | 100%               | BHEL std. / BHEL Drg.             |  |  | A     | J     | S     | W     |  | N | -DO-  |
| 2.2   | <b>LID ASSY. (WITH BUSHING)</b>                          |  |                    |                                   |  |  |       |       |       |       |  |   |   |
| 2.2.1 | Visual checks on welding                                 |  | Surveillance check | BHEL Drg.                         |  |  | A / B | J / K | P / S | W     |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC   |
| 2.2.2 | Air pressure test for leakage                            |  | 100%               | BHEL spec. 0.7 kg/cm2 for 30 sec. |  |  | A / B | J / K | P / S | W     |  | N | -do-  |
| 2.2.3 | Brazing of terminal wire with bushing stud               |  | 100%               | BHEL Drg./Std.                    |  |  | A / B | J / K | P / S | W / Z |  | Y | Review of BHEL records/ Mfr. TC by POWERGRID at the time of final CIP |
| 2.2.4 | Checks for brazing procedure & brazer qualification      |  |                    | As per BHEL Drg./Spec.            |  |  | A / B | J / K | P / S | W / Z |  | Y | POWERGRID approval required for each project                          |
| 2.3   | <b>ELEMENT WINDING</b>                                   |  |                    |                                   |  |  |       |       |       |       |  |   |   |
| 2.3.1 | Dry roll electrical test (HV)                            |  | 100%               | BHEL Electrical Specn.            |  |  | A     | J     | S     | W     |  | N | -DO-  |
| 2.3.2 | Thickness of compacted element                           |  | First off check    | BHEL Electrical Specn.            |  |  | A     | J     | S     | W     |  | N | -DO-  |
| 2.3.3 | Marking of Batch No.                                     |  | 100%               | BHEL Spec./Std.                   |  |  |       |       |       |       |  |   | To be verified during issuance of CIP                                 |
|       | <b>PACK FORMATION</b>                                    |  |                    |                                   |  |  |       |       |       |       |  |   | -DO-  |
| 2.4.1 | No. of elements in pack                                  |  | First off check    | BHEL Electrical Specn.            |  |  | A     | J     | S     | W     |  | N | -DO-  |



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|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|---|---|---|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2 | 3 | 4 | 5 | 6 |         |

|       |   |  |                |                             |  |  |   |   |   |       |  |   |   |
|-------|---|--|----------------|-----------------------------|--|--|---|---|---|-------|--|---|---|
| 2.4.2 | Height after pack formation.                        |  | --DO--         | BHEL Electrical Specn.      |  |  | A | J | S | W     |  | N |   |
| 2.4.3 | Electrical withstand test (HV)                      |  | 100%           | BHEL Electrical Specn.      |  |  | A | J | S | W     |  | N |   |
| 2.5   | <b>PACK SOLDERING &amp; WIRING</b>                  |  |                |                             |  |  |   |   |   |       |  |   |   |
| 2.5.1 | Visual check on soldering                           |  | 100%           | BHEL Drg.                   |  |  | A | J | S | W     |  | N |   |
| 2.6   | <b>PACK WIRING, ASSEMBLY &amp; BOXING</b>           |  |                |                             |  |  |   |   |   |       |  |   |   |
| 2.6.1 | Resistance of discharge resistor assembly           |  | 100%           | BHEL Electrical Specn.      |  |  | A | J | S | W     |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC |
| 2.6.2 | Dry Capacitance measurement                         |  | 100%           | BHEL Electrical Specn.      |  |  | A | J | S | W     |  | N | -DO-  |
| 2.7   | <b>LID WELDING ON BOX</b>                           |  |                |                             |  |  |   |   |   |       |  |   |   |
| 2.7.1 | Checks for welding procedure & welder qualification |  | As per WPS-195 | ASME Code II/Drg. / WPS-195 |  |  | A | J | S | W / Z |  | Y | POWERGRID approval required   |
| 2.8   | <b>VACUUM DRYING, IMPREGNATION PROCESS</b>          |  |                |                             |  |  |   |   |   |       |  |   | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC |
| 2.8.1 | Checks for characteristics of impregnation          |  | 100%           | CR 90092 Rev. 02            |  |  | A | J | S | W     |  | N |   |
| 2.8.2 | Sealing test for leak proof ness                    |  | 100%           | --DO--                      |  |  | A | J | U | W / Z |  | Y |   |





## MANUFACTURING QUALITY PLAN

|            |  |                  |  |                                      |                     |                         |                  |            |             |      |   |   |         |
|------------|--|------------------|--|--------------------------------------|---------------------|-------------------------|------------------|------------|-------------|------|---|---|---------|
|            | BHEL<br>BHOPAL                                 | Customer         | Vendor<br>Code                                 | Item                                 | QP. No.:            | Rev.<br>No.             | Rev. Date        | Valid from | Valid up to | Page |   |   |         |
|            |  | POWERGRID        | 23E2 D2  | H.T CAPACITOR<br>(SERIES&SHUNT)      | CAB 111             | 04                      | 14.07.2011       | 01.07.2011 | 30.06.2014  | 14   |   |   |         |
| Sr.<br>No. | Components/ Operation<br>& Description or Test | Type of<br>check | Quantum of<br>check/<br>Sampling<br>With basis | Reference<br>Document for<br>Testing | Acceptance<br>Norms | Format<br>of<br>records | Applicable Codes |            |             |      |   |   | Remarks |
|            |  |                  |  |                                      |                     |                         | 1                | 2          | 3           | 4    | 5 | 6 |         |

