

260 26 26 037 8-ON 3RD

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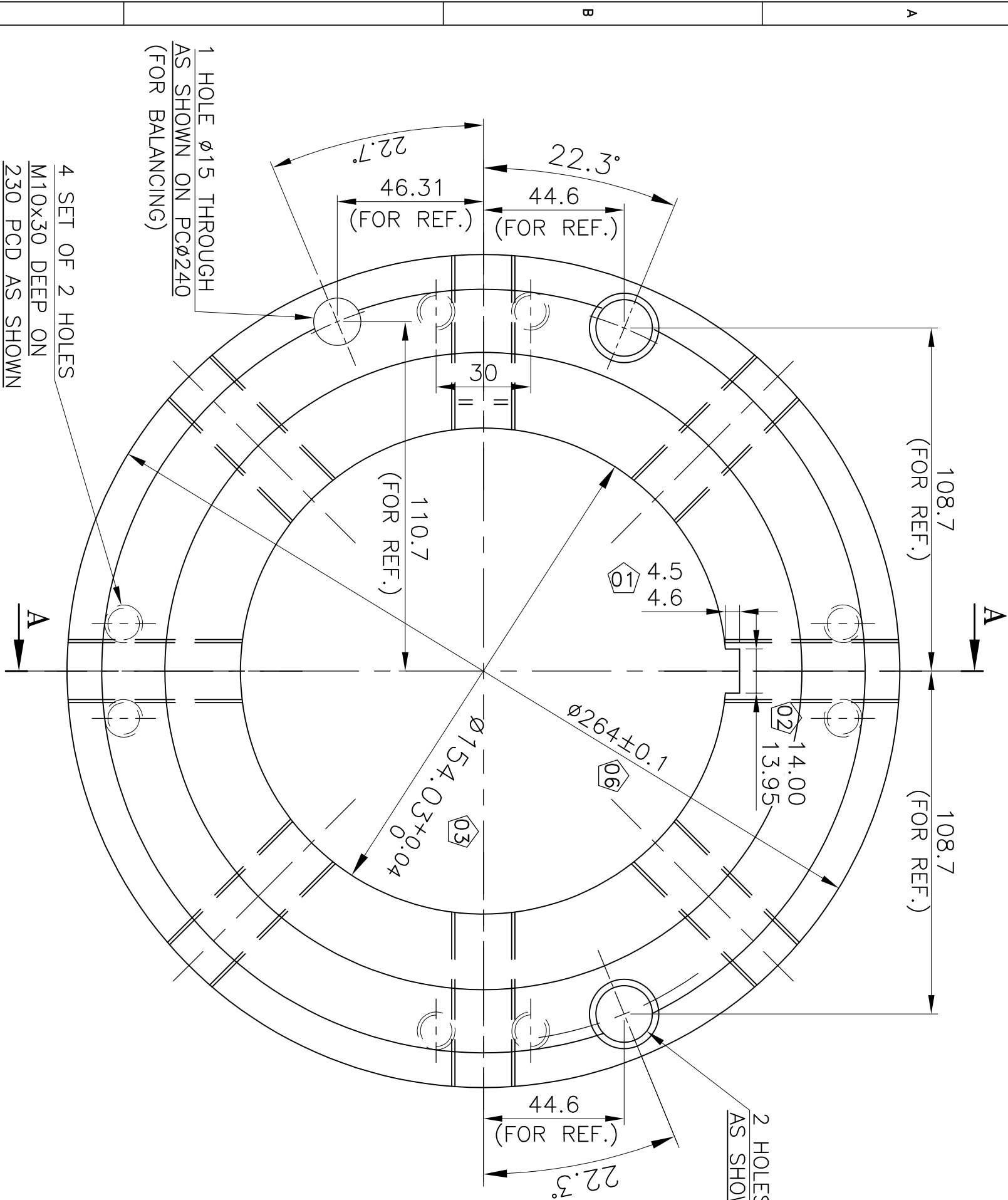
