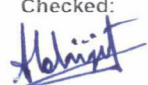


|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                        |                               |                                                                                                                                                                                                                                                  |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|---------------------|------------------|-------------------------------|-----------------|----------------|-----------------------------|---|-------------------|------------|---|------------|-----------|-----------------|-----------------|------------|--|--------------|---------|
| <br>TME/2015                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>PRODUCT STANDARD</b><br><b>TME DIVISION, BHOPAL</b> |                               | <b>TM10406</b>                                                                                                                                                                                                                                   |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                        |                               | <b>Rev 07</b>                                                                                                                                                                                                                                    |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                        |                               | <b>PAGE 01 OF 05</b>                                                                                                                                                                                                                             |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
| <p><b><u>SPECIFICATION OF ROTOR SHAFT (ROUGH MACHINED) FOR THREE PHASE TRACTION MOTOR TYPE 6FRA-6068 &amp; 6FXA 7059.</u></b></p> <p><b>1.0 SCOPE:</b></p> <p>This specification covers the manufacture, testing, inspection, packing &amp; supply of forged and rough machined rotor shaft for 3-phase Traction Motor type 6FRA-6068 &amp; 6FXA-7059.</p> <p>1.1 The material shall comply with these delivery instructions in chemical composition, Mechanical properties and all other listed requirements.</p> <p><b>2.0 REQUIREMENTS:</b></p> <p>2.1 The material shall be fully killed, vacuum degassed and must be free of flaws and cracks. Gas content of the steel shall be as follows:-<br/> <math>H_2 = 2 \text{ ppm (max)}</math><br/> <math>O_2 = 25 \text{ ppm (max)}</math><br/> <math>N_2 = 70 \text{ ppm (max)}</math><br/>         Trace elements like Cu, Al to be specified in the raw material test certificate.<br/>         Radioactive contamination shall be certified.</p> <p>2.2 The material shall be delivered in Quenched and Tempered condition.</p> <p><b>3.0 SPECIFICATION</b></p> <p>3.1 The material of rotor shaft shall in general conform to DIN EN 10083-1, grade 30CrNiMo8 (material No.1.6580). The chemical composition shall be as specified in DIN EN-10083. The special requirements of this standard also applies.</p> <p>3.2 The mechanical properties of the material shall be as under :-</p> <table border="1"> <tr> <td><math>R_m</math></td> <td>Tensile Strength</td> <td>880 to 1030 N/mm<sup>2</sup></td> </tr> <tr> <td><math>R_e, R_{p0.2}</math></td> <td>Yield Strength</td> <td>735 N/mm<sup>2</sup> (min)</td> </tr> <tr> <td>Z</td> <td>Reduction in Area</td> <td>50 % (min)</td> </tr> <tr> <td>A</td> <td>Elongation</td> <td>12% (min)</td> </tr> <tr> <td>KV<sup>b</sup></td> <td>Impact strength</td> <td>45 J (min)</td> </tr> <tr> <td></td> <td>Hardness BHN</td> <td>270-320</td> </tr> </table> |                                                        |                               |                                                                                                                                                                                                                                                  |                                                                                                                | $R_m$               | Tensile Strength | 880 to 1030 N/mm <sup>2</sup> | $R_e, R_{p0.2}$ | Yield Strength | 735 N/mm <sup>2</sup> (min) | Z | Reduction in Area | 50 % (min) | A | Elongation | 12% (min) | KV <sup>b</sup> | Impact strength | 45 J (min) |  | Hardness BHN | 270-320 |
| $R_m$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Tensile Strength                                       | 880 to 1030 N/mm <sup>2</sup> |                                                                                                                                                                                                                                                  |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
| $R_e, R_{p0.2}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yield Strength                                         | 735 N/mm <sup>2</sup> (min)   |                                                                                                                                                                                                                                                  |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
| Z                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Reduction in Area                                      | 50 % (min)                    |                                                                                                                                                                                                                                                  |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Elongation                                             | 12% (min)                     |                                                                                                                                                                                                                                                  |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
| KV <sup>b</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Impact strength                                        | 45 J (min)                    |                                                                                                                                                                                                                                                  |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Hardness BHN                                           | 270-320                       |                                                                                                                                                                                                                                                  |                                                                                                                |                     |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |
| Revision : 00<br>Date: 20.04.1999                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Distribution<br>TXM<br>QTM<br>TME<br>TSD               | Qty.<br>1<br>1<br>1<br>1      | Approved :<br><br>(M. Verma)<br>Prepared<br><br>20.07.23<br>(A. Shukla) | Checked:<br><br>(A. Jain) | Date:<br>20.07.2023 |                  |                               |                 |                |                             |   |                   |            |   |            |           |                 |                 |            |  |              |         |

TME/2015

**PRODUCT STANDARD**  
**TME DIVISION, BHOPAL**

**TM10406**

**Rev 07**

**PAGE 02 OF 05**

**3.3 FORGINGS:**

The forging shall be done so that the forging ratio shall be (6)S\*(ingot) or higher. Utmost attention shall be paid to the overheating so that there shall be no serious oxidation and decarburization.

S\* = Notation for solid forging.

Forging ratio for solid forging = Original section / Reduced section = 6 (Minimum).

The Mill test certificate for the ingot showing the cross section of the ingot to be furnished along with supplier test certificate. Supplier TC to show calculation as per above formulae to authenticate the desired ratio.

**4.0 DIMENSIONS:**

4.1 The dimension of Rotor shaft shall be furnished in the relevant drawing/ PO enclosed with the tender for proof machining after forging.

4.2 Centre Hole:

The rotor shaft shall be provided with center hole at both sides and the dimension and shape shall be as specified in the relevant drawing.