|      |  |  |      |  |  |  |   |   |   |             |  |   |                                       |
|------|--|--|------|--|--|--|---|---|---|-------------|--|---|---------------------------------------|
| 3.0  | ROUTINE TESTS ON<br>CAPACITOR UNITS  |  |      |  |  |  |   |   |   |             |  |   |                                       |
| 3.1  | FOR SHUNT/FILTER<br>CAPACITOR  |  |      |  |  |  |   |   |   |             |  |   |                                       |
| 3.1a | Measurement of Capacitance   |  | 100% | IS 13925 part -1 /IEC-<br>60871-1/IEEE/<br>POWERGRID Specn./<br>Appd. Test procedure   |  |  | A | J | S | W<br>/<br>Z |  | N | REVIEW OF<br>BHEL<br>RECORDS BY<br>PG |
| 3.1b | Capacitor Loss Tangent<br>(Tan delta) Measurement  |  | 100% | IS 13925 part -1 /IEC-<br>60871-1/IEEE/<br>POWERGRID<br>Specn./Appd. Test<br>procedure |  |  | A | J | S | W<br>/<br>Z |  | N | -DO-                                  |
| 3.1c | DC Voltage Test between<br>Terminals   |  | 100% | IS 13925 part -1 /IEC-<br>60871-1/IEEE/<br>POWERGRID<br>Specn./Appd. Test<br>procedure |  |  | A | J | S | W<br>/<br>Z |  | N | -DO-                                  |
| 3.1d | Discharge test (Applicable for<br>internal fuse units)   |  | 100% | IS 13925 part -1 /IEC-<br>60871-1/IEEE/<br>POWERGRID<br>Specn./Appd. Test<br>procedure |  |  | A | J | S | W<br>/<br>Z |  | N | -DO-                                  |
| 3.1e | AC Voltage test between<br>Terminal & Container for unit<br>(Applicable only for double<br>bushing unit) |  | 100% | IS 13925 part -1 /IEC-<br>60871-1/IEEE/<br>POWERGRID<br>Specn./Appd. Test<br>procedure |  |  | A | J | S | W<br>/<br>Z |  | N | -DO-                                  |
|      | Measurement of Discharge<br>Resistance   |  | 100% | IS 13925 part -1 /IEC-<br>60871-1/IEEE<br>POWERGRID<br>Specn./Appd. Test<br>procedure  |  |  | A | J | S | W<br>/<br>Z |  | N | -DO-                                  |



## MANUFACTURING QUALITY PLAN

|                |  |                  |  |                                      |                     |                         |                  |            |             |      |   |   |         |
|----------------|--|------------------|--|--------------------------------------|---------------------|-------------------------|------------------|------------|-------------|------|---|---|---------|
| BHEL<br>BHOPAL |  | Customer         | Vendor<br>Code                                 | Item                                 | QP. No.:            | Rev.<br>No.             | Rev. Date        | Valid from | Valid up to | Page |   |   |         |
|                |  | POWERGRID        | 23E2 D2  | H.T CAPACITOR<br>(SERIES&SHUNT)      | CAB 111             | 04                      | 14.07.2011       | 01.07.2011 | 30.06.2014  | 15   |   |   |         |
| Sr.<br>No.     | Components/ Operation<br>& Description or Test | Type of<br>check | Quantum of<br>check/<br>Sampling<br>With basis | Reference<br>Document for<br>Testing | Acceptance<br>Norms | Format<br>of<br>records | Applicable Codes |            |             |      |   |   | Remarks |
|                |  |                  |  |                                      |                     |                         | 1                | 2          | 3           | 4    | 5 | 6 |         |

|            |  |  |  |  |  |  |   |   |   |             |  |   |      |
|------------|--|--|--|--|--|--|---|---|---|-------------|--|---|------|
| <b>3.2</b> | <b>SERIES CAPACITOR</b>  |  |  |  |  |  |   |   |   |             |  |   |      |
| 3.2a       | Measurement of Capacitance   |  | 100%   | IEC 60143-1/<br>POWERGRID Specn./<br>Appd. Test procedure                          |  |  | A | J | S | W<br>/<br>Z |  | N | -DO- |
| 3.2b       | Capacitor Loss Tangent (Tan delta) Measurement   |  | --do--   | IEC 60143-1/<br>POWERGRID Specn./<br>Appd. Test procedure                          |  |  | A | J | S | W<br>/<br>Z |  | N | -DO- |
| 3.2c       | DC Voltage Test between Terminals  |  | 100%   | IEC 60143-1/<br>POWERGRID Specn./<br>Appd. Test procedure                          |  |  | A | J | S | W<br>/<br>Z |  | N | -DO- |
| 3.2d       | Discharge test (Applicable for internal fuse units)  |  | --do--   | IEC 60143-1/<br>POWERGRID Specn./<br>Appd. Test procedure                          |  |  | A | J | S | W<br>/<br>Z |  | N | -DO- |
| 3.2e       | AC Voltage Test between Terminals & Container for unit (Applicable only for double bushing unit) |  | 100%   | IEC 60143-1/<br>POWERGRID Specn./<br>Appd. Test procedure                          |  |  | A | J | S | W<br>/<br>Z |  | N | -DO- |
| 3.2f       | Measurement of Discharge Resistance  |  | 100%   | IEC 60143-1/<br>POWERGRID Specn./<br>Appd. Test procedure                          |  |  | A | J | S | W<br>/<br>Z |  | N | -DO- |
| <b>4.0</b> | <b>ACCEPTANCE TESTS ON CAPACITOR UNITS</b>   |  |  |  |  |  |   |   |   |             |  |   |      |
| <b>4.1</b> | <b>SHUNT/FILTER CAPACITOR</b>  |  |  |  |  |  |   |   |   |             |  |   |      |
| 4.1a       | Measurement of Capacitance   |  | Annex --<br>D, Clause: 12.3,<br>IS: 13925 (part-1): 1998 | IS 13925 part -1 /IEC-60871-1/IEEE/<br>POWERGRID<br>Specn./Appd. Test<br>procedure |  |  | A | J | U | W<br>/<br>Z |  | Y | CIP  |
|            | Capacitor Loss Tangent (Tan delta) Measurement   |  | --DO--   | IS 13925 part -1 /IEC-60871-1/IEEE/<br>POWERGRID<br>Specn./Appd. Test<br>procedure |  |  | A | J | U | W<br>/<br>Z |  | Y | CIP  |
| 4.1c       | DC Voltage Test between Terminals (at 75% of specified   |  | --DO--   | IS 13925 part -1 /IEC-60871-1/IEEE/  |  |  | A | J | U | W<br>/<br>Z |  | Y | CIP  |



