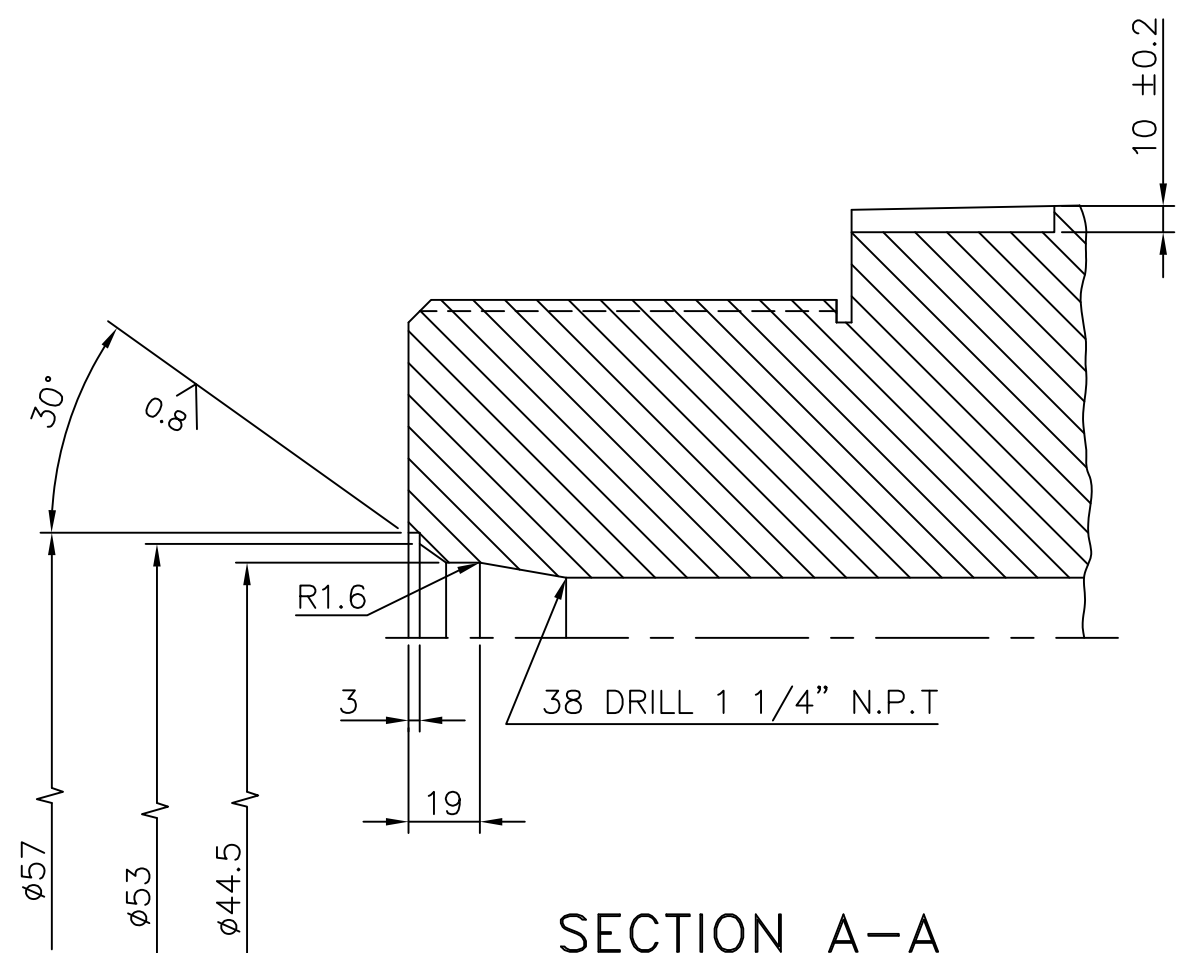
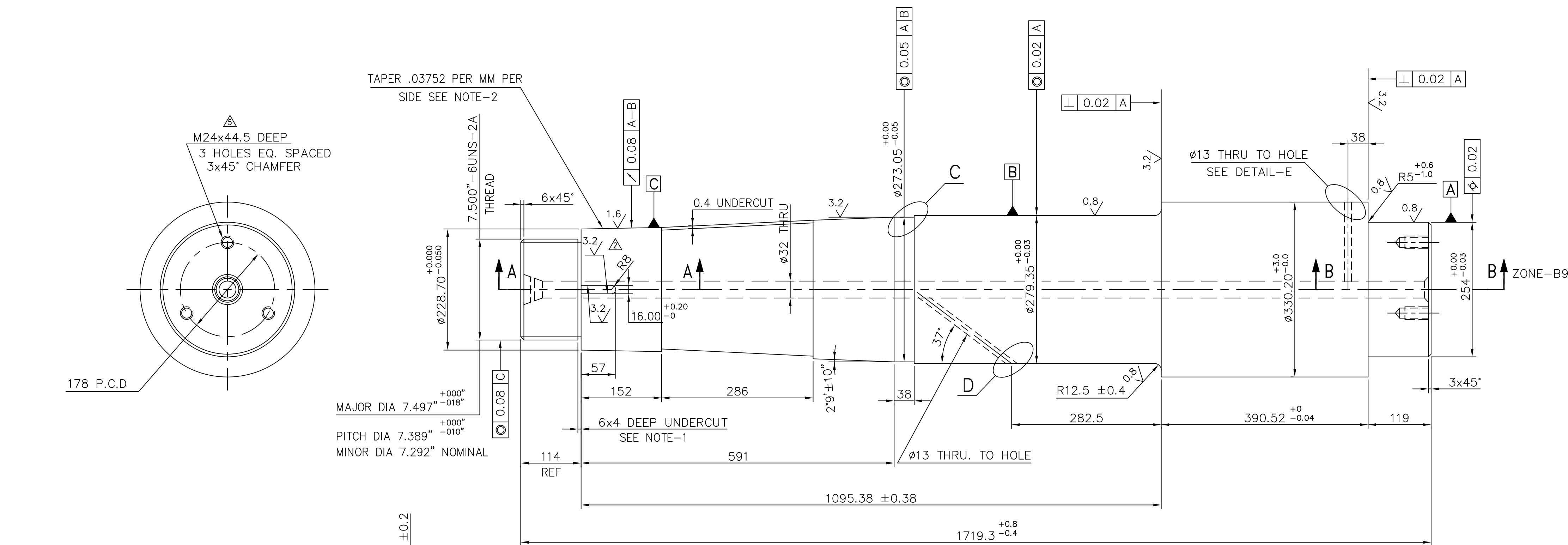
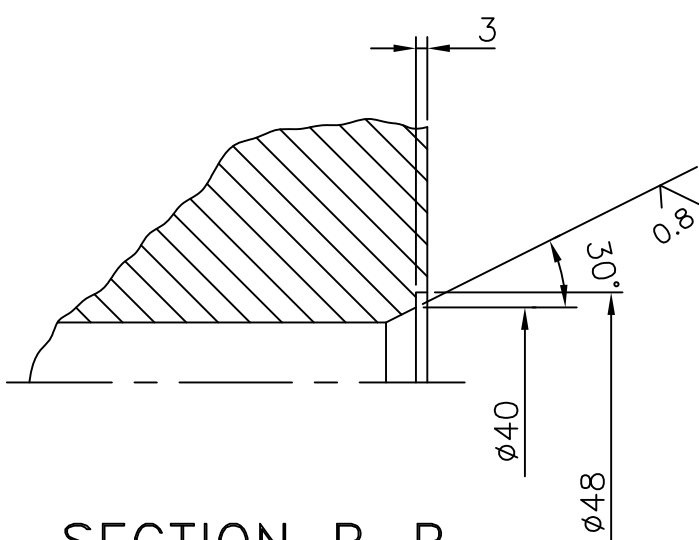


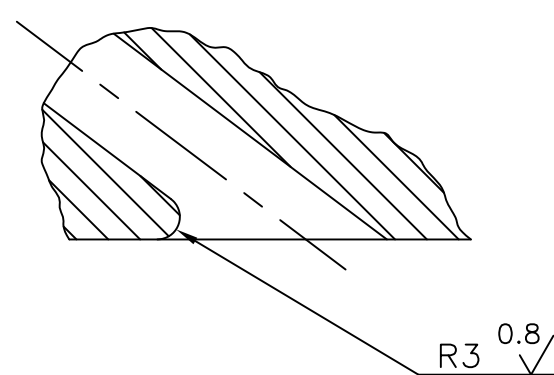
1. BREAK ALL SHARP EDGES AND CORNERS UNLESS OTHERWISE NOTED.
2. SUPPLY AS PER CUSTOMERS APPROVED QUALITY PLAN
3. ATTEST MATERIAL.



SECTION A-A
SCALE-1:2

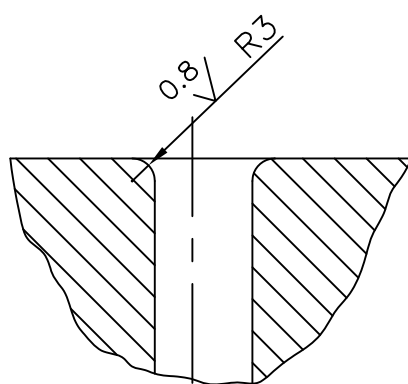


SECTION B-B
SCALE-1:2



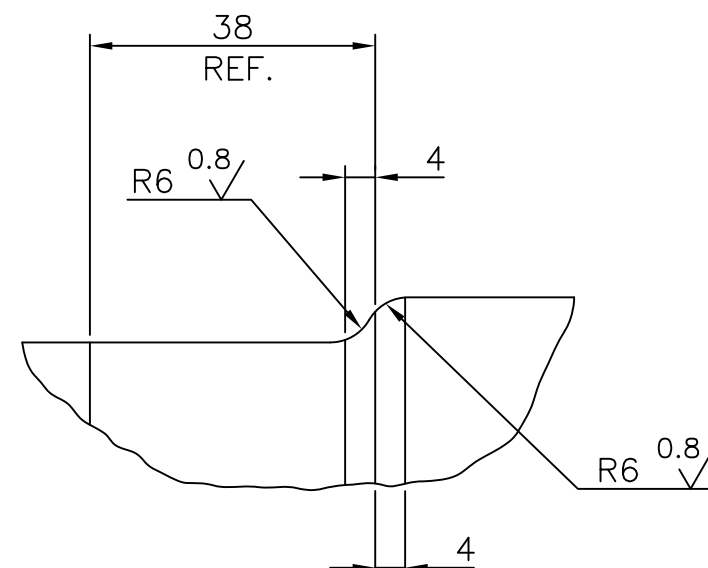
DETAIL-D

SCALE-1:1



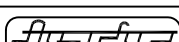
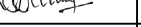
DETAIL-E

SCALE-1:1

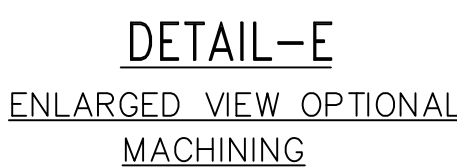


DETAIL-C
SCALE-1:1

	FORGING			3-61-000-90173	BA9413253137	790	036
					AA19332		
ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED... 1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES. 2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°. 3. INTERNAL M/CD CORNER RADII 1 TO 0.7. 4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.	TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		1003 XRP BOWL MILL				
	 BHARAT HEAVY ELECTRICALS LTD. HYDERABAD		NAME	SIGN.	DATE	NO.OF VAR.	
		DRN.	N.D.S		15.4.99		
		CHD.	S.G		15.4.99		
		APPD.	K.M.RAO		15.4.99		
	DEPT. PULV. ENGG		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.		ITEM
CODE 446		1:5	790.036	C-101-01082/R1 CE-P-N-101-01082		NO.	
TITLE				DRAWING NO.			REV.
JOURNAL SHAFT				1-1-000-00363			07
				SHEET NO.		NO OF SHEETS	

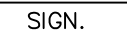
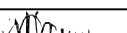
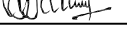
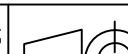
ENTORY NO



1. MACHINE ALL SURFACES TO $\sqrt{\quad}$ UNLESS OTHERWISE SHOWN.
2. BREAK ALL SHARP EDGES AND CORNERS UNLESS OTHERWISE NOTED.
3. SUPPLY AS PER CUSTOMER'S APPROVED QUALITY PLAN.
4. FOR BORE MACHINING & SPACER GRINDING VALUES REFER TABLE OF PROD.STD. BA76002.
5. ATTEST MATERIAL.
6. VAR 01 WITH INCH THDS.
VAR 02 WITH METRIC THDS.