**5.0 HEAT TREATMENT**

Heat treatment shall be done as specified in DIN 10083-1. Heat treatment graph shall be produced at the time of inspection for verification. Soaking time at austenitizing temperature shall be at the rate of ½ hour /inch basis minimum during hardening & 1 hour / inch during tempering. Heat treatment furnace should be calibrated once annually along with Thermocouple, Recorder and Indicators.

**6.0 Test And Test Method**

6.1 Test on material shall be conducted generally as specified in DIN 10083-1 for grade 30CrNiMo8 (material no. 1.6580). However, the no. of sample shall be double than the specified in the standard for various test.

6.2 In addition to the test specified in the above standard, the following tests are also to be conducted (after proof machining).

(a ) Visual/ Dimensional check: 100%.

(b ) Concentricity/ Straightness: 100%.

(c ) Grain Flow/ Structure: 1No. or 2% of each batch whichever is more.

(d ) Magnaflux Test: 100%. (Applicable for rough machined stepped bar and not for rough machined single diameter bar.)

Magnaflux test to be done as per specification IS-3703. Supplier to ensure demagnetization of rough machined shaft after Magnaflux test.

(e ) Ultrasonic Test: 100%.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED  
It must not be used directly or indirectly in any way detrimental to the interest of the company

**PRODUCT STANDARD**  
**TME DIVISION, BHOPAL**

TME/2015

**TM10406**

**Rev 07**

**PAGE 03 OF 05**

**6.3 ULTRASONIC TESTING**

Supplier shall carry out Ultrasonic test on 100% Proof Machined Shafts as per RDSO code of procedure MC-149, Rev-1/ May-2013. Test results and records to be shown to the inspecting authority. However, BHEL shall also carry out magnaflux test and ultrasonic test before using these shafts on the shop floor. If defect is noticed, that shaft shall be rejected.

**6.4** The following metallographic parameters should also be ensured:

- Average grain size (determined microscopically as per IS 4748-88) ASTM 6-B.
- Inclusion rating (determined microscopically as per IS 4163-82).
- Type A B C and D both thick & thin series < 2.
- Free ferrite content of the Q & T steel shall not be more than 5%.

**6.5 HARDNESS TESTING**

Supplier shall carry out hardness testing on 100% shafts. Test results and records to be shown to the inspecting authority. However, BHEL shall also carry out hardness test before using these shafts on the shop floor. If defect is noticed that shaft shall be rejected.

**7.0 SELECTION OF TEST SAMPLE**

**7.1 AT SUPPLIER's WORKS**

(a) One sample shall be taken from each heat for chemical analysis.

One sample shall be taken per heat per heat treatment batch for testing of mechanical properties. Test pieces for mechanical tests shall be taken in the longitudinal direction of the products in accordance with Figure 1 of IS: 5517.

General condition for selection and preparation of samples and test pieces shall be in accordance with IS: 3711.

(b) **TEST CERTIFICATES**

Test certificate in original from NABL approved lab shall be provided along with consignment, preferably in the test certificate format annexed to this specification (Annexure-1). Alternatively supplier can request for testing at BHEL Bhopal on chargeable basis.

In addition, the supplier shall ensure to include one copy of the test certificate along with their dispatch documents.

The test certificate shall bear the following information.

**BHEL Reference**

TM 10406 / DIN EN10083 Material No 1.6580.

BHEL order No.

Size and No.

**Results of Tests**

1. Chemical composition : Per Heat
2. Mechanical Tests : Per Heat Per Heat Treatment Batch.
3. Ultrasonic Examination: All the bars supplied along with their identification number.
4. Hardness test : All the bars supplied along with their identification number.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED**  
It must not be used directly or indirectly in any way detrimental to the interest of the company



TME/2015

**PRODUCT STANDARD  
TME DIVISION, BHOPAL**

**TM10406**

**Rev 07**

**PAGE 04 OF 05**

**7.2 AT BHEL's WORKS**

Three bars having additional length of 300mm other than specified length shall be provided along with each consignment per heat per heat treatment batch for material testing at BHEL. (Material testing may be done by BHEL, at its cost.)

For e.g.: If bar length is 925mm then one bar per heat per heat treatment batch shall be of (925+300) i.e. 1225 mm length.

The bar shall be properly identified and correlated with Heat and Heat treatment Batch No., Test certification No.

**8.0 PACKING AND MARKING**

The bars shall be suitably packed in bundles to prevent corrosion and damage during transit.

Bars shall be stamped TM 10406 and the cast number on the side near the end or on the end face.

A metal label shall be securely attached to each bundle and shall bear the following information.

TM 10406: Nickel Chromium Molybdenum steel bars – Hardened and tempered.

BHEL order No.

Consignment/ Identification Nos.

Cast No. / Melt No.

Heat treatment Batch No.

Size & Weight.

Supplier's Name.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED**  
It must not be used directly or indirectly in any way detrimental to the interest of the company