## MANUFACTURING QUALITY PLAN

|                |  |                  |  |                                      |                     |                         |                  |             |      |   |   |   |         |
|----------------|--|------------------|--|--------------------------------------|---------------------|-------------------------|------------------|-------------|------|---|---|---|---------|
| BHEL<br>BHOPAL | Customer                                       | Vendor<br>Code   | Item   | QP. No.:                             | Rev.<br>No.         | Rev. Date               | Valid from       | Valid up to | Page |   |   |   |         |
|                | POWERGRID                                      | 23E2 D2          | H.T CAPACITOR<br>(SERIES&SHUNT)                | CAB 111                              | 04                  | 14.07.2011              | 01.07.2011       | 30.06.2014  | 16   |   |   |   |         |
| Sr.<br>No.     | Components/ Operation<br>& Description of Test | Type of<br>check | Quantum of<br>check/<br>Sampling<br>With basis | Reference<br>Document for<br>Testing | Acceptance<br>Norms | Format<br>of<br>records | Applicable Codes |             |      |   |   |   | Remarks |
|                |  |                  |  |                                      |                     |                         | 1                | 2           | 3    | 4 | 5 | 6 |         |

|      |   |  |   |  |  |  |   |   |   |   |  |   |     |
|------|---|--|---|--|--|--|---|---|---|---|--|---|-----|
|      | (test voltage)  |  |   | POWERGRID<br>Specn./Appd. Test<br>procedure  |  |  |   |   |   |   |  |   |     |
| 4.1d | Discharge test (Applicable for internal fuse units)   |  | --DO--  | IS 13925 part -1 /IEC-60871-1/IEEE/ POWERGRID Specn./Appd. Test procedure  |  |  | A | J | U | W |  | Y | CIP |
| 4.1e | AC Voltage Test between Terminals & Container for unit (Applicable only for double bushing unit)  |  | Annex - D, Clause: 12.3, IS:13925(part-1):1998                              | IS 13925 part -1 /IEC-60871-1/IEEE/ POWERGRID Specn./Appd. Test procedure  |  |  | A | J | U | W |  | Y | CIP |
| 4.1f | AC Voltage Test between Terminals & Container for Bank (Applicable only when the Bottom Insulators have less insulation level than the Bank insulation level) |  | On 1 No. Assy. of Inter rack and bottom Insulators for the complete project | IS 13925 part -1 /IEC-60871-1/IEEE/ POWERGRID Specn./Appd. Test procedure<br>P.F. level of the bank shall be applied on the assy. Of Inter rack and Bottom support insulators. |  |  | A | J | U | W |  | Y | CIP |
| 4.1g | Measurement of Discharge Resistance   |  | -DO-  | IS 13925 part -1 /IEC-60871-1/IEEE/ POWERGRID Specn./Appd. Test procedure  |  |  | A | J | U | W |  | Y | CIP |
| 4.2  | <b>SERIES CAPACITOR</b>   |  |   |  |  |  |   |   |   |   |  |   |     |
| 4.2a | Measurement of Capacitance  |  | -DO-  | IEC 60143-1/ POWERGRID Specn./ Appd. Test procedure  |  |  | A | J | U | W |  | Y | CIP |
|      | Capacitor Loss Tangent (Tan delta) Measurement  |  | --DO--  | IEC 60143-1/ POWERGRID Specn./ Appd. Test procedure  |  |  | A | J | U | W |  | Y | CIP |
| 4.2c | DC Voltage Test between Terminals (at 75% of specified  |  | --DO--  | IEC 60143-1/ POWERGRID Specn./   |  |  | A | J | U | W |  | Y | CIP |



## MANUFACTURING QUALITY PLAN

|                |  |                  |  |                                      |                     |                         |                  |             |      |   |   |   |         |
|----------------|--|------------------|--|--------------------------------------|---------------------|-------------------------|------------------|-------------|------|---|---|---|---------|
| BHEL<br>BHOPAL | Customer                                       | Vendor<br>Code   | Item   | QP. No.:                             | Rev.<br>No.         | Rev. Date               | Valid from       | Valid up to | Page |   |   |   |         |
|                | POWERGRID                                      | 23E2 D2          | H.T CAPACITOR<br>(SERIES&SHUNT)                | CAB 111                              | 04                  | 14.07.2011              | 01.07.2011       | 30.06.2014  | 17   |   |   |   |         |
| Sr.<br>No.     | Components/ Operation<br>& Description or Test | Type of<br>check | Quantum of<br>check/<br>Sampling<br>With basis | Reference<br>Document for<br>Testing | Acceptance<br>Norms | Format<br>of<br>records | Applicable Codes |             |      |   |   |   | Remarks |
|                |  |                  |  |                                      |                     |                         | 1                | 2           | 3    | 4 | 5 | 6 |         |

|       |   |  |                                |   |  |  |   |   |   |   |  |   |   |
|-------|---|--|--------------------------------|---|--|--|---|---|---|---|--|---|---|
|       | test voltage as per Cl. 16 of IS.13925 Part- 1: 1998  |  |                                | Appd. Test procedure  |  |  |   |   |   |   |  |   |   |
| 4.2d  | Discharge test (Applicable for internal fuse units)   |  | --DO--                         | IEC 60143-1<br>POWERGRID Specn.<br>Appd. Test procedure       |  |  | A | J | U | W |  | Y | CIP   |
| 4.2e  | AC Voltage Test between Terminals & Container for unit (Applicable only for double bushing unit)  |  | --DO--                         | IEC 60143-1<br>POWERGRID Specn.<br>Appd. Test procedure       |  |  | A | J | U | W |  | Y | CIP   |
| 4.2f  | Measurement of Discharge Resistance   |  | --DO--                         | IEC 60143-1<br>POWERGRID Specn.<br>Appd. Test procedure       |  |  | A | J | U | W |  | Y | CIP   |
| 5.1   | <b>SURFACE TREATMENT &amp; PAINTING OF CAPACITOR BOX</b>  |  |                                |   |  |  |   |   |   |   |  |   |   |
| 5.1.1 | Surface cleaning & painting of Capacitor Box  |  | 100%                           | Appd. OGA<br>drg./POWERGRID<br>IS/Appd. Painting<br>procedure |  |  | A | J | S | W |  | N | Surveillance check by POWERGRID for review of BHEL records/ Mfr. TC         |
| 5.1.2 | Check of paint finish, paint film thickness & adhesion test.  |  | 2 Sample per Lot               | -do-, Min. 80 microns   |  |  | A | J | S | W |  | N | --DO--  |
| 5.2   | <b>RACK ASSEMBLY</b>  |  |                                |   |  |  |   |   |   |   |  |   |   |
| 5.2.1 | Check of completeness including rating plate.   |  | 100%                           | BHEL Drg.   |  |  | A | J | S | W |  | N | --DO--  |
|       | <b>TYPE TESTS</b>   |  |                                |   |  |  |   |   |   |   |  |   |   |
|       | All type tests & special tests required as per the contract in question need to be conducted test reports to be submitted. Approval from POWERGRID Engg. to be obtained |  | As agreed with POWERGRID Engg. | As agreed with POWERGRID Engg.                                |  |  | A | J | S | W |  | N | Review of approval of type test certificate from POWERGRID (Engg.) at least |