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED.

1. REF. TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT			1003 XRP BOWL MILL				
 BHARAT HEAVY ELECTRICALS LTD. HYDERABAD				NAME	SIGN.	DATE	NO. OF VAR.
			DRN.	N.D.S		15.4.99	
			CHD.	S.G		15.4.99	
			APPD.	K.M.RAO		15.4.99	
DEPT. PULV. ENGG		SCALE	WEIGHT (KG)	REF. TO ASSY DRG. C-101-01081/5 CE: P/N: 101-01081		ITEM NO.	NO. OF ITEMS
CODE 446		1: 2.5	748.767				
TITLE				DRAWING NO.			REV.
UPPER JOURNAL HOUSING				1-61-000-00365			06
				SHEET NO		NO OF SHEETS	

DRG. NO. 1-61-004-01183

SH.01 OF 01
7

C

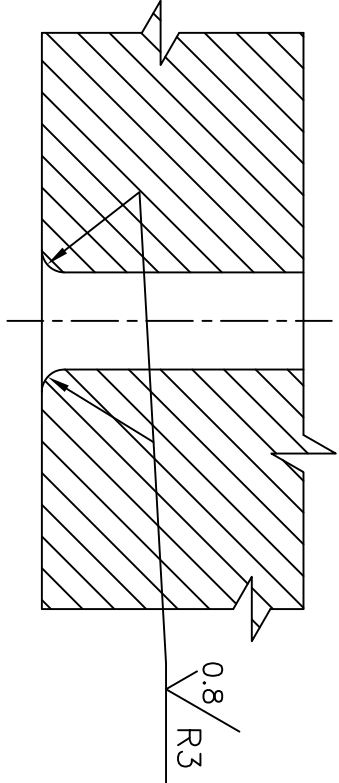
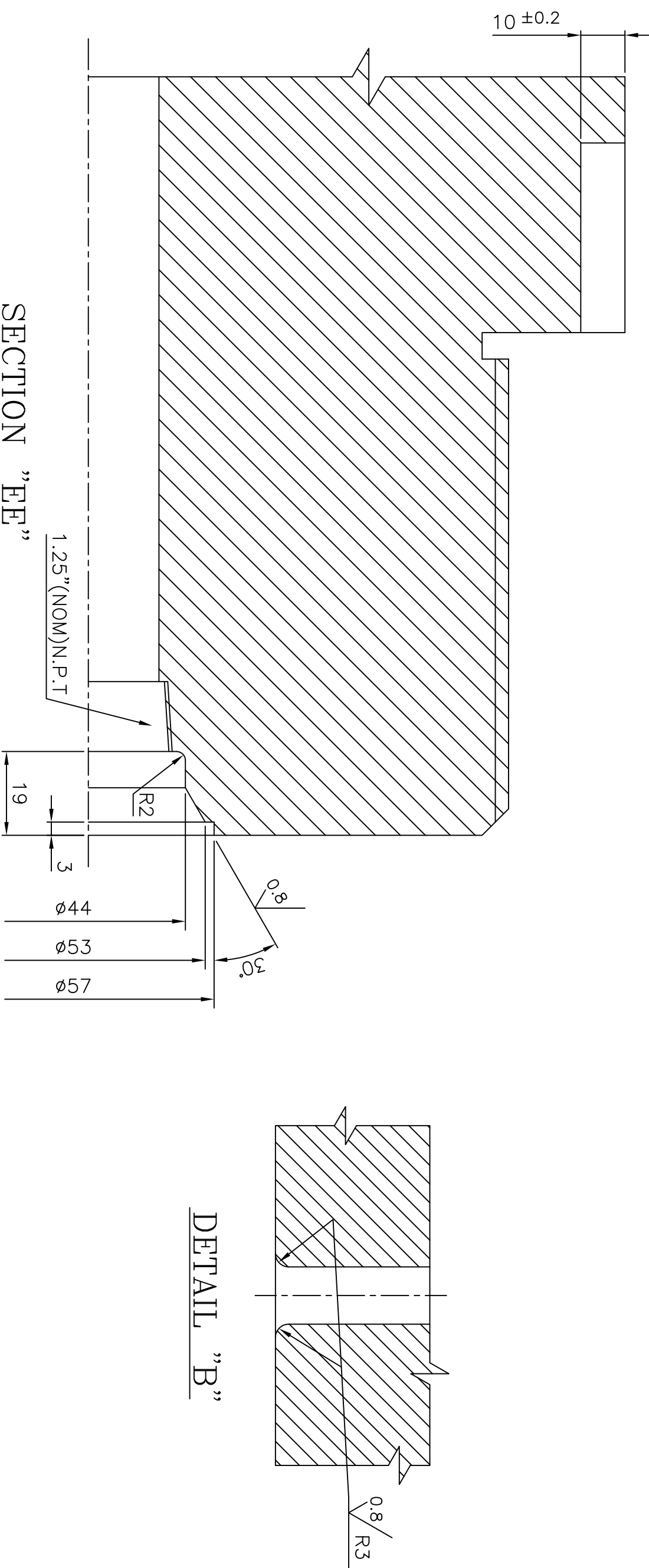
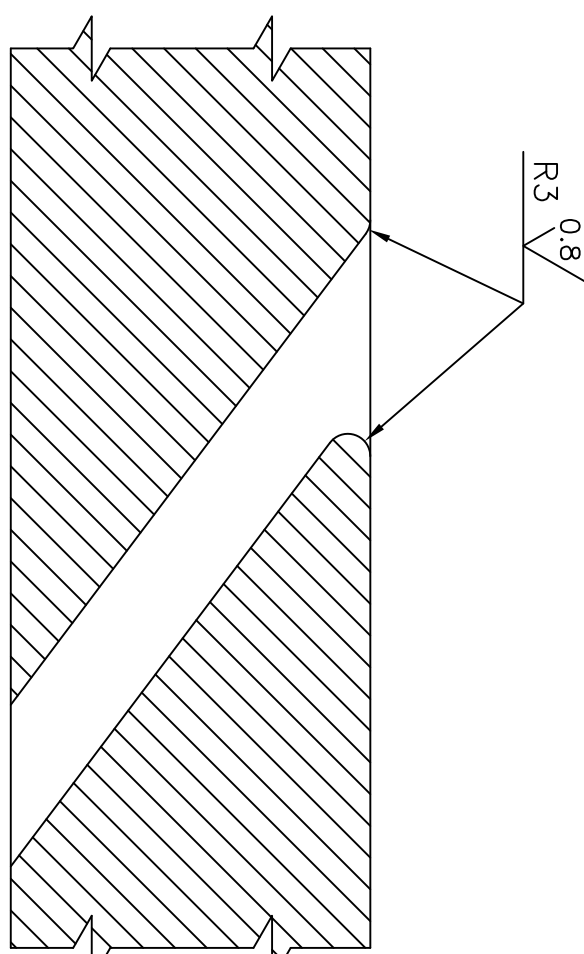
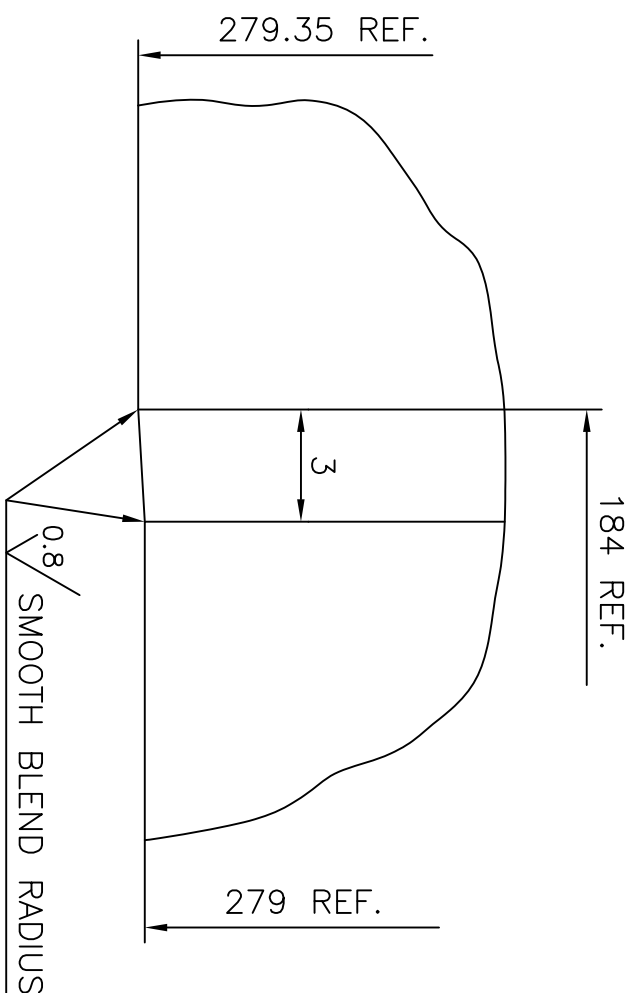
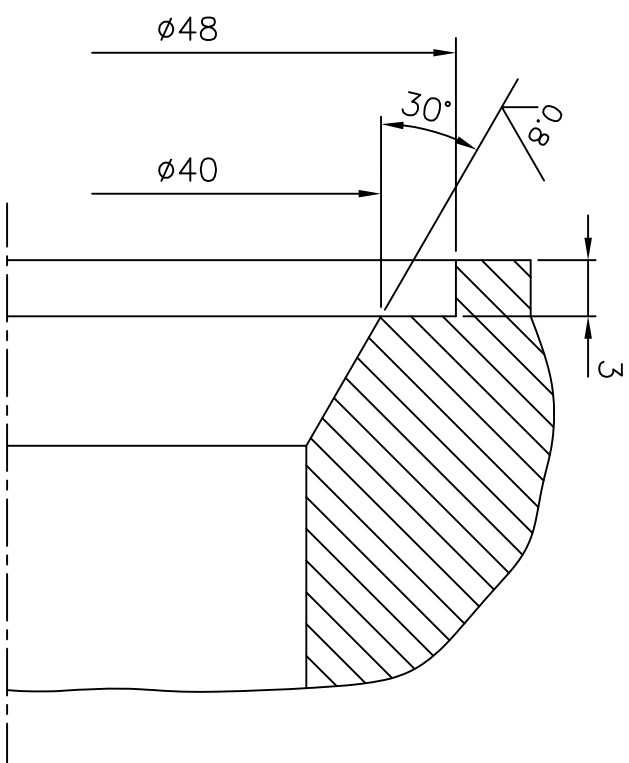
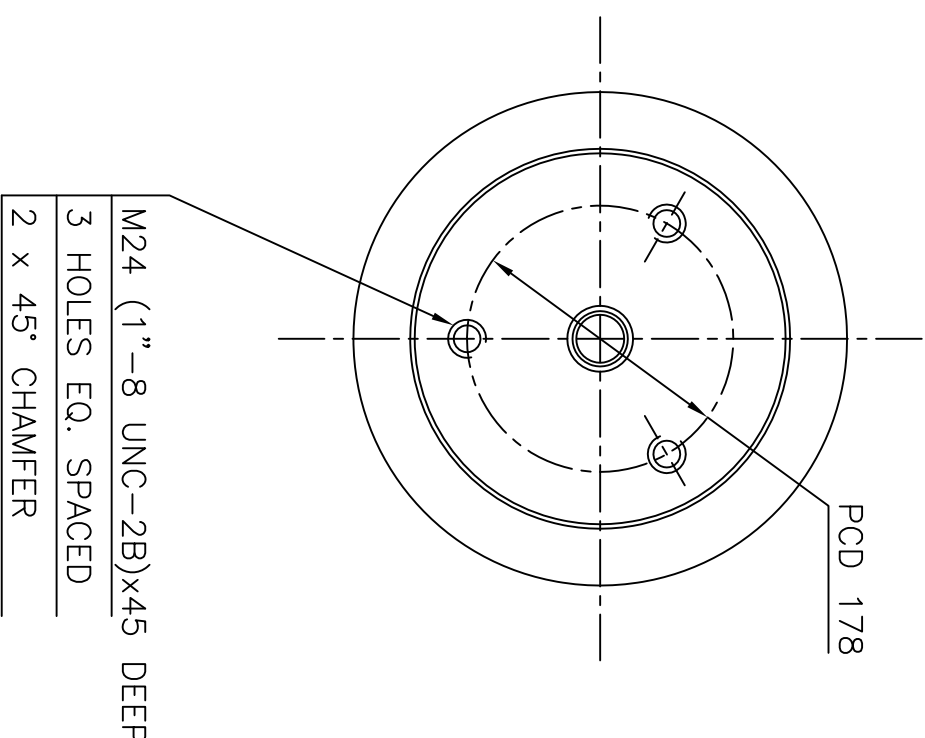
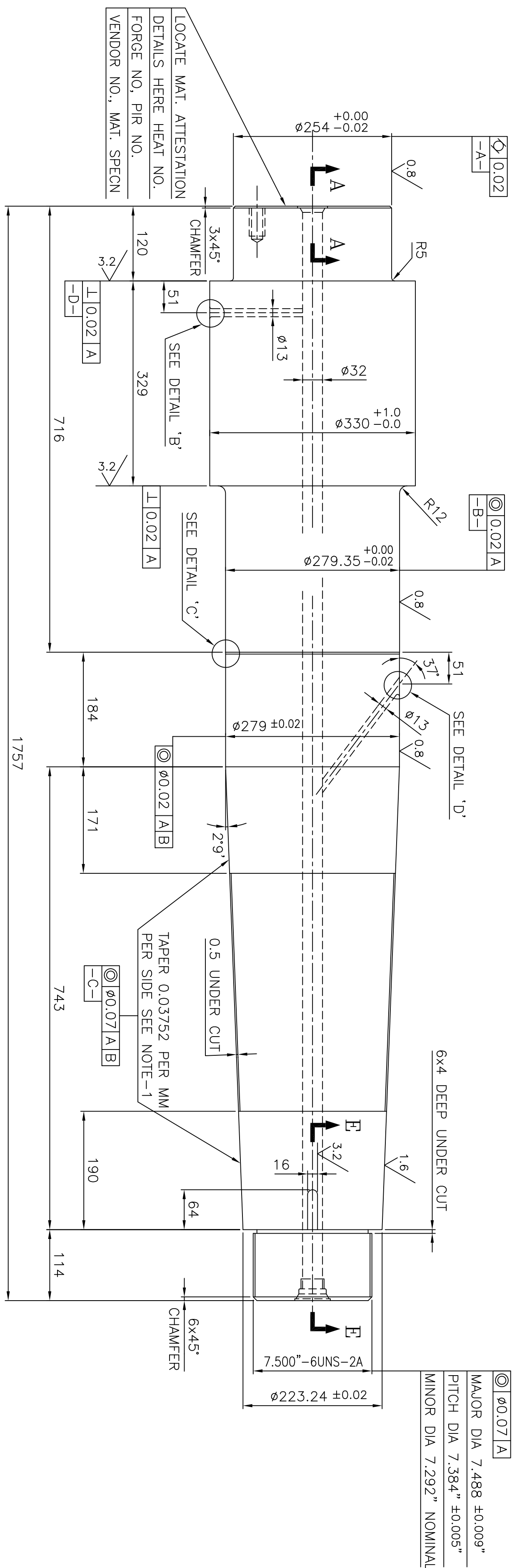
4