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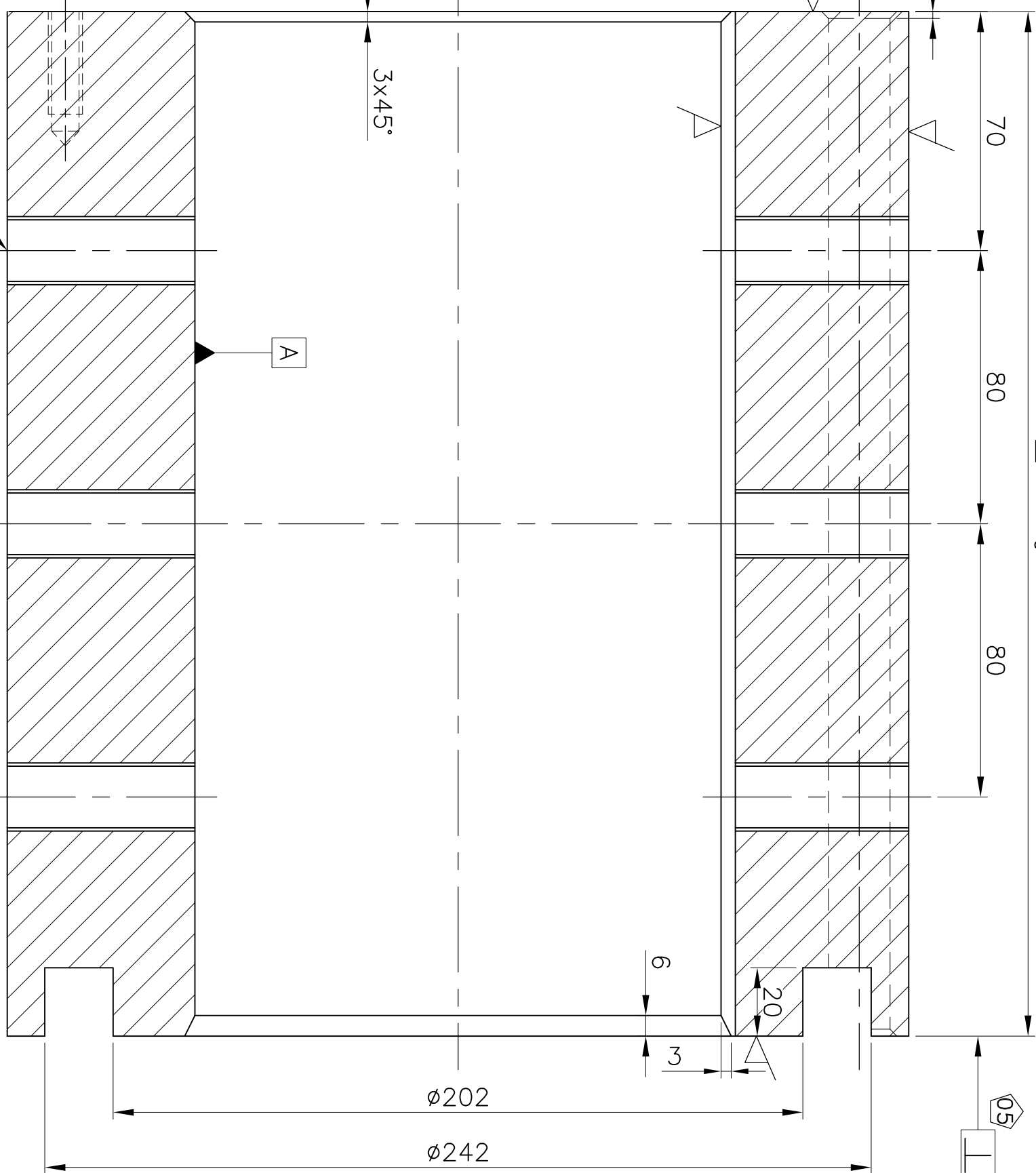
8