| <br>TME/2015 | <b>PRODUCT STANDARD</b><br><b>TME DIVISION, BHOPAL</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>TM10406</b><br><b>Rev 07</b><br><b>PAGE 05 OF 05</b> |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--------------------|-----------------------------------|---------------------------|-------------------|---|---|----|----|-----|-------------------------------------------------------|------------------------------------------------|----------------|---|----|----|---|---|----|----|----|-------------------------------------------------------|------------------------------------------------|---------------|------|--|--|--|--|--|--|--|--|--|--|--|--|------|--|--|--|--|--|--|--|--|--|--|--|--|---------------|--|--|--|--|--|--|--|--|--|--|--|--|--|-----|----------------|----------------|----------------|---|----|----|---|---|----|----|----|-------------------------------------------------------|------------------------------------------------|---------------|------|--|--|--|--|--|--|--|--|--|--|--|--|------|--|--|--|--|--|--|--|--|--|--|--|--|---------------|--|--|--|--|--|--|--|--|--|--|--|--|--|-----------|----------------------|-----------|--------------------|----------------------|----------------|--|--|--|--|--|--|--|--|--|--|--|--|---------------------------|---------------------------------------------|--------------------------------|--------|-----------------------------------|---------------------------|---------------|------|--|--|--|--|------|--|--|--|--|---------------|--|--|--|--|--|---------------|------------------|-----------------|-------|--------|------------------|------------|--|--|--|--|--|---------------|------------------|-----------------|-------|--------|------------------|------------|--|--|--|--|
|                                                                                               | <b>ANNEXURE-I: RECOMMENDED TEST CERTIFICATE FORMAT FOR FORGINGS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
|                                                                                               | <div style="text-align: center; border: 1px solid black; padding: 5px; margin-bottom: 10px;">             SUPPLIER'S NAME &amp; ADDRESS<br/> <b>TEST CERTIFICATE FOR FORGINGS</b> </div> <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>1. Customer:<br/>2. TC No. &amp; Date:<br/>3. PO No.:<br/>4. Process of Melting Ingot:<br/>5. Deoxidisation Process:<br/>6. Forging Method:<br/>7. BHEL's Reference for Approval of Bloom<br/>8. Discard: Top _____ % ; Bottom _____ %</p> </div> <div style="width: 48%;"> <p>9. Reduction Ratio } Ingot to Bloom<br/>                              } Bloom to Blank<br/>10. Batch No.:<br/>11. Heat / Melt No.:<br/>12. Spec. No.:<br/>13. Test Bar Size &amp; Nos.<br/>14. Supplier of the ingot/ billet/ Bloom &amp; TC reference</p> </div> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; margin: 0;">15. FORGINGS COVERED BY TEST CERTIFICATE</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 0;"> <thead> <tr> <th style="width: 15%;">Sl. No.</th> <th style="width: 35%;">Drawing No. &amp; Item No.</th> <th style="width: 35%;">Description</th> <th style="width: 15%;">Quantity &amp; Weight</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 48%;"> <p style="text-align: center; margin: 0;">16. GAS CONTENT (PPM)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 0;"> <thead> <tr> <th style="width: 15%;">Gas</th> <th style="width: 10%;">H<sub>2</sub></th> <th style="width: 10%;">O<sub>2</sub></th> <th style="width: 10%;">N<sub>2</sub></th> <th style="width: 10%;">C</th> <th style="width: 10%;">Si</th> <th style="width: 10%;">Mn</th> <th style="width: 10%;">S</th> <th style="width: 10%;">P</th> <th style="width: 10%;">Cr</th> <th style="width: 10%;">Mo</th> <th style="width: 10%;">Ni</th> <th style="width: 10%;">Other trace elements like Al, Cu (Clause 6 of specn.)</th> <th style="width: 10%;">Radioactive Contamination (Clause 6 of specn.)</th> </tr> </thead> <tbody> <tr> <td rowspan="2">As Per Specn.</td> <td>Min.</td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td>Max.</td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td colspan="14">Actual Values</td> </tr> </tbody> </table> </div> <div style="width: 48%;"> <p style="text-align: center; margin: 0;">17. CHEMICAL COMPOSITION (PERCENT)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 0;"> <thead> <tr> <th style="width: 15%;">Gas</th> <th style="width: 10%;">H<sub>2</sub></th> <th style="width: 10%;">O<sub>2</sub></th> <th style="width: 10%;">N<sub>2</sub></th> <th style="width: 10%;">C</th> <th style="width: 10%;">Si</th> <th style="width: 10%;">Mn</th> <th style="width: 10%;">S</th> <th style="width: 10%;">P</th> <th style="width: 10%;">Cr</th> <th style="width: 10%;">Mo</th> <th style="width: 10%;">Ni</th> <th style="width: 10%;">Other trace elements like Al, Cu (Clause 6 of specn.)</th> <th style="width: 10%;">Radioactive Contamination (Clause 6 of specn.)</th> </tr> </thead> <tbody> <tr> <td rowspan="2">As Per Specn.</td> <td>Min.</td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td>Max.</td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td colspan="14">Actual Values</td> </tr> </tbody> </table> </div> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; margin: 0;">18. HEAT TREATMENT<br/>(To be accompanied by Recorder Chart)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 0;"> <thead> <tr> <th style="width: 15%;">Condition</th> <th style="width: 20%;">Heating Rate, °C/hr.</th> <th style="width: 15%;">Temp., °C</th> <th style="width: 15%;">Soaking Time, Hrs.</th> <th style="width: 15%;">Cooling Rate, °C/hr.</th> <th style="width: 20%;">Cooling Medium</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; margin: 0;">19. MECHANICAL PROPERTIES</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 0;"> <thead> <tr> <th style="width: 15%;">T.S.<br/>N/mm<sup>2</sup></th> <th style="width: 15%;">Y.S.<br/>0.5/0.2%<br/>Proof N/mm<sup>2</sup></th> <th style="width: 15%;">% Elongation<br/>5.65 √So<br/>GL</th> <th style="width: 15%;">% R.A.</th> <th style="width: 15%;">Hardness<br/>BHN (Min.3<br/>Values)</th> <th style="width: 15%;">Impact<br/>Value<br/>Joules</th> </tr> </thead> <tbody> <tr> <td rowspan="2">As Per Specn.</td> <td>Min.</td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td>Max.</td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td colspan="6">Actual Values</td> </tr> </tbody> </table> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; margin: 0;">20. DIMENSIONAL INSPECTION</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 0;"> <thead> <tr> <th style="width: 15%;">Nature o Test</th> <th style="width: 15%;">Acceptance level</th> <th style="width: 15%;">Instrument used</th> <th style="width: 15%;">Range</th> <th style="width: 15%;">Result</th> <th style="width: 15%;">Any other detail</th> </tr> </thead> <tbody> <tr> <td>Ultrasonic</td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; margin: 0;">21. NON-DESTRUCTIVE TESTS</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 0;"> <thead> <tr> <th style="width: 15%;">Nature o Test</th> <th style="width: 15%;">Acceptance level</th> <th style="width: 15%;">Instrument used</th> <th style="width: 15%;">Range</th> <th style="width: 15%;">Result</th> <th style="width: 15%;">Any other detail</th> </tr> </thead> <tbody> <tr> <td>Ultrasonic</td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; margin: 0;">22. IDENTIFICATION OF FORGINGS AS PER PURCHASE SPEC.</p> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 48%;"> <p>We hereby certify that the items mentioned above have been tested and inspected in our presence and are found to be in accordance with drawings, specifications and purchase order.