3

1

Q

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NOTES:—

01. TAPER MUST FIT FULL CONTACT RING GAUGE WITH MIN OF 80% CONTACT BANDS. OF NO CONTACT MUST NOT EXCEED 10° OF ARC.
02. ALL DIAMETERS TO BE CONCENTRIC WITH DATUMS A & B WITHIN 0.25 T.I.R. UNLESS OTHERWISE SPECIFIED.
03. ALL FILETS $\frac{\sqrt{r}}{2}$
04. REFER DRG. NO. 3--61--004--90184 FOR ROUGH FORGING.
05. BREAK ALL SHARP EDGES.
- 06 VAR. 01 METRIC THREADING & VAR. 02 INCH THREADING.

01	FORGING			VAR NO.	RAW MATERIAL SIZE OR CASTING DRG. NO. OR FORGING DRG. NO.	BA9413263242	799.00
						AA19332	1
						MATERIAL CODE	GROSS WGT
						NET WT.	
						MATERIAL SPECN.	QUANTITY

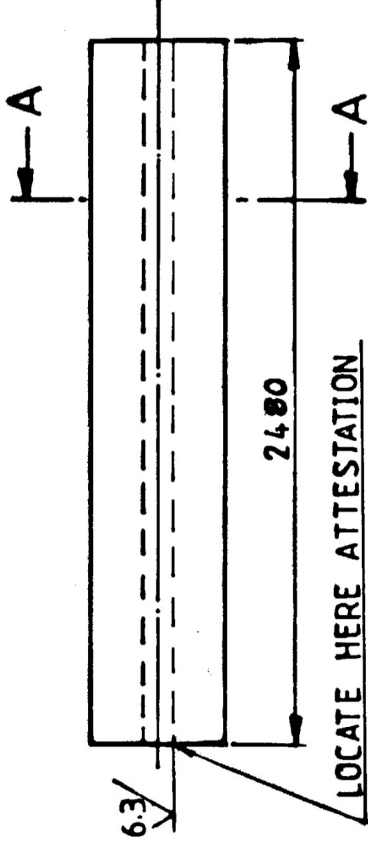
THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED. 1. REF. TO HYD230961 FOR UNSPECIFIED TOLERANCES. 2. CHAMFER M/C/D. SHARP EDGES 1.2 TO 1.0 AT 45°. 3. INTERNAL M/C/D. CORNER RADIUS 1 TO 0.7 4. THE SURFACE ROUGHNESS WHERE-COVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE THE BACK SLASH GIVEN ON THE TOP MOST RIGHT CORNER OF THE DRG.	TYPE OF PRODUCT	1103 XRP BOWL MILL									
	NAME OF CUSTOMER/PROJECT	BHARAT HEAVY ELECTRICALS LIMITED HYDERABAD									
		NAME	SIGN.	DATE	NO.OF REV.						
		UNIC		10.06.99	VAR.						
		CHD. N.SAMUEL		10.06.99	-						
		S.CHATTOE		10.06.99							
	DEPT	INTEL DMC. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO	NO.OF ITEMS	NO.OF SHEETS	REV.		
	PULV ENDS	E/W/P	1:5	799.00	1-61-004-01190	09	30	02			
	CODE	TITLE		CARD CODE	DRAWING NO.		1-61-004-01183				
	446	JOURNAL SHAFT			SHEET NO. 01		NO OF SHEETS 01				

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED			CHECKED
ZONE			ZONE		

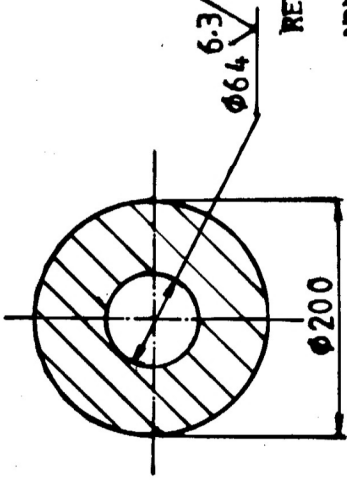


12.5/6.3/

LOCATE HERE ATTESTATION

DETAILS VIZ.
SUPPLIER'S CODE.
FORGE NO.
MAT. SPECN
MELT. NO.NOTE

1. FORGING TO BE ROUGH MACHINED TO DIMENSIONS INDICATED IN DRG.
2. HOLE $\phi 64$ SHOULD CONCENTRIC WITH CENTRE LINE WITH IN ± 1 MM
3. TEST ULTRASONICALLY AS PER SPEN. AA0850118 CAT-3.
4. TOLERANCE ON DIAMETERS AND LENGTH ± 1 MM.
5. FOR FINISH MACHINING REFER DRG. NO. I-61-004-01184

REFER PLANT STANDARD
HY 0230261 FOR
UNSPECIFIED TOLERANCES

SECTION AA

1003XRP BOWL MILL

REF. DRG. NO.

SIGN & DATE

INVENTORY NO.

DEPT BMD CODE 446	GRADE OF TOL. DIM. F/M/J	SCALE NTS	WEIGHT (Kg) 548.0	REF. TO ASSY. DRG. D-110-00767	ITEM NO. 75	NO. OF ITEMS 77
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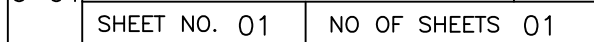
BHARAT HEAVY ELECTRICALS LTD
HYDERABAD

DRN.	NAME	SIGN.	DATE	73	74
CHD.	N.D.S	W. D. S.	25-1-93	NO. OF	NO. OF
APPD.	Y S L. Rao	yshao	31-3-93	VAR.	VAR.