MANUFACTURING QUALITY PLAN

|            | BHEL<br>BHOPAL  | Customer         | Vendor<br>Code                                 | Item                                 | QP. No.:            | Rev.<br>No.             | Rev. Date        | Valid from | Valid up to | Page        |   |   |               |
|------------|---|------------------|--|--------------------------------------|---------------------|-------------------------|------------------|------------|-------------|-------------|---|---|---------------|
|            |   | POWERGRID        | 23E2 D2  | H.T CAPACITOR<br>(SERIES&SHUNT)      | CAB III             | 04                      | 14.07.2011       | 01.07.2011 | 30.06.2014  | 18          |   |   |               |
| Sr.<br>No. | Components/ Operation<br>& Description or Test                                      | Type of<br>check | Quantum of<br>check/<br>Sampling<br>With basis | Reference<br>Document for<br>Testing | Acceptance<br>Norms | Format<br>of<br>records | Applicable Codes |            |             |             |   |   | Remarks       |
|            |   |                  |  |                                      |                     |                         | 1                | 2          | 3           | 4           | 5 | 6 |               |
|            |   |                  |  |                                      |                     |                         |                  |            |             |             |   |   |               |
| 7          | FINAL INSPECTION<br>BEFORE DESPATCH   |                  |  |                                      |                     |                         |                  |            |             |             |   |   | each contract |
| 7.1        | Check of completeness of all<br>previous stages before issue of<br>final CIP / MICC |                  | 100%   | Checklist /OGA drg.                  |                     |                         | A                | J          | S           | W<br>/<br>Z |   | Y | CIP           |
| 7.2        | PACKING   |                  | 100%   | Shipping list                        |                     |                         |                  |            |             |             |   |   |               |



कुमार गुप्ता  
वरिष्ठ प्रबंधक (गु.आ.)  
गुणता आश्वासन-टी.सी.बी  
बी.एच.ई.एल.,भोपाल



## MANUFACTURING QUALITY PLAN

| Sr. No. | Components/ Operation & Description or Test | Type of check | Quantum of check/ Sampling With basis | Reference Document for Testing | Acceptance Norms | Format of records | Applicable Codes |            |             |      |   |   | Remarks |
|---------|---|---------------|---------------------------------------|--------------------------------|------------------|-------------------|------------------|------------|-------------|------|---|---|---------|
|         |   |               |                                       |                                |                  |                   | 1                | 2          | 3           | 4    | 5 | 6 |         |
|         | BHEL BHOPAL                                 | Customer      | Vendor Code                           | Item                           | QP. No.:         | Rev. No.          | Rev. Date        | Valid from | Valid up to | Page |   |   |         |
|         |   | POWERGRID     | 23E2 D2                               | H.T CAPACITOR (SERIES&SHUNT)   | CAB 111          | 04                | 14.07.2011       | 01.07.2011 | 30.06.2014  | 19   |   |   |         |

## SECTION : GENERAL NOTES

|    |  |
|----|--|
| 1  | The MQP should be read in conjunction with POWERGRID specification and shall deem to include additional tests if any required as per the contract.   |
| 2  | POWERGRID specification shall include provisions of letter of award. POWERGRID approved drawings/ technical data sheet/BOM/test procedure applicable to the specific contract.   |
| 3  | In case of any contradiction between the manufacturers' plant standards, this MQP and POWERGRID specification following precedence shall be followed :-<br>a) POWERGRID specification<br>b) This manufacturing Quality plan<br>c) Manufacturer's plant standards.  |
| 4  | It is the responsibility of the manufacturer to ensure that this document is readily available at their works as well as at the works of their sub-vendors in order to avoid any delay at the time of inspection.  |
| 5  | The manufacturer shall ensure that their as well as their sub-vendor control metering & instruments are duly calibrated and should have calibration certificates traceable to Indian/international standards calibration records should be available during inspection by POWERGRID. All testing instrument will be calibrated only at NABL accredited laboratories. |
| 6  | In case of any tests being carried out at third party lab such lab/facility should be NABL accredited/accepted by POWERGRID.   |
| 7  | All Raw Material /bought out items where sub-vendor approval is envisaged should be procured from POWERGRID approved sources.  |
| 8  | The manufacturer shall maintain the proper co-relation of test certificates from raw material stage to finished product stage and the records should be available during inspection by POWERGRID.  |
| 9  | Manufacturer shall show the approval of POWERGRID engineering for all contract specific type tests. Including specific if any as per the POWERGRID specification at the time of final inspection.  |
| 10 | All packing cases should be marked with POWERGRID LOA details name of project item description and CIP/MICC number by which material has been cleared for dispatch.  |
| 11 | One copy of test report CIP & MICC shall also be sent along with consignment.  |
| 12 | Inspection of spare items ordered by POWERGRID shall also be governed by the provisions of this MQP items. If not governed under MQP shall be offered for inspection as per POWERGRID specification/ relevant Indian /international specification.   |



## MANUFACTURING QUALITY PLAN

|                 |  |                  |  |                                      |                     |                         |                  |            |             |      |   |   |         |
|-----------------|--|------------------|--|--------------------------------------|---------------------|-------------------------|------------------|------------|-------------|------|---|---|---------|
| BHEL<br>BHOPAL. |  | Customer         | Vendor<br>Code                                 | Item                                 | QP. No.:            | Rev.<br>No.             | Rev. Date        | Valid from | Valid up to | Page |   |   |         |
|                 |  | POWERGRID        | 23E2 D2  | H.T CAPACITOR<br>(SERIES&SHUNT)      | CAB 111             | 04                      | 14.07.2011       | 01.07.2011 | 30.06.2014  | 20   |   |   |         |
| Sr.<br>No.      | Components/ Operation<br>& Description or Test | Type of<br>check | Quantum of<br>check/<br>Sampling<br>With basis | Reference<br>Document for<br>Testing | Acceptance<br>Norms | Format<br>of<br>records | Applicable Codes |            |             |      |   |   | Remarks |
|                 |  |                  |  |                                      |                     |                         | 1                | 2          | 3           | 4    | 5 | 6 |         |

|    |  |  |  |  |  |  |  |  |  |  |  |  |  |
|----|--|--|--|--|--|--|--|--|--|--|--|--|--|
| 13 | Any material rejected during POWERGRID inspection shall be disposed off with the approval of POWERGRID. For destructive disposal POWERGRID may depute its representative for witnessing. In case the material is to be returned to sub-vendor, all such items shall be indelibly marked (to prevent mixing) at the works of the manufacturer and offered to POWERGRID inspector for verification of marking. |  |  |  |  |  |  |  |  |  |  |  |  |
| 14 | The manufacturer shall align their quality system and that of their sub-vendor to the requirements of latest ISO 9000 quality standards in a time bound manner.  |  |  |  |  |  |  |  |  |  |  |  |  |
| 15 | The latest revision of reference documents shall be applicable at the time of inspection.  |  |  |  |  |  |  |  |  |  |  |  |  |