</p> <p><b>SIGNATURE, NAME &amp; SEAL OF THE INSPECTING OFFICER</b><br/>DATE: _____</p> <p><b>INSTRUCTIONS</b></p> <p>a) Details of all heat treatment processes carried out should be furnished sequentially in 17.<br/>b) Test certificates are to be furnished as per Purchase order and specification, in A4 size preferably in transparent paper.<br/>c) All the entries including signature should be in black colour ink.<br/>d) If testing is done by outside agencies, the original TCs shall be furnished.<br/>e) The actual TC may run into more than one A4 size paper, if needed, to facilitate filling up of details.</p> </div> <div style="width: 48%;"> <p><b>SIGNATURE, NAME &amp; SEAL OF THE CHIEF OF QUALITY CONTROL/ CHIEF METALLURGIST OF THE SUPPLIER</b><br/>DATE: _____</p> </div> </div> </div> |                                                         | Sl. No.            | Drawing No. & Item No.            | Description               | Quantity & Weight |   |   |    |    | Gas | H <sub>2</sub>                                        | O <sub>2</sub>                                 | N <sub>2</sub> | C | Si | Mn | S | P | Cr | Mo | Ni | Other trace elements like Al, Cu (Clause 6 of specn.) | Radioactive Contamination (Clause 6 of specn.) | As Per Specn. | Min. |  |  |  |  |  |  |  |  |  |  |  |  | Max. |  |  |  |  |  |  |  |  |  |  |  |  | Actual Values |  |  |  |  |  |  |  |  |  |  |  |  |  | Gas | H <sub>2</sub> | O <sub>2</sub> | N <sub>2</sub> | C | Si | Mn | S | P | Cr | Mo | Ni | Other trace elements like Al, Cu (Clause 6 of specn.) | Radioactive Contamination (Clause 6 of specn.) | As Per Specn. | Min. |  |  |  |  |  |  |  |  |  |  |  |  | Max. |  |  |  |  |  |  |  |  |  |  |  |  | Actual Values |  |  |  |  |  |  |  |  |  |  |  |  |  | Condition | Heating Rate, °C/hr. | Temp., °C | Soaking Time, Hrs. | Cooling Rate, °C/hr. | Cooling Medium |  |  |  |  |  |  |  |  |  |  |  |  | T.S.<br>N/mm <sup>2</sup> | Y.S.<br>0.5/0.2%<br>Proof N/mm <sup>2</sup> | % Elongation<br>5.65 √So<br>GL | % R.A. | Hardness<br>BHN (Min.3<br>Values) | Impact<br>Value<br>Joules | As Per Specn. | Min. |  |  |  |  | Max. |  |  |  |  | Actual Values |  |  |  |  |  | Nature o Test | Acceptance level | Instrument used | Range | Result | Any other detail | Ultrasonic |  |  |  |  |  | Nature o Test | Acceptance level | Instrument used | Range | Result | Any other detail | Ultrasonic |  |  |  |  |
| Sl. No.                                                                                       | Drawing No. & Item No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Description                                             | Quantity & Weight  |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
|                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Gas                                                                                           | H <sub>2</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | O <sub>2</sub>                                          | N <sub>2</sub>     | C                                 | Si                        | Mn                | S | P | Cr | Mo | Ni  | Other trace elements like Al, Cu (Clause 6 of specn.) | Radioactive Contamination (Clause 6 of specn.) |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| As Per Specn.                                                                                 | Min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
|                                                                                               | Max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Actual Values                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Gas                                                                                           | H <sub>2</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | O <sub>2</sub>                                          | N <sub>2</sub>     | C                                 | Si                        | Mn                | S | P | Cr | Mo | Ni  | Other trace elements like Al, Cu (Clause 6 of specn.) | Radioactive Contamination (Clause 6 of specn.) |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| As Per Specn.                                                                                 | Min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
|                                                                                               | Max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Actual Values                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Condition                                                                                     | Heating Rate, °C/hr.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Temp., °C                                               | Soaking Time, Hrs. | Cooling Rate, °C/hr.              | Cooling Medium            |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
|                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
|                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| T.S.<br>N/mm <sup>2</sup>                                                                     | Y.S.<br>0.5/0.2%<br>Proof N/mm <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | % Elongation<br>5.65 √So<br>GL                          | % R.A.             | Hardness<br>BHN (Min.3<br>Values) | Impact<br>Value<br>Joules |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| As Per Specn.                                                                                 | Min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
|                                                                                               | Max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Actual Values                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Nature o Test                                                                                 | Acceptance level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Instrument used                                         | Range              | Result                            | Any other detail          |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Ultrasonic                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Nature o Test                                                                                 | Acceptance level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Instrument used                                         | Range              | Result                            | Any other detail          |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |
| Ultrasonic                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                    |                                   |                           |                   |   |   |    |    |     |                                                       |                                                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |     |                |                |                |   |    |    |   |   |    |    |    |                                                       |                                                |               |      |  |  |  |  |  |  |  |  |  |  |  |  |      |  |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |  |  |           |                      |           |                    |                      |                |  |  |  |  |  |  |  |  |  |  |  |  |                           |                                             |                                |        |                                   |                           |               |      |  |  |  |  |      |  |  |  |  |               |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |  |               |                  |                 |       |        |                  |            |  |  |  |  |