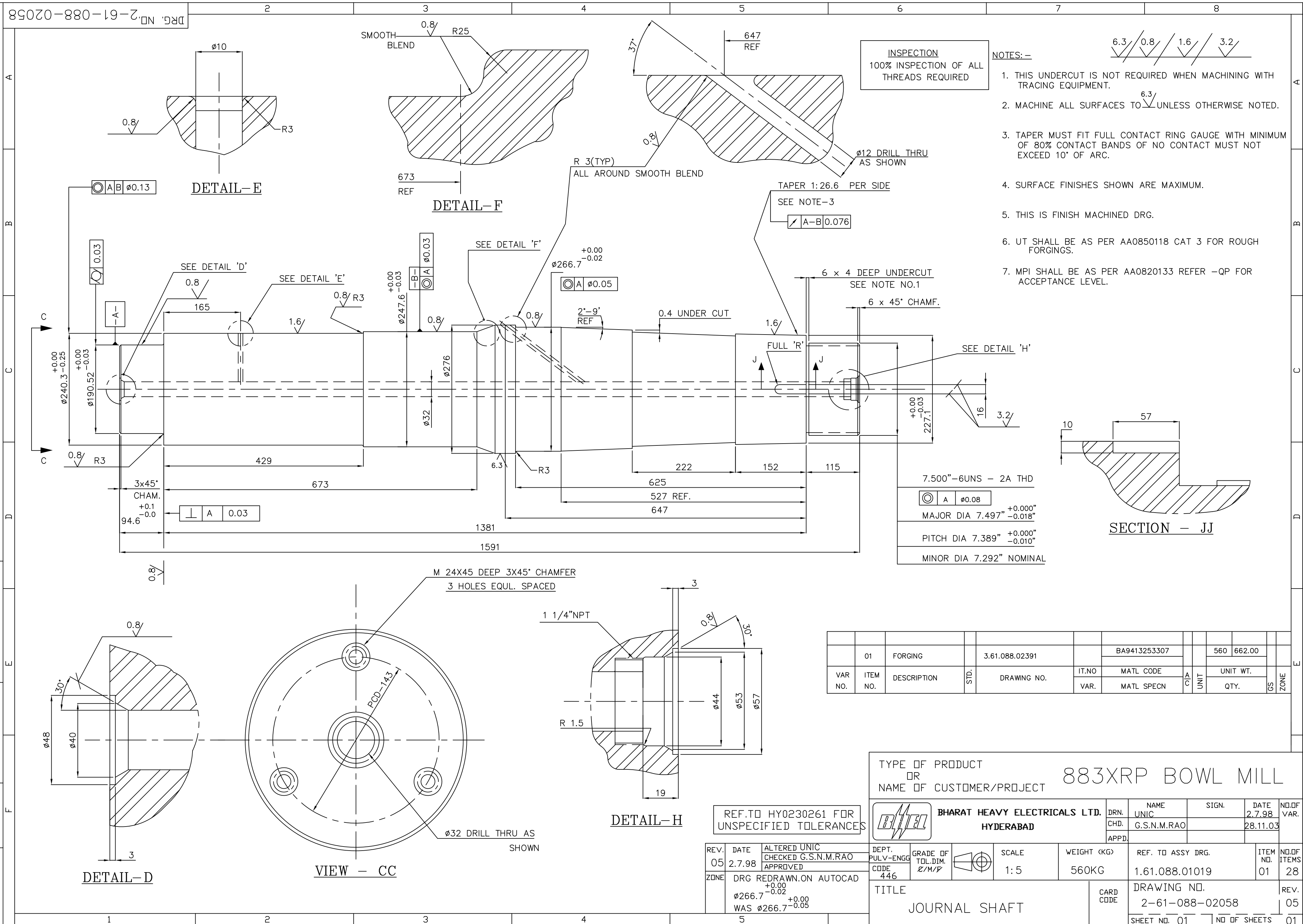
CARD TYPE-3	28	CARD TYPE-2	28	CARD TYPE-1	28
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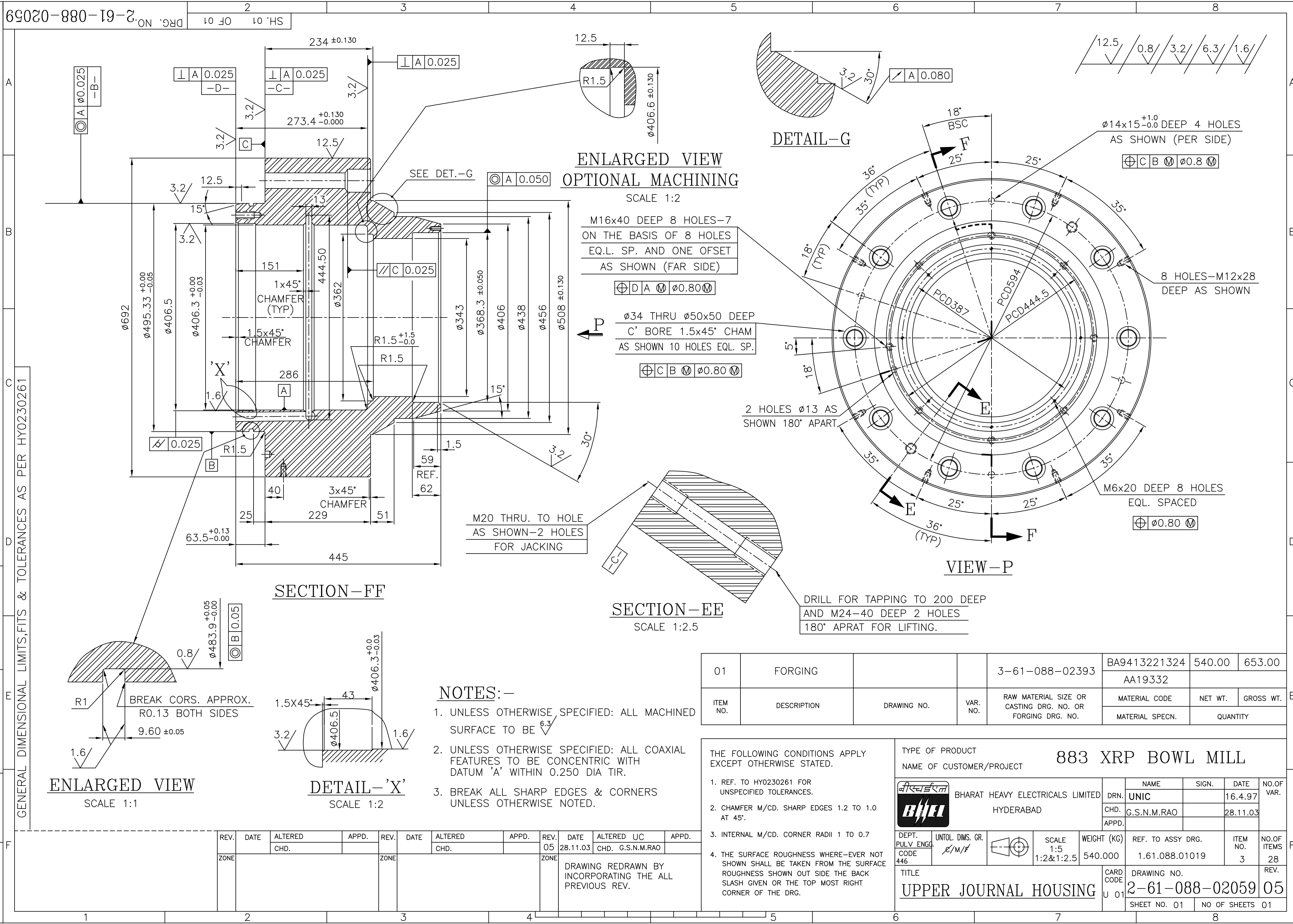
TITLE TRUNNION SHAFT (ROUGH FORGING)	CARD CODE	DRAWING NO. 4-61-004-90249	REV. 00	NO. OF SHEETS 22	NO. OF SHEETS 24
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0.00	NO. OF VAR.	NO. OF ITEMS
1	/	28
SS WT.		REV.
		07
		01

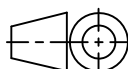


INVENTORY NO. SIGN. AND DATE REF. DRG. NO. C-94-851 REF. DRG. NO. 26102058.DWG THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY





01	FORGING			3-61-088-02393	BA9413221324		540.00	653.00
					AA19332			
ITEM NO.	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG. NO. OR FORGING DRG. NO.	MATERIAL CODE		NET WT.	GROSS WT.
					MATERIAL SPECN.		QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED. 1. REF. TO HY0230261 FOR UNSPECIFIED TOLERANCES. 2. CHAMFER M/CD. SHARP EDGES 1.2 TO 1.0 AT 45°. 3. INTERNAL M/CD. CORNER RADII 1 TO 0.7 4. THE SURFACE ROUGHNESS WHERE-EVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE THE BACK SLASH GIVEN OR THE TOP MOST RIGHT CORNER OF THE DRG.	TYPE OF PRODUCT NAME OF CUSTOMER/PROJECT 883 XRP BOWL MILL										
					BHARAT HEAVY ELECTRICALS LIMITED		DRN.	NAME	SIGN.	DATE	NO.OF VAR.
					HYDERABAD		CHD.	G.S.N.M.RAO		16.4.97	
							APPD.			28.11.03	
	DEPT. PULV ENGG.	UNTOL. DIMS. GR.		SCALE 1:5 1:2&1:2.5	WEIGHT (KG)	REF. TO ASSY DRG.			ITEM NO.	NO.OF ITEMS	
	CODE 446	℄/M/℄			540.000	1.61.088.01019			3	28	
TITLE						CARD CODE	DRAWING NO.			REV.	
UPPER JOURNAL HOUSING						U 01	2-61-088-02059			05	
							SHEET NO. 01		NO OF SHEETS 01		