सुबोध कुमार गुप्ता  
वरिष्ठ प्रबंधक (गु.आ.)  
गुजरात आश्वासन-टी.सी.डी.  
वी.एच.टी. प्लांट, भोपाल

## MANUFACTURING QUALITY PLAN

|            |  |                  |  |                                      |                     |                         |                  |            |             |      |   |   |         |
|------------|--|------------------|--|--------------------------------------|---------------------|-------------------------|------------------|------------|-------------|------|---|---|---------|
|            | BHEL<br>BHOPAL                                 | Customer         | Vendor<br>Code                                 | Item                                 | QP. No.:            | Rev.<br>No.             | Rev. Date        | Valid from | Valid up to | Page |   |   |         |
|            |  | POWERGRID        | 23E2 D2  | H.T CAPACITOR<br>(SERIES&SHUNT)      | CAB 111             | 04                      | 14.07.2011       | 01.07.2011 | 30.06.2014  | 21   |   |   |         |
| Sr.<br>No. | Components/ Operation<br>& Description or Test | Type of<br>check | Quantum of<br>check/<br>Sampling<br>With basis | Reference<br>Document for<br>Testing | Acceptance<br>Norms | Format<br>of<br>records | Applicable Codes |            |             |      |   |   | Remarks |
|            |  |                  |  |                                      |                     |                         | 1                | 2          | 3           | 4    | 5 | 6 |         |

|  |  |
|--|--|
| <b>Code 1.</b> Indicates place where testing planned to be performed i.e. Inspection location.<br>A At Equipment Manufacturer's works<br>B At Component Manufacturer's works<br>C At Authorized Distributor's place<br>D At Independent Lab<br>E At Turn Key Contractor's place<br>F Not specified   | <b>Code 2.</b> Indicates who has to perform the tests i.e. Testing Agency<br>J The Equipment Manufacturer<br>K The component Manufacturer<br>L The Third Party<br>M The Turnkey Contractor.  |
| <b>Code 3.</b> Indicates who shall witness the tests i.e. Witnessing Agency<br>P Component Manufacturer itself<br>Q Component Manufacturer and Equipment Manufacturer or authorized representative<br>R Component Manufacturer, Equipment Manufacturer and Contractor<br>S Equipment Manufacturer itself<br>T Equipment Manufacturer and Contractor<br>U Equipment Manufacturer, Contractor and POWERGRID(jointly)<br>V Third Party itself | <b>Code 4.</b> Review of Test Reports/Certificates<br>W By Equipment Manufacturer<br>X By Contractor during product/process inspection<br>Y By POWERGRID during product/process inspection<br>Z By Contractor and/or POWERGRID during product/process inspection |
| <b>Code 5.</b> Whether specific approval of sub-vendor, Component made is envisaged.<br>E Envisaged<br>N Not Envisaged.  | <b>Code 6.</b> Whether test records required to be submitted after final inspection for issuance of CIP/MICC<br>Y Yes<br>N No  |



**Sub C**  
**गुणता आरवाशन** गुणता  
वरिष्ठ प्रबंधक (गु.आ.)  
गुणता आरवाशन-टी.सी.टी.  
बी.एच.ई.एल. भोपाल

|   |                                    |  |               |
|---|------------------------------------|--|---------------|
|  | CORPORATE PURCHASING SPECIFICATION |  | AA 123 17     |
|   |                                    |  | Rev. No. 03   |
|   |                                    |  | PREFACE SHEET |

ALUMINIUM ALLOY PLATES, GR : 54300(M)

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Comparable Standards:

- |             |   |   |
|-------------|---|---|
| 1. INDIAN   | : | IS : 736 – 1986<br>Gr : 54300           |
| 2. AMERICAN | : | ASTM : B209M – 1992a,<br>alloy 5083 (O) |
| 3. BRITISH  | : | BSEN : 485 –1998                        |
| 4. GERMAN   | : | DIN : 1725 – 1983,<br>AlMg4.5Mn (W)     |

Suggested/Probable Suppliers and Grades:

Refer plant vendors list.

User Plant References:

1. BHOPAL : P.S. 12326

|   |         |  |           |                              |
|---|---------|--|-----------|------------------------------|
| Revisions :<br>Cl: 20.10.26 of MOM of MRC-NFCW+HE |         | APPROVED :<br>INTERPLANT MATERIAL RATIONALISATION<br>COMMITTEE-MRC (NFCW+HE) |           |                              |
| Rev. No. 03                                       | Amd.No. | Reaffirmed   | Prepared  | Issued                       |
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|   |         |  |           | Dt. of 1st Issue<br>01-03-78 |

|   |   |  |                    |
|---|---|--|--------------------|
|  | <b>CORPORATE PURCHASING SPECIFICATION</b> |  | <b>AA 123 17</b>   |
|   |   |  | <b>Rev. No. 03</b> |
|   |   |  | <b>PAGE 1 OF 3</b> |

## ALUMINIUM ALLOY PLATES, GR : 54300(M)

### 1.0 GENERAL:

This specification governs the quality of aluminum alloy plates of Gr: 54300 (M).

### 2.0 APPLICATION:

For general engineering purposes.

### 3.0 CONDITION OF DELIVERY:

As manufactured.

Plates shall be supplied flat with sheared, milled or sawn edges.

### 4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply with the requirements of the following national standards and also meet the requirements of this specification.

IS: 736 – 1986, Gr: 54300 : Wrought Aluminum And Aluminum Alloy Plates For General Condition : WP : Engineering purposes.

### 5.0 DIMENSIONS AND TOLERANCES:

**5.1 Sizes:** Plates shall be supplied to the dimensions specified in BHEL order.

### 5.2 Tolerances:

Tolerance shall be as per IS : 2677.

### 6.0 FREEDOM FROM DEFECTS :

The plates shall be sound and free from harmful defects such as scratches, cracks, laminations and other injurious imperfections.