 COPYRIGHT AND CONFIDENTIAL  
 The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED  
 It must not be used directly or indirectly in any way detrimental to the interest of the company



# AMENDMENT - NOTIFICATION

AA 085 01 18 REV.No. 01

PAGE 1 OF 1

## AA 085 01 18:ULTRASONIC TESTING CLASSIFICATION AND ACCEPTANCE STANDARDS FOR STEEL FORGINGS, BILLETS AND BLOOMS

### 1.0 PAGE 1 OF 6; Cl 1.0 SCOPE:

Last sentence of the para is modified as follows:

"This standard does not apply to austenitic steel forgings for which AA 085 01 19 may be referred to."

### 2.0 Cl 3.2 Sensitivity:

Title of the left hand column of the table is modified as "Frequency, MHz" in place of Frequency range, MHz.

### 3.0 PAGE 2 OF 6; Cl 5.0 COUPLANT:

Last line is modified as "or water shall be used."

### 4.0 Cl 6.1: Eight line is modified as follows:

"shall not exceed 150mm/second. The following techniques"

Please see instructions on the reverse.

| Ref:                   | Amd. No. | Approved | Issued    | Date    | Cum. Sr. No. |
|------------------------|----------|----------|-----------|---------|--------------|
| Cl 1.0 of AA 085 01 18 | 01       | WG-NDT   | CORP. R&D | 15.1.96 | A 1822       |

## **INSTRUCTIONS**

**Changes to be incorporated in the controlled copies  
for "AMENDMENT -- NOTIFICATION".**

- a) The "AMD. No." of this "Amendment Notification" shall be recorded against the sheet / clause, being amended, on the margin.
- b) This, "Amendment Notification" shall be filed over the concerned preface sheet of the Specification / or First sheet of the standard or over the previous Amendment, if any.



# CORPORATE STANDARD

AA 085 01 18

REV.No. 01

PAGE 1 OF 6

## ULTRASONIC TESTING, CLASSIFICATION AND ACCEPTANCE STANDARDS FOR STEEL FORGINGS, BILLETS AND BLOOMS

### 1.0 SCOPE:

This standard deals with the ultrasonic testing of steel forgings, billets and blooms. The procedure covers pulse echo direct contact manual ultrasonic flaw detection technique. This standard does not apply to austenitic steel forgings.

### 2.0 PERSONNEL REQUIREMENT:

Personnel performing non-destructive examination and evaluation shall be qualified to the recommended practice SNT - TC - 1A or any other recognised practice.

### 3.0 EQUIPMENT CHARACTERISTICS:

#### 3.1 Frequency range:

The ultrasonic equipment shall be suitable for operating at frequencies within the range of 0.5 to 6 MHz.

#### 3.2 Sensitivity:

The sensitivity of the equipment shall be tested to ensure that the number of full screen back wall echo is not less than that given below, when the appropriate probe is placed on the metalised surface of plastic insert of the Indian Standard reference block (IS:4904)/IIW block.

| <u>Frequency range, MHz</u> | <u>Min.No. of full screen back echoes</u> |
|-----------------------------|-------------------------------------------|
| 1                           | 5                                         |
| 2                           | 4                                         |
| 4 to 6                      | 2                                         |

#### 3.3 Resolution:

The resolution of the equipment and probe combined shall be such as to show separately indications of the three grooves in the IIW - VI block.

#### Revision:

C1.9.4 OF MOM OF WG(NDT)

#### Approved:

INTERPLANT STANDARDIZATION  
COMMITTEE - ( WG-NDT )

Rev.No. 01

Amd.No.

Reaffirmed 15

Prepared  
CFFP  
HARDWARIssued  
CORP. R&DDt. of 1st issue  
Jan '80

Dt. Jan '95

Dt.

Year:



AA 085 01 18

REV.No. 01

PAGE 2 OF 6

## CORPORATE STANDARD

बीएसईएल

**4.0 SURFACE CONDITION:**

The test surface shall be free from loose scales, rust and such other extraneous material that would interfere with the ultrasonic energy transmission. In case of machined surface, it is desirable to have a surface finish of 6.25 microns or better. A gramophone record type of finish and tear produced by machining tools shall be avoided since these give rise to spurious echoes and cause probe wear.

**5.0 COUPLANT:**

To ensure adequate transmission of ultrasonic energy between the probe and the test object, a suitable couplant having good wetting characteristics such as oil, grease, water, glycerine or cellulose paste shall be used.

**6.0 TESTING TECHNIQUE:**

6.1 Selection of testing technique shall be made after giving due consideration to the method of manufacture and shape of the object tested. Testing technique should be such that each and every part of the object volume is scanned at least once. Successive scans shall overlap a minimum of 15% of the probe width. Uniform contact shall be maintained between probe and object and scanning speed shall not exceed 100 mm/ second. The following techniques are considered to be minimum for providing adequate coverage.