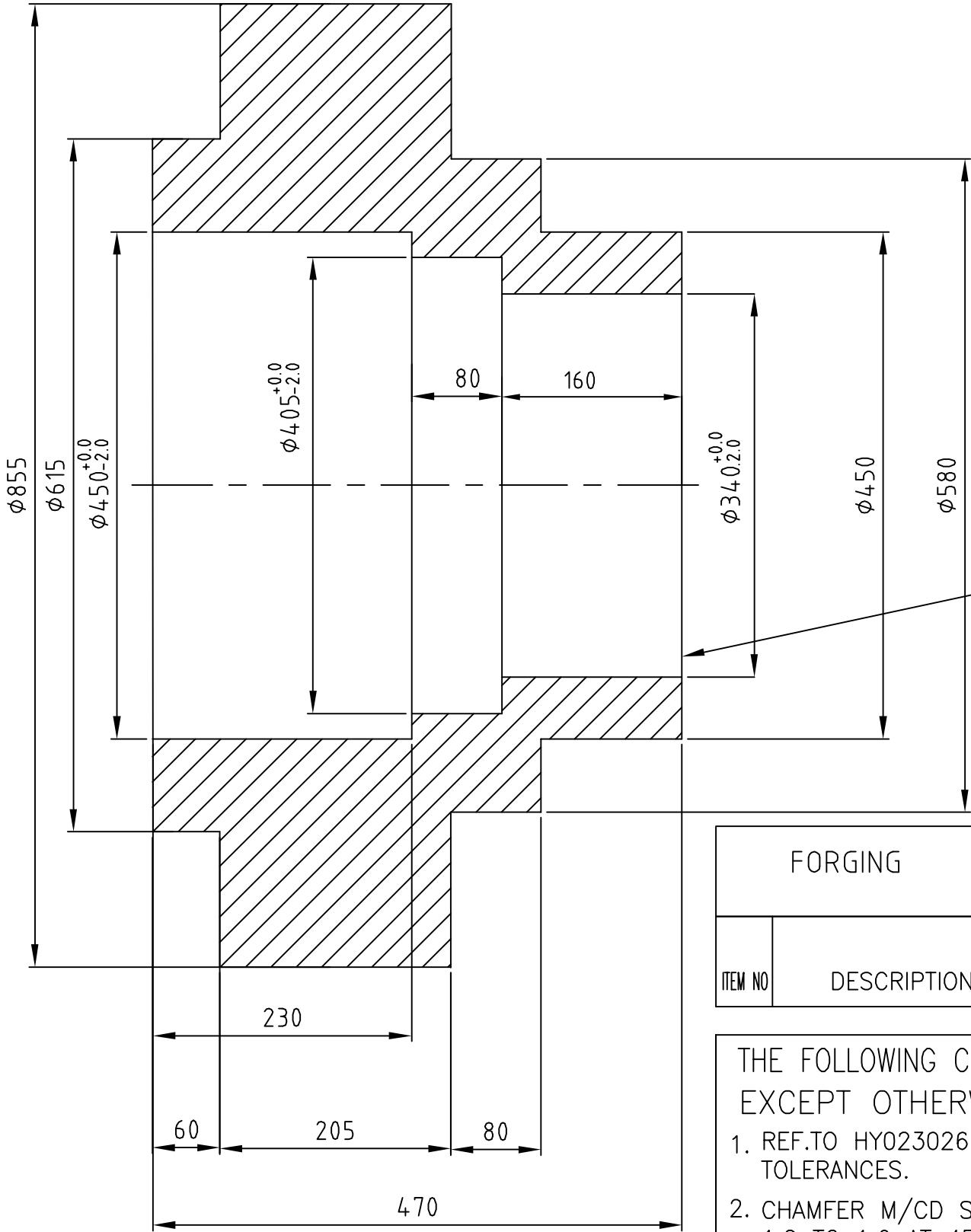
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

FILE NAME

1-61-000-90168
REF.DRG.NO.

INVENTORY NO.

DRG.NO. 3-61-000-90168



NOTE

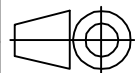
1. FORGING TO BE ROUGH MACHINED TO DIMENSIONS INDICATED IN THE DRAWING
- 2.CHAMFER CORNERS TO R2 & FILLET RADIUS ARE TO BE R3
3. TEST ULTRASONICALLY AS PER SPECIFICATIONS AA0850118 CAT-3
4. FORGING SHOULD BE AS PER SPECIFICATIONS AA19332
5. TOLERANCE ON DIAMETERS AND LENGTHS±1MM
6. FOR FINISH MACHINING REFER 1-61-000-00365

12.5

FORGING				BA9413221235			
				AA 19332			
ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

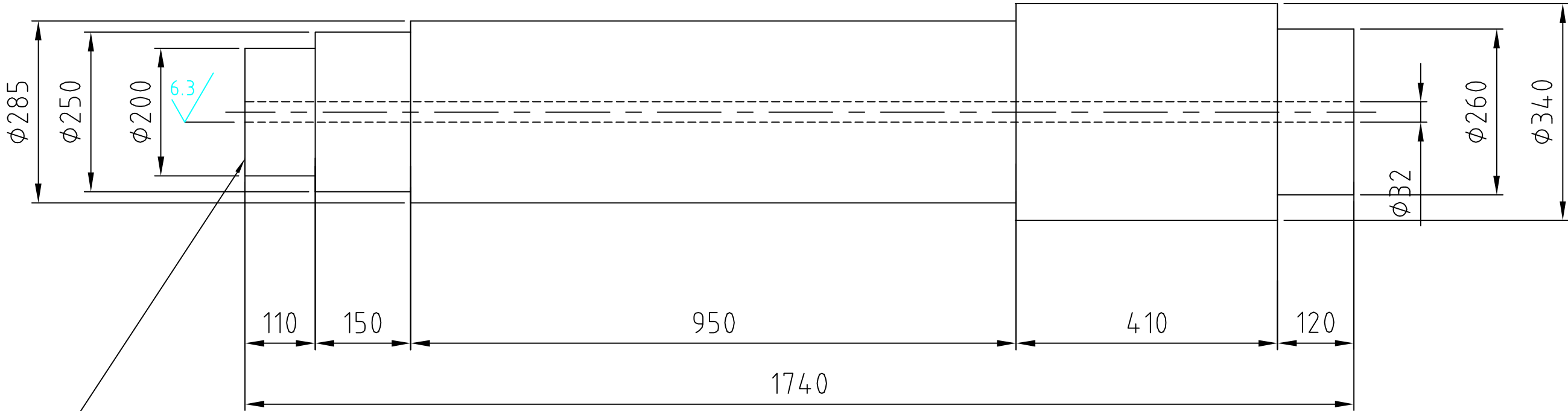
THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT				1003 XRP BOWL MILL KORBA&RAMAGUNDAM 500MW				
 BHARAT HEAVY ELECTRICALS LTD. HYDERABAD					NAME	SIGN.	DATE	NO.OF VAR.
				DRN.	NARAYANA		3.11.03	
				CHD.	N.D.S		3.11.03	
				APPD.	S.GHADGE			
DEPT.	PULVE.ENGG		SCALE 1:5	WEIGHT (KG) 854.00	REF. TO ASSY DRG. 1-61-000-90168		ITEM NO.	NO.OF ITEMS
ODE	446							
TITLE UPPER JOURNAL HOUSING					DRAWING NO. 3-61-000-90168			REV. 01
					SHEET NO. 01		NO OF SHEETS 01	

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DRG.NO. 3-61-000-90173



LOCATE HARE ATTESTATION DETAILS VIZ.
SUPPLIERS CODE
FORGE No.
MAT. SPECN.
MELT.No.

NOTE

1. FORGING TO BE MACHINED TO DIMENSIONS INDICATED IN THE DRAWING
- 2 CHAMFER SHARP CORNERS TO R2 & ALL FILLET RADIUS TO R3
- 3TEST ULTRASONICALLY AS PER SPECIFICATIONS AA0850118 CAT-3
- 4.FORGING SHOULD BE AS PER SPECIFICATIONS AA19332
5. TOLERANCE ON DIAMETERS AND LENGTHS ± 1 MM
6. HOLE $\phi 32$ SHIULD BE CONCENTRIC WITH CENTRE LINE WITH ± 1 MM
7. FOR FINISH MACHINING REFER 1-61-000-00363

	FORGING			BA9413253226	876.00	
				AA19332		
ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT. GROSS WT.
					MATERIAL SPECN.	QUANTITY

THE FOLLOWING CONDITIONS APPLY
EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT 1003 XRP BOWL MILL
OR
NAME OF CUSTOMER/PROJECT KORBA & RAMAGUNDAM 500 MW



BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

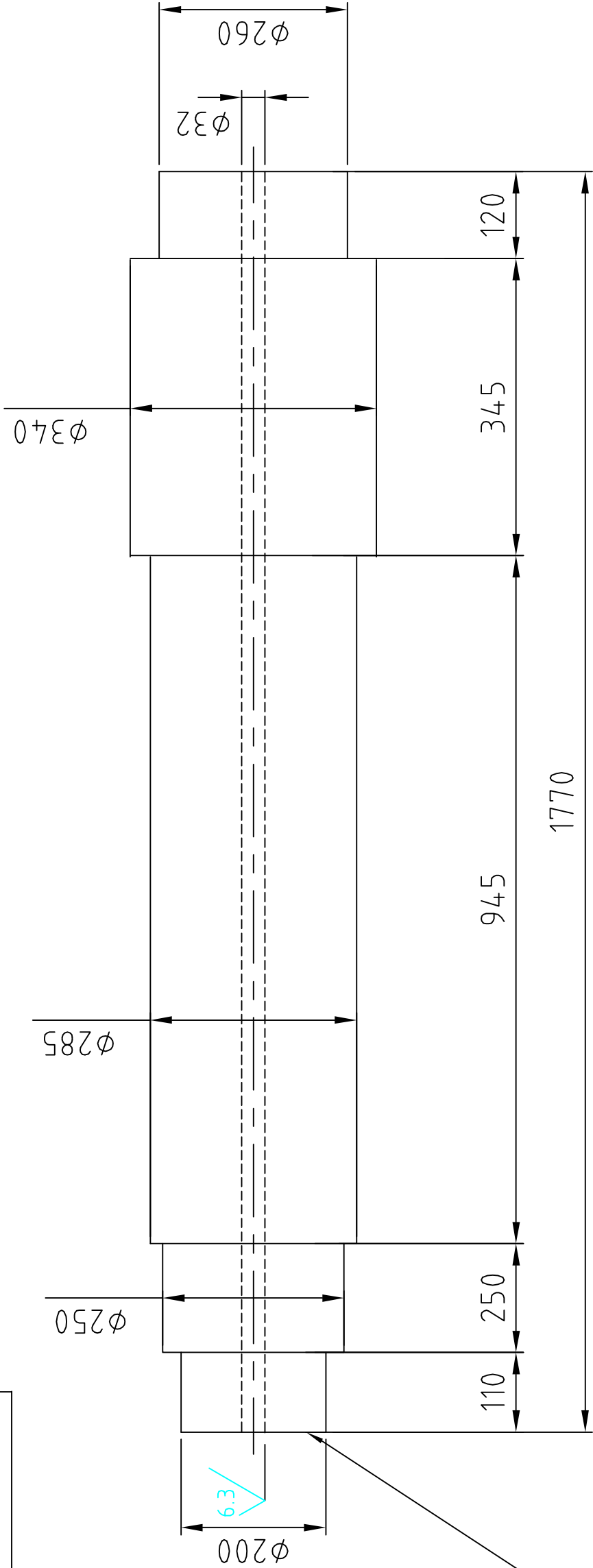
DEPT. PULVE.ENG	SCALE 1:10	WEIGHT (KG) 876.00	REF. TO ASSY DRG. 1-61-000-00363	ITEM NO.	NO.OF ITEMS
CODE 446					
TITLE JOURNAL SHAFT (ROUGH MACHINED)			DRAWING NO. 3-61-000-90173	REV. 01	
			SHEET NO. 01	NO OF SHEETS 01	

78106-700-19-E 'ON'GRD

BHARAT HEAVY ELECTRICALS LTD.

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12.5 // 6.3 ✓



LOCATE HARE ATTESTATION DETAILS VIZ.
SUPPLIERS CODE
FORGE No.
MAT. SPECN.
MELT.No.