### 7.0 CHEMICAL COMPOSITION :

The chemical composition of the material when analyzed in accordance with IS : 504 or any other suitable conventional/ instrumental/chemical method shall be as follows :

#### Revisions :

Cl: 20.10.26 of MOM of MRC-NFCW+HE

#### APPROVED :

INTERPLANT MATERIAL RATIONALISATION  
COMMITTEE-MRC (NFCW+HE)

| Rev. No. 03 | Amd.No. | Reaffirmed | Prepared  | Issued    | Dt. of 1st Issue |
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| PAGE 2 OF 3 |                                    |  |



| Element   | Percent |           |
|---|---------|-----------|
|   | Min     | Max.      |
| *Copper   | --      | 0.1       |
| Magnesium                                       | 4.0     | 4.9       |
| *Silicon  | ---     | 0.4       |
| *Iron   | --      | 0.7       |
| *Zinc   | --      | 0.2       |
| Manganese                                       | 0.5     | 1.0       |
| *Titanium and/or/ other grain refining elements | --      | 0.20      |
| *Chromium                                       | --      | 0.25      |
| Aluminum  |         | Remainder |

\*Note: These elements need not be determined when the material supplied conforms to the mechanical properties specified in this specification. However, the supplier shall ensure that the composition of the material lies within the limits specified above.

## 8.0 TEST SAMPLES:

- 8.1 One sample per heat shall be taken for chemical analysis.
- 8.2 Material of the same thickness, produced under similar conditions, shall be grouped into batches of not more than 4000 kg.
- 8.3 Before the test samples are cut off, they shall be marked to identify them with the batch they represent. The test samples shall be taken from the material as supplied and shall not be further heat treated or mechanically worked (except for preparing the test piece) before being tested. The test samples may be cut from the margins of the material before cutting it to size.
- 8.4 The tensile test piece shall be rectangular section having dimensions as given in IS: 1608 with a gauge length of 50 mm. The test piece shall be cut transverse to the direction of rolling for plates 300 mm wide and over, and parallel to the direction of rolling for plates under 300 mm wide. When the width of the material to be tested is insufficient to permit preparation of the standard tensile test piece, a piece of the full width of the material may be used.

## 9.0 MECHANICAL PROPERTIES:

The test pieces, when tested in accordance with IS : 1608 (Method for tensile tests for light metals and their alloys), shall show the following properties:

|                                  |   |                              |
|----------------------------------|---|------------------------------|
| Tensile strength                 | : | 285 N/mm <sup>2</sup> , min. |
| 0.2% Proof Stress                | : | 125 N/mm <sup>2</sup> , min. |
| Elongation on 50 mm gauge length | : | 12 %, min.                   |



## CORPORATE PURCHASING SPECIFICATION

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### 10.0 RETEST:

Should any of the test pieces first selected fail, two further samples from the same batch shall be selected for testing, one of which shall be from the tube from which the original test sample was taken, unless the tube has been withdrawn by the supplier. Should the test pieces from both these additional samples pass, the batch represented by the test sample shall be deemed to comply with this specification. Should be test pieces from either of these additional samples fail the batch represented by these samples shall be deemed not to comply with this specification.

### 11.0 INSPECTION AT SUPPLIER'S WORKS

Tests and inspection are to be conducted in the presence of the customer's representative. The representative shall have free access at all times while the work on the contract is being performed, to all parts of the manufacture's works. The supplier shall offer the purchaser's representative all reasonable facilities, without charge, to satisfy the latter that the material is being furnished in accordance with this specification.

The supplier shall prepare and provide necessary test specimens for testing to be carried out at his premises. If facilities are not available at his works, the supplier shall make necessary arrangement for carrying out the prescribed test elsewhere.

### 12.0 TEST CERTIFICATES:

The supplier shall submit three copies of test certificates giving the following information:  
In addition, the supplier shall make sure to enclose one copy of the test certificate along with dispatch documents for quick clearance of the material.

AA 12317 (Rev.03) Aluminium Alloy Plates, Gr: 54300 (M)

BHEL Order No,

Supplier's name :

Batch No.

Consignment/Identification No.

Results of chemical analysis, mechanical and all other tests as called for in this specification.

### 13.0 PACKING AND MARKING:

The material shall be suitably packed to prevent corrosion and damage during transit.

Each package or crate shall be legibly marked with the following information :

BHEL Order No.

AA 12317

Heat No,

Identification mark/No.

Size & Weight.

Supplier's reference and name.

### 14.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1. IS: 736    2. IS:504    3. IS: 1608    4. IS: 2677

|  |   |             |               |
|--|---|-------------|---------------|
|  | <b>CORPORATE PURCHASING SPECIFICATION</b> |             | AA 123 31     |
|  |   | Rev. No. 03 | PREFACE SHEET |

## HEAT TREATED ALUMINIUM ALLOY DRAWN TUBES, Gr.:64430 (T6)

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### Comparable Standards:

- |             |   |
|-------------|---|
| 1. INDIAN   | : IS : 738 - 1994, alloy 64430 (T6)         |
| 2. AMERICAN | : ASTM B 221M-1992, Alloy 6351 (T6)         |
| 3. GERMAN   | : DIN 1725-1983, 17147-1983, Al Mg Si (F32) |
| 4. BRITISH  | : BS EN 754-97                              |

### Suggested/Probable Suppliers and Grades:

Refer plant vendors list.

### User Plant References:

- |              |            |
|--------------|------------|
| 1. BHOPAL    | : PS 12327 |
| 2. HYDERABAD | : --       |


### Revisions :


Cl: 19.10.40 of MOM of MRC-NFCW+HE

### APPROVED :

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COMMITTEE-MRC (NFCW+HE)

| Rev. No. 03    | Amd.No. | Reaffirmed | Prepared | Issued    | Dt. of 1st Issue |
|----------------|---------|------------|----------|-----------|------------------|
| Dt: 15.11.2004 | Dt :    | Year :     | BHOPAL   | Corp. R&D | MARCH, 1978      |