Ø4 300<sup>+0.2</sup><sub>0</sub>



24 HOLES M20 THROUGH  
EQUI SPACED AS SHOWN  
(SEE NOTE-5)

SECTION-AA



VIEW FROM NON-CONNECTION END (NCE)

NOTES:-

1. M/C ALL OVER. SURFACE FINISH  $\sqrt{32}$  UNLESS OTHERWISE SPECIFIED.
2. ALL 6 NOS. "◇" MARKED DIMENSIONS ARE CRITICAL TO QUALITY (CTQ) & SL. NO. OF CTQ DIMENSIONS ARE INSCRIBED IN ◇ e.g. ◇06.
3. a) CTQ DIMENSIONS TO BE CHECKED & ENSURED ON 100% JOBS. IF CTQ DIMENSION IS CHECKED BY GAUGE ON 100% JOBS, SAME SHALL BE ENSURED BY CHECKING THROUGH INSTRUMENT (IF FEASIBLE BY INSTRUMENT) ON RANDOM BASIS IN MIN. 10% JOBS.

b) REMAINING DIMENSIONS TO BE CHECKED ON SAMPLE BASIS. QUANTUM OF INSPECTION SHALL BE AS GIVEN BELOW :-

SL.NO.	CHECKING PARAMETER	T <sub>P</sub> (TASK PERFORMER)	BHEL Q.C.
001	CTQ DIMS.	DIMENSIONAL TOLERANCE	100%
		GEOMETRICAL TOLERANCE	100%
002	REMAINING DIMS.		20%
			5%

4. MACHINED SURFACES SHALL BE PROTECTED WITH TRP.
5. THREAD OF M20 HOLES TO BE CHECKED BY GO & NO-GO GAUGES ON 100% BASIS.

REV.	DATE	ALTERED	CHKD	REV.	DATE	ALTERED	CHKD
06	20.07.21	APPROVED	KD	05	12.05.21	APPROVED	KD
ZONE 4	SETS OF 2 HOLES M10 WERE 8 SETS OF 2 HOLES M10.	ZONE	LOCATION OF 2 HOLES Ø15 MODIFIED. 8 SETS OF 2 HOLES M10 WERE 4 SETS OF 2 HOLES M10.	ZONE	IN TOOL LIST TOOL NO. 1606706 MODIFIED.		

REV.	DATE	ALTERED	CHKD	REV.	DATE	ALTERED	CHKD
09	29.10.21	APPROVED	RC/KD	10	15.11.21	APPD	KD
ZONE 2	HOLES Ø18 WAS Ø17. PCØ235 WAS PCØ240. CHMF. 2x45° ADDED.	ZONE	ON 240PCD Ø15 HOLE AT 22.7° ADDED.				

REV.	DATE	ALTERED	CHKD	REV.	DATE	ALTERED	CHKD
08	24.09.21	APPROVED	RC/KD	07	07.08.21	APPROVED	KD
ZONE 2	HOLES Ø17 WAS Ø15 ON 240 PCD.	ZONE	DIMN. 111 WAS 111.6 & 110.4				

ADDITIONAL INFORMATION  
STATUS OF DRAWING  
DISTRIBUTION OF PRINTS  
TIME-1, TAM-3,  
TNX-1



BHARAT HEAVY ELECTRICALS LTD.  
BHOPAL

TYPE OF PRODUCT  
OR  
NAME OF CUSTOMER/PROJECT

DETG UNDER-SLING TRACTION ALTERNATOR

TA4502AZ

DRN.	SDB	NAME	SIGN	DATE	NO. OF VAR.
01	RC			03/07/19	

DEPT.	TIME	UNTO.	DIMS.	GR.	SCALE	WEIGHT	REF. TO ASSY. DRG.	ITEM NO.	NO. OF REV.
405	AA0230208	M'			NTS	79.5	24304592078	011	001
TITLE BARREL (MACHINED) D-IV							DRAWING NO. 3 430 32 92 097	REV.	11



## PLANT PURCHASING SPECIFICATION BHOPAL

BP 19389

Rev No. 07

PAGE 1 OF 5

**SUPERSEDES**  
BP 19389 Rev.06

### ALLOY STEEL FORGINGS - HARDENED AND TEMPERED

#### 1. GENERAL:

This specification governs the quality forged alloy steel forgings in Hardened & Tempered Condition.

#### 2. APPLICATION:

Pole and plates and shaft for small generators.

#### 3. CONDITION OF DELIVERY:

Forged, Hardened & Tempered in the rough turned condition. Forgings shall be commercially straight.

#### 4. COMPLIANCE WITH NATIONAL STANDARDS:

There is no Indian Standard covering this type of material. Assistance has been taken from ASTM A508, Gr.2, IS 4367 Gr. 21Cr4Mo2 & HW19581

#### 5. DIMENSIONS & TOLERANCE:

The dimension and tolerance shall be as specified on the order/drawing and shall not exceeds these dimensions. A tolerance of 3 mm for finish has been provided in the specifying the rough turned dimensions.