- NOTE
- 1. FORGING TO BE MACHINED TO DIMENSIONS INDICATED IN THE DRAWING
 - 2. CHAMFER SHARP CORNERS TO R2 & ALL FILLET RADIUS TO R3
 - 3. TEST ULTRASONICALLY AS PER SPECIFICATIONS
 - AA0850118 CAT-3
 - 4. FORGING SHOULD BE AS PER SPECIFICATIONS AA19332
 - 5. TOLERANCE ON DIAMETERS AND LENGTHS ± 1MM
 - 6. HOLE Ø32 SHOULD BE CONCENTRIC WITH CENTRE LINE WITH ± 1MM
 - 7. FOR FINISH MACHINING REFER 1-61-004-01183

- THE FOLLOWING CONDITIONS APPLY
EXCEPT OTHERWISE STATED...
- 1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
 - 2. CHAMFER M/CD SHARP EDGES
1.2 TO 1.0 AT 45°.
 - 3. INTERNAL M/CD CORNER RADII
1 TO 0.7.
 - 4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

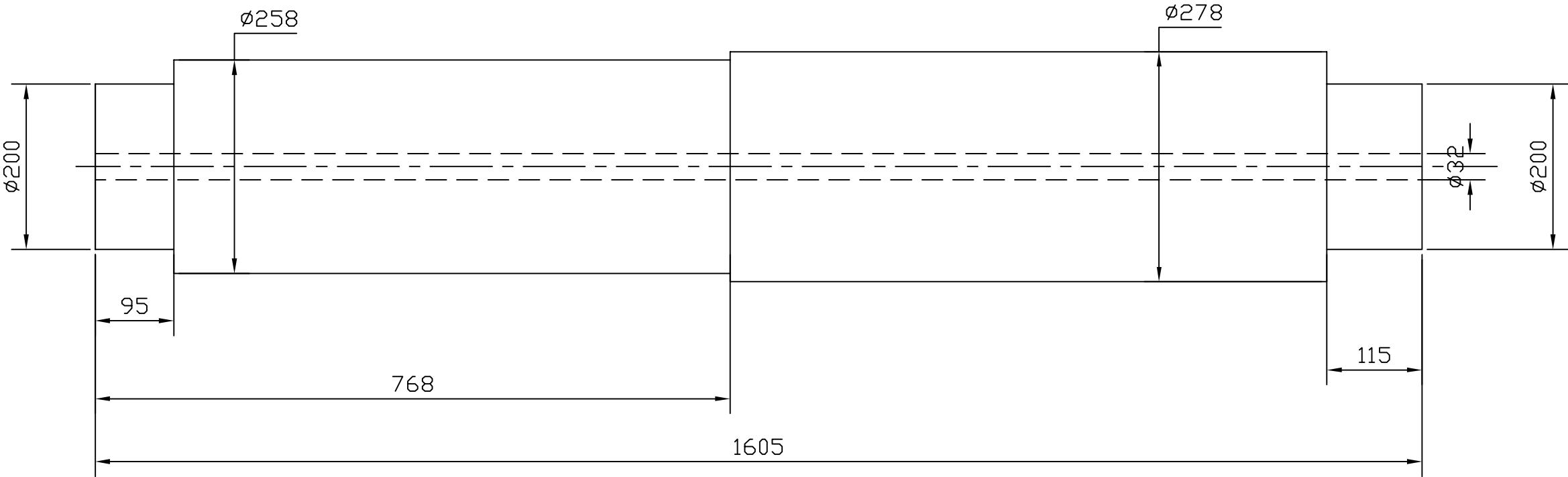
01	FORGING			BA9413253242	890	
				AA19332		
ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.		GROSS WT.
				MATERIAL CODE	NET WT.	QUANTITY

TYPE OF PRODUCT		1043 XRP BOWL MILL	
OR		NAME OF CUSTOMER/PROJECT CHANDRAPUR 500 MW	
	NAME		DATE
	SIGN.		NO.OF VAR.
	DRN.		07.11.12
	CHD.		07.11.12
BHARAT HEAVY ELECTRICALS LTD.		V KUMAR	
HYDERABAD		07.11.12	
DEPT. PULVE.ENG	SCALE	WEIGHT (KG)	ITEM NO.
CODE 446	NTS	890.00	
DRAWING NO.		REV.	
JOURNAL SHAFT		3-61-004-90184 01	
(ROUGH MACHINED)		SHEET NO. 01	NO OF SHEETS 01

REV.	DATE	ALTERED	REV.	DATE	ALTERED	PKP
		CHD.	01	07.11.12	CHD.	APPD. V KUMAR
ZONE			ZONE	DRAWING DRAWN ON AUTOCAD DIM. 120, 94.5, 250 WERE 105, 950 AND 260 RESPECTIVELY.		

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

DRG.NO. 3-61-088-02391



- 1.FORGING SHALL BE ROUGH MACHINED TO DIMENSIONS INDICATED IN THE DRAWING
2.BREAK ALL SHARP EDGES&ALLCORNER RADII TO BE R2
3.FORGING SHALL BELTESTED ULTRASONICALLY AS PER BHEL CORP.STDAA0850118 CAT-2
4.REFER DRG 2-61-088-02058 FOR FINISH MACHINING
5.HOLE ± 32 SHOULD BE CONCENTRIC WITH RESPECT TO CENTRE LINE WITH IN 0.5MM

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	BA9516953018		
					HY19369,REV,01		
					MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

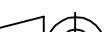
THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT 883 XRP BOWL MILL



BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

DEPT.	PULVE.ENG		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
CODE	446		1:5	662	-		
TITLE JOURNAL SHAFT (ROUGH MACHINED)					DRAWING NO.		REV.
					3-61-088-02391		01
					SHEET NO. 01	NO OF SHEETS 01	

DRAWING DRAWN ON AUTOCAD

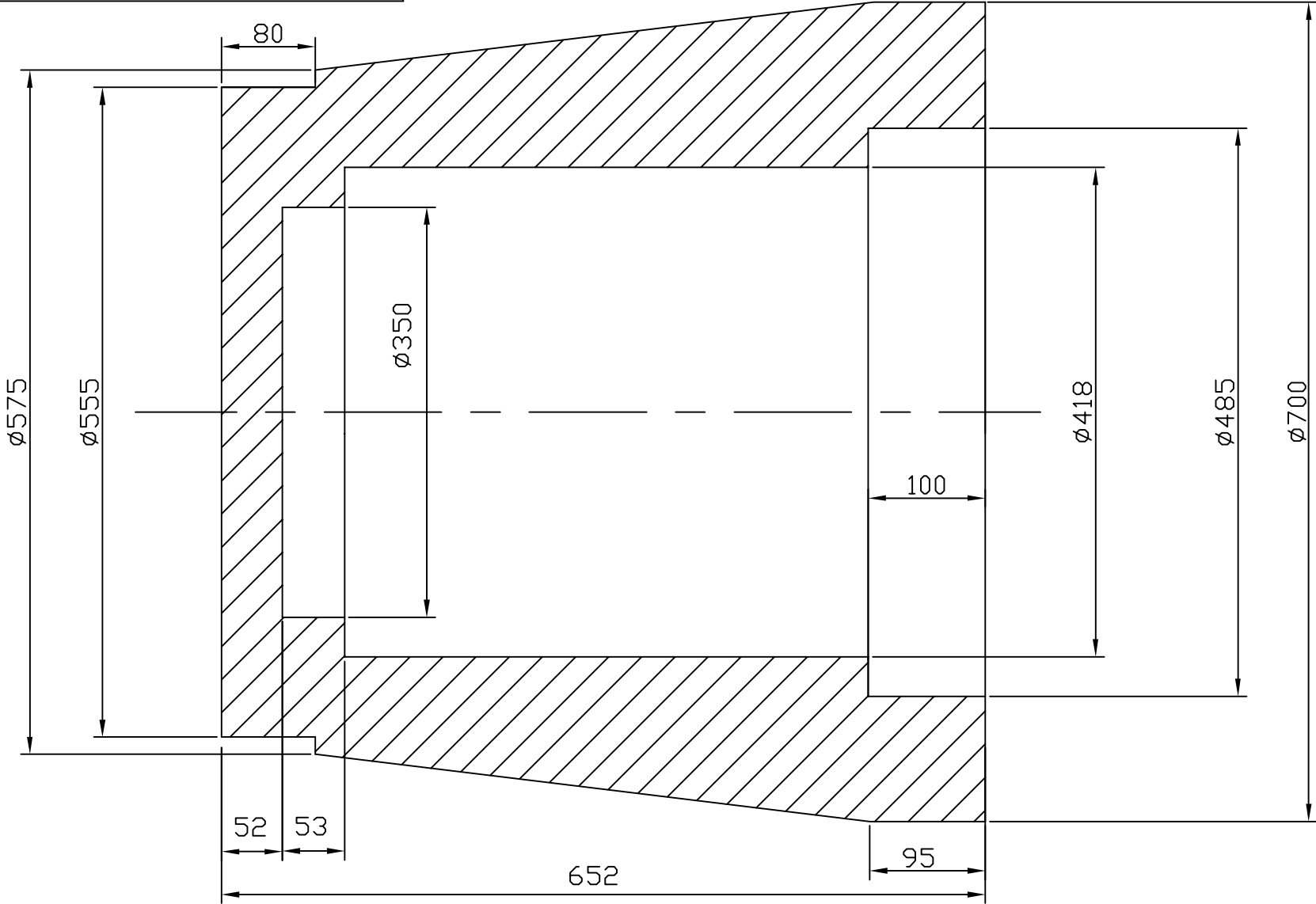
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36102392.DWG
FILE NAME

REF.DRG.NO.

INVENTORY NO.

DRG.NO. 3-61-088-02392



12.5

NOTE

1. FORGING TO BE ROUGH MACHINED TO DIMENSIONS INDICATED IN THE DRG
- 2.BREAK ALL SHARP EDGES &ALL CORNER RADII TO BE R2
3. TEST ULTRASONICALLY AS PER SPECIFICATIONS AA0850118 CAT-3
4. FOR FINISH MACHINING REFER 2-61-088-02056

FORGING					BA9413221316	990	
					AA 19332		1
ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT 883 XRP BOWL MILL



BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

DEPT. PULVE.ENG	SCALE 1:5	WEIGHT (KG) 990	REF. TO ASSY DRG. 26108802056	ITEM NO. 1	NO.OF ITEMS 1
CODE 446			DRAWING NO. 3-61-088-02392	REV. 03	
TITLE LOWER JOURNAL HOUSING (ROUGH MACHINED)			SHEET NO. 01	NO OF SHEETS 01	