|  |                                    |   |                    |                     |                                 |
|--|------------------------------------|---|--------------------|---------------------|---------------------------------|
|   | CORPORATE PURCHASING SPECIFICATION |   | AA 123 31          |                     |                                 |
|  |                                    |   | Rev. No. 03        |                     |                                 |
|  |                                    |   | PAGE 1 OF 4        |                     |                                 |
| <p><b>HEAT TREATED ALUMINIUM ALLOY DRAWN TUBES, Gr.:64430 (T6)</b></p> <p><b>1.0 GENERAL:</b><br/>This specification governs the quality requirements of drawn Al-Mg-Mn alloy tubes, having good mechanical properties, corrosion resistance and weldability.</p> <p><b>2.0 APPLICATION:</b><br/>For general engineering purposes.</p> <p><b>3.0 CONDITION FO DELIVERY:</b><br/>Fully heat treated.</p> <p><b>4.0 COMPLIANCE WITH NATIONAL STANDARDS:</b><br/>The material shall comply with the requirements of the following national standard and also meet the requirements of this specification.<br/>IS : 738-1994 : Aluminum Alloys, Drawn Tube for General Engineering Purposes.<br/>Gr: Alloy 64430 (T6)</p> <p><b>5.0 DIMENSIONS AND TOLERANCES:</b><br/><b>5.1</b> The material shall be supplied to the dimensions specified in BHEL order:<br/><b>5.2</b> Tolerances shall be as per IS:2678.</p> <p><b>6.0 MANUFACTURE:</b><br/>By cold drawing.</p> <p><b>7.0 HEAT TREATMENT:</b><br/>The material shall be fully heat treated, i.e. Solution treated and subsequently precipitation treated to the specified strength.</p> <p><b>8.0 FREEDOM FROM DEFECTS:</b><br/>The tubes shall be seamless, straight, round, clean, smooth, uniform in diameter and free from cracks, scales, silvers and other harmful defects.</p> |                                    |   |                    |                     |                                 |
| <b>Revisions :</b><br>Cl: 19.10.40 of MOM of MRC-NFCW+HE   |                                    | <b>APPROVED :</b><br>INTERPLANT MATERIAL RATIONALISATION<br>COMMITTEE-MRC (NFCW+HE) |                    |                     |                                 |
| Rev. No. 03  | Amd.No.                            | Reaffirmed  | Prepared<br>BHOPAL | Issued<br>Corp. R&D | Dt. of 1st Issue<br>MARCH, 1978 |
| Dt:15.11.2004  | Dt :                               | Year :  |                    |                     |                                 |

|             |                                    |   |
|-------------|------------------------------------|---|
| AA 123 31   | CORPORATE PURCHASING SPECIFICATION |  |
| Rev. No. 03 |                                    |   |
| PAGE 2 OF 4 |                                    |   |

### 9.0 CHEMICAL COMPOSITION:

The analysis of copper when analysed in accordance with IS:504 (Method for chemical analysis of aluminium and its alloys) or any other conventional/Instrumental methods shall be as follows:

| Element   | Percent   |      |
|-----------|-----------|------|
|           | Min.      | Max  |
| *Copper   | --        | 0.10 |
| Magnesium | 0.4       | 1.2  |
| Silicon   | 0.6       | 1.3  |
| Manganese | 0.4       | 1.0  |
| *Zinc     | --        | 0.1  |
| *Iron     | --        | 0.6  |
| *Titanium | --        | 0.2  |
| *Chromium | --        | 0.25 |
| Aluminium | Remainder |      |

\* **Note:** These elements need not be determined, when the materials supplied conform with the mechanical properties specified in this specification. However, the supplier shall ensure that the composition of the material lies within the limits specified above.

### 10.0 TEST SAMPLES:

- 10.1 One test sample shall be cut from a tube selected from each heat treatment batch.
- 10.2 Before any of the test samples are cut, they shall be marked to identify them with the heat treatment batch they represent.
- 10.3 The test samples shall be tested in the condition as supplied. The test samples shall not be further heat treated or mechanically worked (except for preparing the test piece) before they are tested.

|   |   |  |                    |
|---|---|--|--------------------|
|  | <b>CORPORATE PURCHASING SPECIFICATION</b> |  | <b>AA 123 31</b>   |
|   |   |  | <b>Rev. No. 03</b> |
|   |   |  | <b>PAGE 3 OF 4</b> |

## 11.0 MECHANICAL PROPERTIES:

### 11.1 Tensile Test:

The material, when tested in accordance with IS 1608, shall show the following properties:

| Wall thickness<br>in, mm  | Tensile strength,<br>N/mm <sup>2</sup> , min. | 0.2% proof stress<br>N/mm <sup>2</sup> , min. | % elongation on 50mm<br>gauge length, min. |
|---------------------------|---|---|--|
| Upto and incld. 6         | 310   | 245   | 7  |
| Over 6 upto and incld. 10 | 310   | 230   | 9  |

### 11.2 Hardness:

When tested in accordance with IS:1501, the material shall have a hardness of 70 HV, minimum.

**Note:** Hardness test shall be conducted only when tensile test can not be performed.

### 11.3 Flattening Test:

The material, when tested in accordance with IS:2328, the test piece not less than 50mm in length and cut from the test sample selected shall be flattened until the interior surfaces of the tube meet. The test pieces shall not show any visible cracks when so tested.


## 12.0 INSPECTION AT SUPPLIER ' WORKS:

When ever specified, tests and inspection are to be conducted in the presence of BHEL's representative..

The supplier shall offer BHEL's representative all reasonable facilities, without charge to satisfy the latter that the material is being furnished in accordance with this specification. The supplier shall prepare and provide necessary test specimens for testing to be carried out at his premises. If facilities are not available at his works, the supplier shall make necessary arrangements for carrying out the prescribed test elsewhere. The supplier shall notify BHEL in advance about the readiness of the material for inspection and testing.

BHEL reserves the right to test the material at BHEL's works and the final acceptance of the material shall be based on these test results.



|             |                                    |   |
|-------------|------------------------------------|---|
| AA 123 31   | CORPORATE PURCHASING SPECIFICATION |  |
| Rev. No. 03 |                                    |   |
| PAGE 4 OF 4 |                                    |   |

**13.0 TEST CERTIFICATES:**

Unless other wise stated, three copies of certificates shall be supplied along with each consignment.

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

The test certificate shall bear the following information:

AA 123 31, Rev.03: Heat treated aluminium alloy drawn tubes, Gr.: 64430 (T6)  
 BHEL Order No.  
 Manufacturer 's/Supplier's Name:  
 Melt No.  
 Heat treatment details  
 Results of dimensional inspection, chemical analysis, mechanical and all other tests as called for.  
 Drawing /Pattern No.  
 Consignment/Identification No.