**6.2 Scanning Scheme (Solid And Hollow Forgings):**

Complete length of the forging shall be scanned radially from sides / cylindrical surface through 360° using longitudinal wave probe. Whenever practicable the forging shall be scanned in axial direction also. Hollow forgings, and when necessary, solid forgings also shall be scanned using appropriate shear wave probes to detect axial and radial cracks. Hollow forgings are the forgings made hollow on the press by punching or ring rolling operation.

**6.3 Solid Rectangular Forgings, Billets And Blooms:**

Complete length of the object shall be scanned from two adjacent faces and whenever practicable one end face using longitudinal wave probe.

6.4 Radial cracks on round sections which can not be detected by normal testing method may be subjected to other crack detection methods such as MPI.

**7.0 SCANNING:****7.1 Probes and Frequency:**

Overall scanning shall be done using 2 MHz nominal, 20-25 mm diameter probes except when large grain size and path length make it necessary to use a lower frequency. Smaller probes may be used when necessary. However, for forgings intended for backing material for white metal lined bearings, the examination shall be carried out by 4 MHz probes.

|                                                                                                                   |                    |              |
|-------------------------------------------------------------------------------------------------------------------|--------------------|--------------|
| <div>वीएचईपीएल</div> <div></div> | CORPORATE STANDARD | AA 085 01 18 |
|                                                                                                                   |                    | REV.No. 01   |
|                                                                                                                   |                    | PAGE 3 OF 6  |

**7.2 Time Base Calibration:**

The time base shall be calibrated using a calibration block or a known dimension of forging under examination.

**7.3 Sensitivity:**

**7.3.1 When Calibrated Attenuator Is Not Available:**

Reference sensitivity of equipment shall be set such that the maximum acceptable defect equivalent flat bottomed hole in the test block is equal to 75% of the full screen height. Testing shall be carried out at the highest sensitivity possible.

**7.3.2 When Calibrated Attenuator Is Available:**

The sensitivity of the equipment during scanning shall be set 6 dB more than the sensitivity required to give a full screen height echo from the maximum acceptable size of defect.

Note: The above sensitivity level adjustment is purely for scanning purposes. Once a defect is encountered, the sensitivity shall be brought down to estimate the size of defect for evaluation of the material under test.

**8.0 ESTIMATION OF FLAW SIZE:**

**8.1 Large Size Flaws:**

The size of large flaws can be estimated by moving the probe in all directions and plotting the midpoint of the probe when echo falls to 50 percent or 6 dB.

**8.2 Small Size Flaws:**

**8.2.1 When Calibrated Attenuator Is Not Available:**

8.2.1.1 The size of the flaw may be estimated by comparing with the echoes of the flat bottomed holes at appropriate depths in a test block of ultrasonically similar material.

8.2.1.2 The size of the flaw may also be estimated by moving probe successively in all the four directions at right angles to each other and plotting the mid point of the probe when echo height falls to 50% or 6 dB. Due allowance shall also be made for beam spread, depth and orientation of flaw and diameter of the forging if the scanning is done from the curved surface.

**8.2.2 When Calibrated Attenuator Is Provided With The Equipment:**

The size of the flaw (smaller than the beam spread) can be estimated accurately in millimetres of equivalent circular flaw with the help of Krautkramer's DGS (Distance - gain - size) diagram. Method of estimating flaw size using a DGS diagram is given in Annexure - A.

AA 085 01 18

REV.No. 01

PAGE 4 OF 6

## CORPORATE STANDARD

**9.0 CLASSIFICATION OF FORGINGS, BILLETS AND BLOOMS:**

9.1 Forgings, billets and blooms are classified into the following five categories depending upon the defect size admissibility for the purpose of ultrasonic testing:

CategoryUnacceptable defects

- |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | (i) Cracks, flakes, seams & laps.<br>(ii) Defects giving indication larger than that from a 2 mm diameter equivalent flaw.<br>(iii) Groups of defects with maximum indication less than that from a 2 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 70%.<br>(iv) Defects giving indications of 1 to 2 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws. |
| 2 | (i) Cracks, flakes, seams & laps.<br>(ii) Defects giving indication larger than that from a 4 mm diameter equivalent flaw.<br>(iii) Groups of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%.<br>(iv) Defects giving indications of 2 to 4 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws. |
| 3 | (i) Cracks, flakes, seams & laps.<br>(ii) Defects giving indication larger than that from a 6 mm diameter equivalent flaw.<br>(iii) Groups of defects with maximum indication less than that from a 6 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 40%.<br>(iv) Defects giving indications of 3 to 6 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws. |
| 4 | (i) Cracks, flakes, seams & laps.<br>(ii) Defects giving indication larger than that from a 10 mm diameter equivalent flaw.<br>(iii) Groups of defects with maximum indication less than that from a 10 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 20%.                                                                                                                                                                   |



## CORPORATE STANDARD

AA 085 01 18

REV.No. 01

PAGE 5 OF 6

- (iv) Defects giving indications of 5 to 10 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws.
- 5 (i) Cracks, flakes, seams & laps.
- (ii) Defects giving indication larger than that from a 15 mm diameter equivalent flaw.
- (iii) Groups of defects with maximum indication less than that from a 15 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 10%.

**Note:** Loss of back wall echo not attributable to the presence of defects or geometry and exceeding the limits mentioned in item (iii) of each category of unacceptable defects shall be a cause for rejection.

**ANNEXURE - A**

The equivalent flaw size curves of the DGS diagram is prepared by plotting the amplitude in decibels from a series of circular reflectors with increasing distance from the probe in water and so the graph incorporates only the loss in water. When it is found that the attenuation in the material under test is more (this can be checked using back echo curve of DGS diagram), this shall be taken into account while calculating the flaw size. Corrections will not be required for majority of heat treated forgings when tested with 2-4 MHz probes.