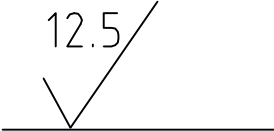
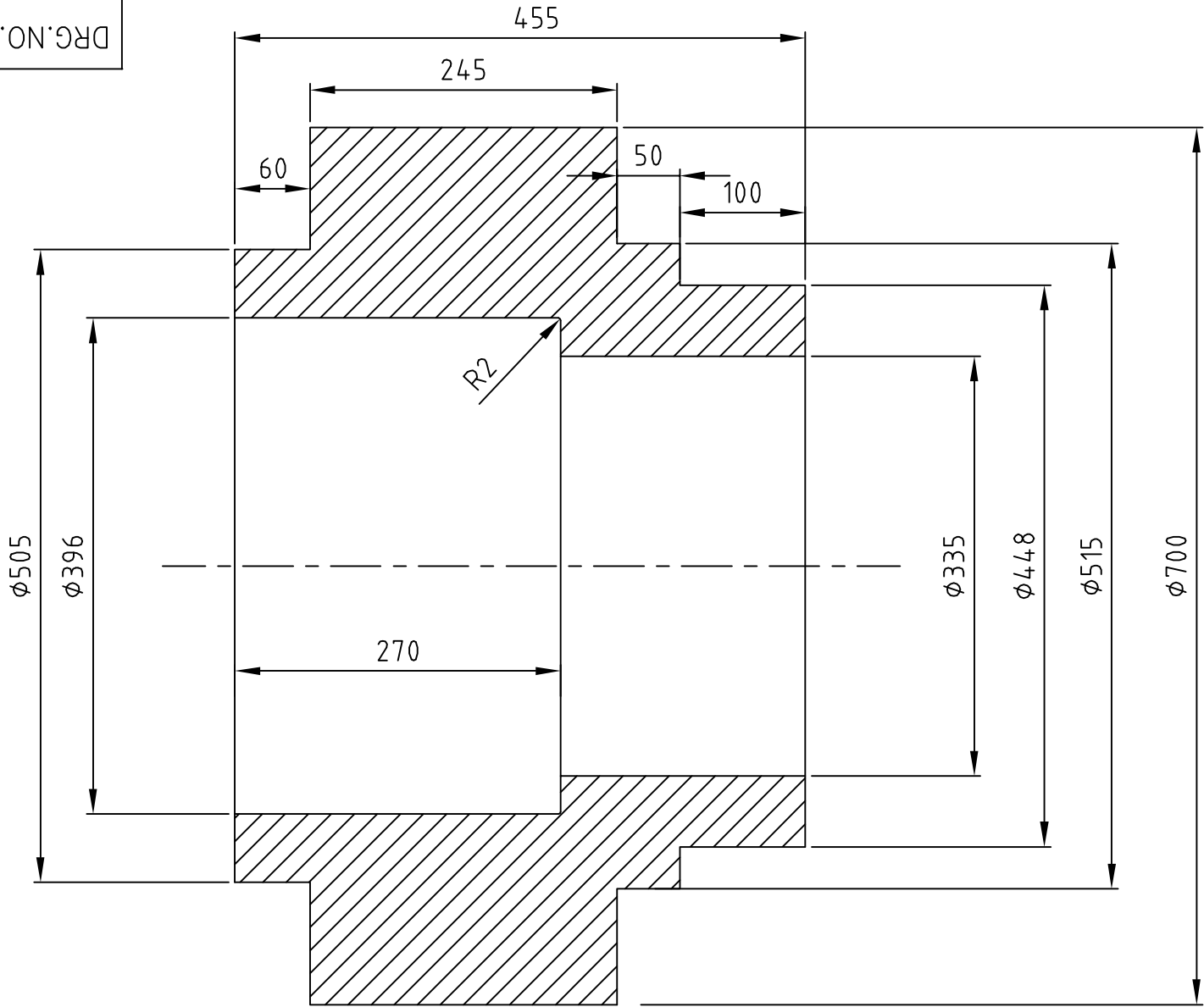
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36102393.DWG
FILE NAME

REF.DRG.NO.

INVENTORY NO.

DRG.NO. 3-61-088-02393



NOTE

1. FORGING TO BE ROUGH MACHINED TO DIMENSIONS INDICATED IN THE DRAWING
- 2.BREAK ALL SHARP EDGES &ALL CORNER RADII TO BE R2
3. TEST ULTRASONICALLY AS PER SPECIFICATIONS AA0850118 CAT-3
4. FOR FINISH MACHINING REFER 2-61-088-02059

FORGING					BA9413221324	653.0	
					AA 19332		
ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT 883 XRP BOWL MILL



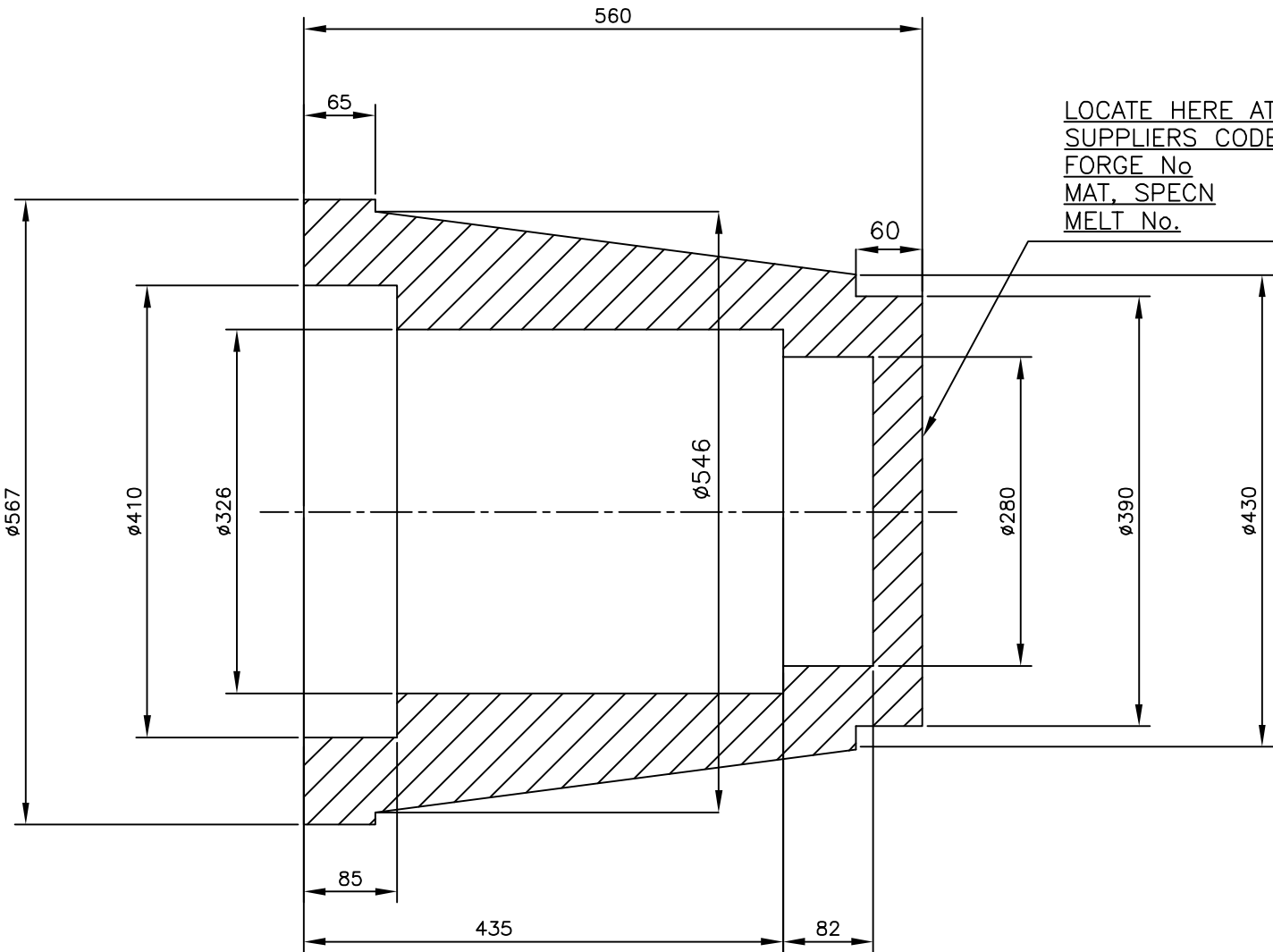
BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

DEPT. PULVE.ENG	SCALE 1:5	WEIGHT (KG) 653	REF. TO ASSY DRG. 2.61.088.02059	ITEM NO. 1	NO.OF ITEMS 1
CODE 446			DRAWING NO. 3-61-088-02393	REV. 01	
TITLE UPPER JOURNAL HOUSING (ROUGH MACHINED)			SHEET NO. 01	NO OF SHEETS 01	

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

DRG.NO. 3-61-376-90010

12.5



LOCATE HERE ATTESTATION DETAILS VIZ
SUPPLIERS CODE
FORGE No
MAT. SPECN
MELT No.

- NOTE:—
- 1.FORGING TO BE ROUGH MACHINED TO DIMERNSIONS INDICATED IN DRG
 - 2.FIGURE IN DASHED LINE REPRESENTS SHAPE OF FINAL MACHINED COMPONENT
 - 3.CORNER CHAMFERS –R2;FILLET RADIUS–R3.
 - 4.TOLERENCE ON DIAMETERS AND LENGTH ±1MM
 - 5.FORGING SHOULD BE AS PER CPS-AA19332
 - 6.TEST ULTRASONICALLY AS PER CORP ORATION STD AA-085-01-18-CAT-3

	FORGING			BA9413221022		
				AA 19332		
ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT. GROSS WT.
					MATERIAL SPECN.	QUANTITY

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

- 1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
- 2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
- 3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
- 4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR MATERIAL ATTEST
NAME OF CUSTOMER/PROJECT 76”BOWL MILL



BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

DEPT. PULVE.ENGG	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
CODE 446	N.T.S	480	40-F-002-016		
TITLE			DRAWING NO.	REV.	
LOWERJOURNAL HOUSING			3-61-376-90010	08	
			SHEET NO. 01	NO OF SHEETS 01	

INVENTORY NO.

REF.DRG.NO.

FILE NAME

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NOTE

DRG.NO. 3-61-376-90011

LOCATE HERE ATTESTATION DETAILS VIZ
SUPPLIERS CODE
FORGE No
MAT SPECN
MELT No

114

1416

340

100

12.5

6.3

170

215

250

200

32

1. FORGING TO BE ROUGH MACHINED TO DIMENSIONS INDICATED IN THE DRAWING.

2. CHAMFER SHARP CORNERS TO R2 & ALL FILLET RADIUS TO R3.

3.TEST ULTRASONICALLY AS PER SPECIFICATION AA0850118 CAT-2.

4.FORGING SHOULD BE AS PER SPECIFICATION AA19332

5.TOLERANCE ON DIAMETERS AND LENGTHS ± 1 mm.

6.HOLE φ32 SHOULD BE CONCENTRIC WITH CENTER LINE WITHIN ± 1mm.

FORGING

ITEM NO

DESCRIPTION

DRAWING NO.

VAR. NO.

RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.

BA9413253048

AA19332

MATERIAL CODE

MATERIAL SPECN.

NET WT.

GROSS WT.

QUANTITY

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.

2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.

3. INTERNAL M/CD CORNER RADII 1 TO 0.7.

4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

76"BOWL MILL

'MATERIAL ATTEST'

DEPT.

PULVE.ENGG

CODE

446

17

11

03

17

11

03

17

11

03

DRN.

NARAYANA

CHD.

N.D.S

APPD.

S.GHATGE

NAME

SIGN.

DATE

NO.OF VAR.

SCALE

NTS

WEIGHT (KG)

463

DRAWING NO.

3-61-376-90011

SHEET NO.

01

NO OF SHEETS

01

TITLE

JOURNAL SHAFT

(ROUGH MACHINED)

REV.