**14.0 PACKING AND MARKING:**

The tubes shall be suitably packed in crates to prevent corrosion and damage during transit. Each package or crate shall be legibly marked with the following information:

AA 123 31 : Heat treated aluminium alloy drawn tubes, Gr.: 64430 (T6)  
 BHEL Order No.  
 Batch No  
 Melt No  
 Identification No:  
 Weight  
 Supplier's Reference and Name

**15.0 REFERRED STADARDS :** (Latest Publications Including Amendments):

|             |             |             |
|-------------|-------------|-------------|
| 1. IS: 504  | 2. IS: 738  | 3. IS: 1501 |
| 4. IS: 1608 | 5. IS: 2328 | 6. IS: 2678 |

|   |  |  |   |
|---|--|--|---|
| <br>TSD 6206A   | <b>PLANT PURCHASING SPECIFICATION</b><br><b>BHOPAL</b> |  | BP 19993                                    |
|   |  |  | Rev. No. 04                                 |
|   |  |  | PAGE 1 OF 3                                 |
| <b>ALUMINUM ALLOY GRAVITY CASTING</b><br><b>Gr. 4450 T6</b>   |  |  | <b>SUPERSEDES</b><br><b>BP 19993 Rev.03</b> |
| <p><b>1. GENERAL :</b><br/>This specification governs the quality of Aluminum alloy casting produced by permanent mould (gravity) casting process.</p> <p><b>2. APPLICATION :</b><br/>For complex, thin walled, pressure tight casting with high strength, high corrosion resistance and dimensional stability on temperature variations.</p> <p><b>3. CONDITION OF DELIVERY :</b><br/>The casting shall be supplied in the solution-treated and precipitation treated (T6) condition.</p> <p><b>4. COMPLIANCE WITH NATIONAL STANDARDS :</b><br/>The casting shall comply with the requirements of.<br/>IS: 617 – 1994 Alloy: 4450 T6 } Specification for Aluminum and Aluminum alloy (Reaffirmed 2014) } ingots and casting for general engineering purpose.</p> <p><b>5. DIMENSIONS AND TOLERANCES :</b><br/>The dimensional of the casting shall be in accordance with the drawings supplied with the order. All surfaces marked for machining shall have sufficient machining allowance but it has not been too excessive resulting in more machining. For un-machined surfaces, unless otherwise stated in the order / drawing, two tolerances on linear dimensions and wall thickness shall be as per tolerance class -4 of Corporate Standard AA 023 04 02.</p> <p><b>6. MANUFACTURE :</b><br/>The casting shall be produced by permanent mould (gravity) casting process.</p> <p><b>7. FINISH :</b><br/>The casting shall be properly fettled and dressed and shall be thoroughly cleaned. The casting shall be supplied either in un-machined, rough machined on finish machined condition as stated in the order / drawing.</p> <p><b>8. FREEDOM FROM DEFECTS :</b><br/>The castings shall be sound &amp; free from harmful defects such as blow holes, inclusions, shrinkage, gas cavities, hot spots, cold shuts, cracks, gross porosities, dross etc. which may adversely affect the machining and utility of casting.</p> |  |  |   |
| <b>Revision :</b> Reviewed & IS Reaffirmed 2014   |  | <b>Issued by :</b> <br><b>STANDARDS AND MATERIALS GROUP</b><br><b>TECHNICAL SERVICES DEPARTMENT</b> |   |
| <b>Rev No : 04</b>  |  | <b>Date : 12.02.2020</b>   |   |
| <b>Date of first issue : Aug. 1983</b>  |  |  |   |

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TSD 6207 A

## PLANT PURCHASING SPECIFICATION BHOPAL

BP 19993

Rev. No. 04

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### 9. CHEMICAL COMPOSITION :

The chemical composition of the material when analyzed in accordance with IS:504 (Methods of chemical analysis of Aluminum and its alloys) or any other suitable Instrumental / Chemical method, shall be as follows:

| Element   | % Min.   | % Max. |
|-----------|----------|--------|
| Copper    | -        | 0.1    |
| Silicon   | 6.5      | 7.5    |
| Magnesium | 0.20     | 0.45   |
| Iron      | -        | 0.50   |
| Manganese | -        | 0.30   |
| *Nickel   | -        | 0.1    |
| *Zinc     | -        | 0.1    |
| *Lead     | -        | 0.1    |
| *Tin      | -        | 0.05   |
| *Titanium | -        | 0.20   |
| Aluminum  | Reminder |        |

**Note :** If titanium alone is used for grain refining the amount present shall be not less than 0.05%.

\*These elements need not be determined when the material supplied conforms with the mechanical properties specified in the specification. However, the supplier shall ensure that the composition of the material lies within the limits specified above.

### 10. TEST SAMPLES:

- 10.1 One test specimen shall be selected from each heat for chemical analysis care shall be taken to discard the first drillings till a clean oxide-free surface is reached.
- 10.2 One representative tensile test specimen shall be prepared from each cast / heat treatment batch as per Cl. 7 of IS: 617 and shall be supplied along with the consignment.

### 11. MECHANICAL PROPERTIES:

#### 11.1 Tensile:

The test specimen when tested in accordance with IS:1608 (Method for tensile test of light metals and their alloys) shall show the following tensile properties.

|  |     |
|--|-----|
| Tensile Strength N/mm <sup>2</sup> Min | 275 |
| % Elongation on 5.65 √ So G.L. Min     | 2   |

Hardness Brinell – (For information) : 80 – 110 HB

**Note :** If deemed necessary, BHEL reserve right, to test the tensile test piece & the castings it represents to a Brinell Hardness Test, which shall comply with the above.  
Brinell range i.e. 80 -110 HB.

|  |                                       |  |             |
|--|---------------------------------------|--|-------------|
| <br>TSD 6207 A | <b>PLANT PURCHASING SPECIFICATION</b> |  | BP 19993    |
|  | <b>BHOPAL</b>                         |  | Rev. No. 04 |
|  |                                       |  | PAGE 3 OF 3 |

**12. ADDITIONAL TESTS :**

If specified in the order/drawing, the following additional tests shall be conducted on the castings.

1. Pressure test.
2. Radiographic test

The requirements of these tests shall be prescribed in the order/drawing or as mutually agreed upon.

**13. REPAIR OF CASTINGS :**

Castings shall not be repaired without the prior permission of the purchaser.

**14. TEST CERTIFICATE :**

Unless otherwise stated three copies of the certificate shall be supplied along with each consignment

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

The test certificate shall be bear the following information.

BHEL Reference :

BHEL order No:

BP 19933 : (Rev.04) Aluminum alloy gravity castings gr. 4450 T6

Supplier's Reference & Name:

Method of Manufacture

Melt No.

Drawing/Pattern No.

**RESULTS OF TESTS.**

Results of chemical analysis, mechanical test, dimensional tolerances and other tests called for in this specification /order /drawings.

**15. PACKING AND MARKING :**

Castings shall be suitably packed to prevent corrosion & damage during transit. Machined surfaces shall be properly protected with anticorrosive compounds.

Each package or casting shall be legibly marked with the following information.

BHEL Order No.

BP 19993 : Aluminum alloy gravity castings gr. 4459 T6

Melt No.

Identification mark/No,

Weight

Supplier's reference and Name.