A step by step method of estimating flaw size using universal DGS diagram is given below:

- (a) Adjust the depth range of the equipment to the required depth.
- (b) Adjust the back echo to 70% of screen height from a defect free area parallel wall of the material under test or ultrasonically similar test block and note the dB value (A) on the calibrated gain control.
- (c) Mark on the back echo curve of the diagram, the back wall of the distance in terms of near field in millimetres in the case of universal DGS diagram.
- (d) Move the probe to the defective area and get the maximum defect echo. Read off the flaw depth. Increase the gain with the calibrated gain control until echo height reaches 70% of screen height. Note the attenuator reading in dB (B).
- (e) Calculate the gain (G) in dB by subtracting 'A' from 'B'. Count off the gain 'G' downwards from the marked point on the back echo curve, and then move horizontally to intersect the vertical line from the base line corresponding to the flaw depth 'D' in terms of near field in the case of universal diagram.

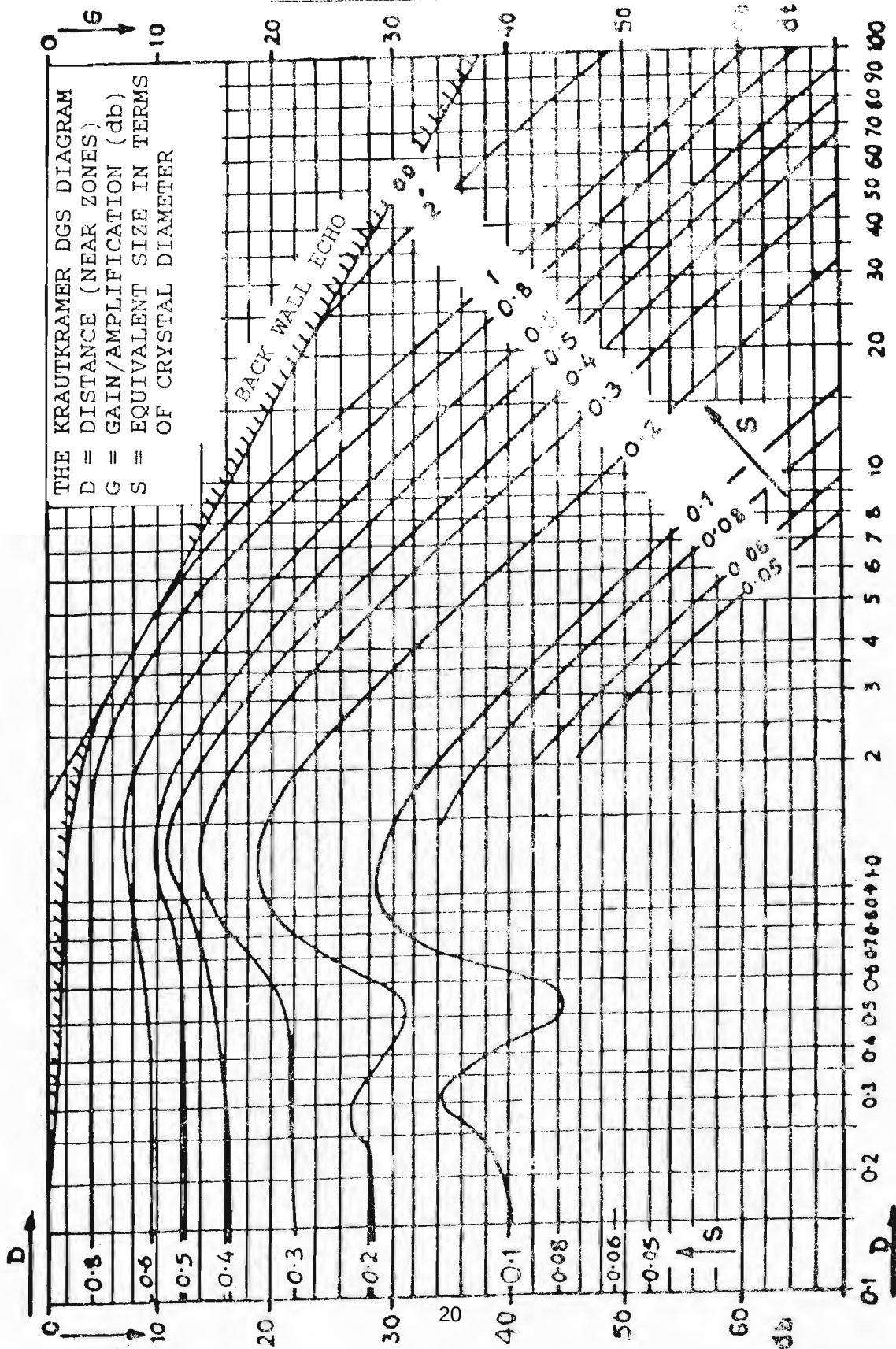


## CORPORATE STANDARD



- (f) Note the equivalent flaw size curve passing through the above point. Multiply the reduced flaw dimension (S) of the curve by the probe diameter to give the equivalent flaw size in millimetres.