Any forging which is bent to interfere with its finishing to desired sizes shall be rejected.

#### 6. MANUFACTURE:

Forgings shall be manufactured from steel produced by the open-hearth, electric or such other process as may be agreed to between the BHEL and the supplier. The steel shall be "Fully killed".

Sufficient discard shall be made from each ingot to ensure freedom from pipe, segregation and other defects.

The amount of hot working and finishing temperature shall be such as to ensure complete soundness and adequate uniformity of structure and mechanical properties after heat treatment. Forgings shall not be over heated.

The minimum reduction ratio when forgings are made out of ingots shall be 4:1.

Revision :  
Reviewed and brought upto date.

Issued by :   
STANDARDS AND MATERIALS GROUP  
TECHNICAL SERVICES DEPARTMENT

Rev.07

Date: 12.03.2022

Date of first Issue: Jan - 1966



## PLANT PURCHASING SPECIFICATION BHOPAL

BP 19389

Rev. No. 07

PAGE 2 OF 5

The coupling or driven end of the shaft be indicated on the drawing. These ends, shall correspond to the bottom of the ingot.

### 7. HEAT TRETMENT:

After forging and rough turning, the forgings shall be hardened & tempered. Forgings shall be free from uneven internal stresses, and shall have homogenous grain structure.

### 8. FREEDOM FROM DEFECTS:

The forgings shall be homogenous, free from excessive hardness, slag spots, sand seams, blow holes, clinks, cracks or other imperfections.

### 9. CHEMICAL COMPOSITION:

The chemical composition of the material based on melt analysis shall comply with the following requirement.

Element	% Minimum	% Maximum
Carbon	0.19	0.25
Manganese	0.60	1.00
Silicon	-	0.35
Sulphur	-	0.03
Phosphorus	-	0.03
Nickel	0.35	0.75
Chromium	0.35	0.65
Molybdenum	0.15	0.25

\*Note – Carbon equivalent shall not to exceed 0.50 percent when calculated from the formula given below:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

### 10. TEST SAMPLES:

10.1 Unless otherwise specified on the order / drawing, test samples shall be taken from each cast and each heat treatment batch. Test samples should be cut from the heat treated forgings by cold process only and shall receive no further heat treatment.

Test samples shall be taken from locations indicated on the drawing, leaving enough material, if required, for testing at purchaser's end, integral with the forging.

Test samples shall be cylindrical or rectangular in shape and cut a distance of one third radius or one-sixth diagonal from the outer surface.



## PLANT PURCHASING SPECIFICATION BHOPAL

BP 19389

Rev. No. 07

PAGE 3 OF 5

10.2 When integral test pieces are not called for and it is not possible to destroy the forgings, separate test samples as mentioned on the order / drawing shall be provided from the blooms and billets from which the forgings are made. They shall be forged to the ruling section of the main forgings and shall be heat treated similarly and simultaneously with the forgings they represent. Test samples shall be taken at one-third radius from the outer surface of the test bar.

10.3 Test samples shall generally be taken in the longitudinal direction. However, for economic reason or where the size / configuration does not permit the same, test samples may be taken in the transverse or radial direction, properties of which shall be agreed to between suppliers & BHEL.

### 11. MECHANICAL PROPERTIES:

When tested in accordance with IS: 1608 / EN 10002 Part 1 the material / test pieces shall show the following properties.

Tensile Strength	- 620 N/mm <sup>2</sup> Minimum
Yield Strength	- 460 N/mm <sup>2</sup> Minimum
Elongation on 5.65√So Gauge length	- 18%, Minimum
Reduction in Area	- 40 percent Minimum.
Hardness	- 190 – 260 BHN (for information only)

Note:- for an indication of the general quality of the steel, the broken test pieces shall show a fracture of uniform silky appearance free from granular black or brilliant specks, though this would not be a criteria for rejection.

### 12. MAGNETIC PROPERTIES: (For information only).

Magnetic Field Strength (H) A/m	Magnetic Induction (B) Minimum Tesla or Wb/m <sup>2</sup>
-----	-----
3400	1.39
5200	1.55
10400	1.70
14800	1.78

### 13. NON – DESTRUCTIVE TESTING (OPTIONAL):

When stated on the order / drawing, the forgings shall be ultrasonically tested to BHEL Corporate Standards AA 085 01 18 and the Acceptance Standards shall comply with category class mentioned in this standards & called for on the order / drawing.



## PLANT PURCHASING SPECIFICATION BHOPAL

BP 19389

Rev. No. 07

PAGE 4 OF 5

### 14. TEST CERTIFICATES:

Three copies of test certificate shall be supplied unless otherwise stated on the order / drawing in the recommended Test Certificate Format annexed to this specification (Annexure 1).

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

### 15. PACKING AND MARKING:

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

Machined surface shall be properly protected with anti-corrosive compounds suitable for outdoor storage for a minimum period of six month. Each package or forging (when supplied separately) shall be legibly marked with the following information.

BP 19389: Alloy Steel Forgings – Hardened & Tempered.

Our Order No.

Consignment or Identification No.

Batch No.

Heat No.

Melt No.

Weight.

Supplier's Name.



# PLANT PURCHASING SPECIFICATION BHOPAL

BP 19389

Rev. No. 07

PAGE 5 OF 5

## ANNEXURE-I: RECOMMENDED TEST CERTIFICATE FORMAT FOR FORGINGS

SUPPLIER'S NAME AND ADDRESS															
TEST CERTIFICATE FOR FORGINGS															
1. Customer:					9. Reduction Ratio					Ingot to Bloom Bloom to Blank					
2. TC No. & Date:					10. Batch No.:										
3. PO No.:					11. Heat/Melt No.										
4. Process of Melting Ingot					12. Spec. No.										
5. Desoxidation Process:					13. Test Bar Size & No.										
6. Forging Method:					14. Supplier of the ingot/billet/Bloom and TC reference.										
7. BHEL's Reference for Approval of Bloom Discard: Top _____ % Bottom _____ %															
15. FORGINGS COVERED BY TEST CERTIFICATE															
S.No.		Drawing No. & Item No.			Description					Quantity & Weight					
16. CHEMICAL COMPOSITION (PERCENT)															
Element		C	Si	Mn	S	P									
As Per Specn.	Min.														
	Max.														
Actual Values															
17. HEAT TREATMENT (To be accompanied by Recorder Chad, Whenever called for)															
Condition		Heating Rate, °C/hr.		Temp. °C		Soaking Time. Mins.		Cooling Rate, °C/hr		Cooling Medium					
18. MECHANICAL PROPERTIES															
		TS, N/mm <sup>2</sup>	Y.S. 0.5/0.2% Proof N/mm <sup>2</sup>	Elongation 5.65√A <sub>5</sub> GL	%RA Min	Hardness BHN (HIN.3 values)	Impact Value Joules	Bend Test							
As Per Specn.	Min.							Angle of Bend	Dia of mandrel	Result					
	Max.														
Actual Values															
19. SURFACE FINISH (When called for in the order/drg.)															
20. DIMENSIONAL INSPECTION															
21. NON-DESTRUCTIVE TESTS															
Nature of Test		Acceptance level		Instrument used		Range		Results		Any other detail					
Ultrasonic															
Radiographic															
Dye penetrant/ Magnetic Particle															
22. METALLOGRAPHIC EXAMINATION (To be conducted if called for and photo micrographs to be attached along with a report)															
Location of Sample		Etchant used		Magnification		Constituent observed		Relative %							
Microstructure		Macroetch		Inclusion Rating											
23. OTHER TESTS IF ANY (MICROSCOPIC, SULPHUR PRINTS, ETC)															
24. IDENTIFICATION OF FORGINGS AS PER PURCHASE SPEC.															
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.															
SIGNATURE, NAME & SEAL OF THE INSPECTING OFFICER DATE:										SIGNATURE, NAME & SEAL OF THE CHIEF OF QUALITY CONTROL CHIEF METALLURGIST OF THE SUPPLIER DATE:					
<b>INSTRUCTIONS</b> a) Details of all heat treatment processes carried out should be furnished sequentially in 17. b) Test certificates are to be furnished as per Purchase order and specification, in A4 size preferably in transparent paper. c) All the entries including signature should be in block colour ink. d) If testing, is done by outside agencies, the original TCs shall be furnished. e) The actual TC may run into more than one A4 size paper, if needed, to facilitate filling up of details.															