ANNEXURE - A  
KRAUTKRAMER'S DGS DIAGRAM





# BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL

## QUALITY ASSURANCE PLAN FOR ROTOR SHAFT ROUGH MCH TO BHEL ORDERING SPECIFICATION/DRAWING

### AS PER PO

QUALITY PLAN NO. – QAP/OTM/VENDOR QAP/2021-22/ROTOR SHAFT ROUGH MCD DTD 08.07.2021 REV 00  
Reference Document- PO DRAWING/SPECIFICATION

Page : 2 of 3

| SL. NO | COMPONENT                                                                            | CHARACTERISTICS       | TYPE OF CHECK                     | QUANTAM OF CHECK |            | REFERENCE DOCUMENT             | ACCEPTANCE NORMS               | FORMAT OF RECORD | REMARKS                                                                  |
|--------|--------------------------------------------------------------------------------------|-----------------------|-----------------------------------|------------------|------------|--------------------------------|--------------------------------|------------------|--------------------------------------------------------------------------|
|        |                                                                                      |                       |                                   | TP               | TP/A       |                                |                                |                  |                                                                          |
| 5)     | Metallurgical parameters<br>a) Inclusion<br>b) Grain size<br>c) Free ferrite content | Metallurgical testing | TC verification                   | 100%             | 100%       | As per drawing & specification | As per drawing & specification | TC               | Microstructure report to be submitted to BHEL                            |
| 6)     | Dimension check                                                                      | Dimension             | TC verification & inspection      | 100%             | 100% & 20% | As per drawing & specification | As per drawing & Specification | TC               | All dimension reports to be submitted to BHEL along with witness reports |
| 7)     | Non-destructive testing (NDT)<br>a) UT<br>b) MPI<br>c) Straightness                  | Routine test          | TC verification & testing witness | 100%             | 100% & 10% | As per drawing & specification | As per drawing & Specification | TC               | NDT reports to be provided to BHEL                                       |

21

Prepared By

Approved By

Prepared By / Checked By / Engineer (QAP)  
BHEL, Bhopal

Approved By / Manager  
BHEL, Bhopal

QUALITY PLAN NO. - QAP/QTM/VENDOR QAP/2021-22/ROTOR SHAFT ROUGH MCD DTD 08.07.2021 REV 00  
Reference Document- PO DRAWING/SPECIFICATION

| SL. NO | COMPONENT                                                                | CHARACTERISTICS                                      | TYPE OF CHECK                     | QUANTAM OF CHECK                         |            | REFERENCE DOCUMENT             | ACCEPTANCE NORMS               | FORMAT OF RECORD | REMARKS                                              |
|--------|--------------------------------------------------------------------------|------------------------------------------------------|-----------------------------------|------------------------------------------|------------|--------------------------------|--------------------------------|------------------|------------------------------------------------------|
|        |                                                                          |                                                      |                                   | TP                                       | TP/A       |                                |                                |                  |                                                      |
| 1)     | Raw Material test<br>a) Mechanical properties<br>b) Chemical composition | All tests                                            | TC verification                   | One sample/heat treatment batch/heat/lot | 100%       | As per drawing & specification | As per Specification           | MTC              | TEST LAB NABL/EQUIVALENT ACCREDITED/SOURCE MILL 22   |
| 2)     | Heat Treatment                                                           | Soaking temperature/soaking time                     | TC verification                   | 100%                                     | 100%       | As per drawing & specification | As per drawing & Specification | TC               | Heat treatment graph to be provided to BHEL          |
| 3)     | Hardness test                                                            | Routine test                                         | TC verification & testing witness | 100% shaft                               | 100% & 10% | As per drawing & specification | As per drawing & Specification | TC               | Witness by portable hardness tester                  |
| 4)     | Reduction ratio                                                          | Reduction ratio from ingot to bloom & bloom to blank | TC verification                   | 100%                                     | 100%       | As per drawing & specification | As per drawing & Specification | TC               | Stage wise reduction & its measurement on actual job |

Approved By

मोहन सिंह / Mohan Singh Rathour  
वीरे, अभियंता (गैर. प्र. प्र.) / Mr. Engineer (GEPD)  
गुणवत्ता नियंत्रण / Quality Control/CM  
डी.एच.ए.ए.ए. / DHAHA / BHEL, BHOPAL

राहुल टोपो / RAHUL T  
प्रबंधक (Manager)  
न.टी.एस. विभाग / QTM



# **BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL** **QUALITY ASSURANCE PLAN FOR ROTOR SHAFT ROUGH MCH TO BHEL ORDERING SPECIFICATION/DRAWING** **AS PER PO**

**QUALITY PLAN NO. – QAP/QTm/VENDOR QAP/2021-22/ROTOR SHAFT ROUGH MCD DTD 08.07.2021 REV 00**  
**Reference Document- PO DRAWING/SPECIFICATION**

Page : 3 of 3

| SL NO | COMPONENT              | CHARACTERISTICS                                                                                                                       | TYPE OF CHECK       | QUANTAM OF CHECK |      | REFERENCE DOCUMENT             | ACCEPTANCE NORMS               | FORMAT OF RECORD | REMARKS |
|-------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------|------|--------------------------------|--------------------------------|------------------|---------|
|       |                        |                                                                                                                                       |                     | TP               | TP/A |                                |                                |                  |         |
| 8)    | Visual inspection      | Component to be free from any abnormality such as blow hole, pin hole, dent etc.                                                      | Visual check        | 100%             | 100% | As per drawing & specification | Free form visual defect        |                  |         |
| 9)    | Identification marking | Serial no., vendor name, PO NO., heat no., by punching/engraving on location shown in BHEL Drawing or location may be taken from BHEL | Visual verification | 100%             | 100% | As per drawing & specification | As per drawing & specification |                  | 23      |

TP- Task Performer, TC-Test Certificate, TP/A- Third party inspection Agency,

**Prepared By**

**Approved By**

राजेश कुमार / Gopal Singh Rathour  
 Quality Engineer (QAP)  
 BHEL, BHOPAL

राजेश कुमार / RAHUL T  
 Manager  
 QTM Div.  
 BHEL, BHOPAL