03

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

TD-151/REV. 03

SIZE A3



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	Com. Sr. No.
Cl:10.2.4 of MOM	01	WG-NDT	CORP. R&D	15.1.96	A 1822



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: Cl.9.4 OF MOM OF WG(NDT)			Approved: INTERPLANT STANDARDIZATION COMMITTEE - (WG-NDT)		
Rev.No. 01	Amd.No.	Reaffirmed	Prepared CFFP	Issued CORP. R&D	Dt. of 1st issue
Dt. Jan '95	Dt.	Year:	HARDWAR		Jan '80

**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.



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.

**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:

Category**Unacceptable defects**

- | | |
|---|---|
| 1 | <ul style="list-style-type: none">(i) Cracks, flakes, seams & laps.(ii) Defects giving indication larger than that from a 2 mm diameter equivalent flaw.(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%.(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 | <ul style="list-style-type: none">(i) Cracks, flakes, seams & laps.(ii) Defects giving indication larger than that from a 4 mm diameter equivalent flaw.(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%.(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 | <ul style="list-style-type: none">(i) Cracks, flakes, seams & laps.(ii) Defects giving indication larger than that from a 6 mm diameter equivalent flaw.(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%.(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 | <ul style="list-style-type: none">(i) Cracks, flakes, seams & laps.(ii) Defects giving indication larger than that from a 10 mm diameter equivalent flaw.(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%. |



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AA 085 01 18

REV.No. 01

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- (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.

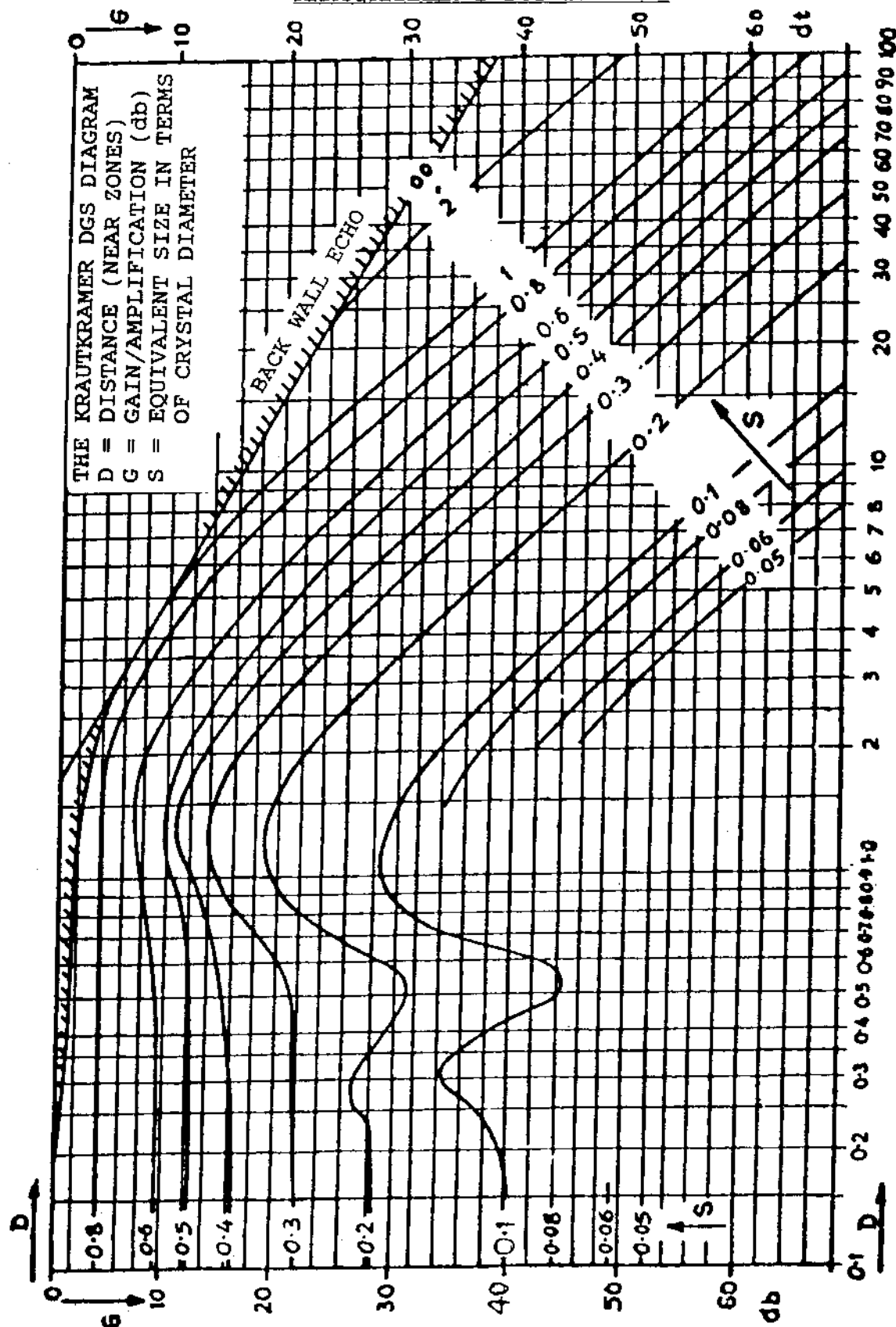
A step by step method of estimating flaw size using universal DGS diagram is given below:

- (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.

- (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





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AA 085 01 33

Rev. No. 03

PAGE 1 OF 7

PROCEDURE FOR MAGNETIC PARTICLE EXAMINATION

1.0 SCOPE:

- 1.1 This standard outlines the procedure for magnetic particle examination of ferro-magnetic materials.
- 1.2 Typical surface and subsurface discontinuities detectable by this method are cracks, seams, laps, cold shut, inclusions, etc.
- 1.3 This shall be applied to all forms of ferromagnetic material as formed and semiformal as well as, finished state, such as welds, forgings, castings, etc.
- 1.4 This standard is generally based on ASTM E 709.

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 TEST METHOD:

-
4

Finely divided magnetic particles are applied to the surface of a part which has been suitably magnetised. The particles are attracted to regions of magnetic non-uniformity associated with defects and discontinuities, thus producing indications which are observed visually. The magnetic particle is applied either as dry powder or in a wet suspension in a liquid medium.

4.0 SURFACE CONDITION/PREPARATION:

The surface being inspected shall be clean and dry. It shall be free from dirt, oil, grease, sand, rust or loose scale. As cast or as welded surfaces are generally satisfactory if clean. A pressure blast is useful for this purpose. Thin paint does not interfere with the formation of indications but must be removed at points where electrical contact is to be made. If the surface is unusually rough, such as with burned in sand or very rough weld bead, interpretation may be difficult because the particle is being trapped mechanically. In case of doubt, light grinding may be necessary to determine if actual indications are present..

Revisions:

Cl. 12.8.8 of MOM of WG-NDT

APPROVED:
INTERPLANT STANDARDIZATION
COMMITTEE (WG-TOOLS)

Rev. No. 02

Amd.No.

Reaffirmed

Prepared
HYDERABAD

Issued
Corp. R&D

Dt. of 1st Issue
Sept.'79

Dt: 15-12-97

Dt:

Year:



5 .0 SEQUENCE OF OPERATION:

5 .1 Method Of Examination:

Examination shall be generally carried out by the continuous method, i.e., the magnetising current remains on, while the examination medium is being applied and excess being removed.

5 .2 Magnetisation:

Any suitable and appropriate means for establishing the necessary magnetic flux may be employed, such as passing current through the material (e.g. 'Prod' method) using magnetic yoke, or wrapping the part with a coil through which a magnetising current is passed.

5 .3 Examination Medium:

5 .3 .1 The finely divided ferromagnetic particles used for detection of discontinuities shall be of fine grain and the same shall be of high permeability and low retentivity. It shall be of dry powders (Fluorescent and nonfluorescent) ready for use, as supplied or powder concentrates (Fluorescent and non-fluorescent) for dispersion in water or suspending light petroleum distillates.

5 .3 .2 Dry Particles:

When dry particles are used, they shall be sprayed either by a low pressure pneumatic instrument or hand operated bulb blower. Colour of the powder shall be such as to provide adequate visual contrast with the back ground of the surface being examined. The temperature of the surface of the part under examination shall not exceed 315°C (600°F). Adequate lighting should be provided for easy observation of the indication. Some coloured organic coatings applied to dry particles to improve contrast lose their colour at higher temperatures- Fluorescent dry particles shall not be used at this high temperature. Manufacturer's recommendations for temperature limitation shall be followed.

5 .3 .3 Wet Particles:

When wet particles are used, the solid magnetic particles shall be suspended in a suitable liquid medium. The concentration of the particles in the liquid medium shall be 0.2 to 0.4 ml in a 100ml sample for fluorescent particles and from 1.2 to 2.4 ml in a 100 ml for non-fluorescent particles unless otherwise specified by the particle manufacturer.

5 .3 .4 Florescent Particlaes

5 .4 .3 .1 The fluorescent particle examination shall be performed using a black light in a darkned area.



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AA 085 01 33

Rev. No. 02

PAGE 3 OF 7

- 5.3.4.2** The black light used for fluorescent particle testing shall be capable of developing the wave length of 365nm; in any case the wave length should be in the range of 330 to 390nm. with an intensity of not less than 1000 uw/cra² on t surface of the part.
- 5.3.4.3** The black light shall be allowed to warm up for a minimum of 5 min. prior to its use or measurement of the intensity of the ultraviolet light emission.
- 5.3.4.4** The examiner shall be in the darkened area for atleast 5 min. prior to examining the parts using black light so that his eyes will adopt to dark viewing. Photochromic or permanently tinted lenses shall not be worn during examination.
- 5.3.4.5** The black light intensity shall be measured with a black light meter at least once every 8 hours and whenever the work station is changed.
- 5.4** **Orientation of Discontinuities And Examination Coverage:**
Examination shall be conducted with sufficient overlap to ensure cent percent coverage at established test sensivity. To ensure most effective detection of discontinuities each area shall be examined at least twice with the lines of flux approximately perpendicular to each other.
- 5.5** **Demagnetisation:**
Demagnetisation following examination shall be carried out where residual magnetism can interfere with subsequent process or usage. Demagnetisation is not normally required on the type of parts where the dry powder Prod magnetisation is used.
- 6.0** **METHODS OF MAGNETISATION:**
- 6.1** **Prod Method:**
- 6.1.1** **Magnetising Technique:**
- 6.1.1.1** Magnetisation shall be accomplished by portable Prod type electrical contacts pressed against the surface in the area to be examined. To avoid arcing, a remote control switch may be provided to permit the current to be turned on after the prods have been properly positioned and turned off before they are removed.
- 6.1.2** **Prod Spacing:**
Prod Spacing shall be maximum of 200 mm. Shorter spacing may be used to meet the limitation of geometry or dimensions of the area being examined, or to increase the sensitivity, but prod spacing less than 75 mm usually is not recommended owing to banding of the particles around the prods



6.1.3 Magnetising Current:

Alternating, direct or rectified magnetising current shall be used. The current shall be 90 to 110 A per 25mm. of prod spacing for sections less than 19mm. thick and 110 to 125 A per 25mm. prod spacing for sections 19mm. and greater.'

- 6.1.4 Prod shall be kept free of iron pick up by frequent filing. Local areas of metal being tested which have been subjected to arcing shall be ground to clean metal wherever necessary.

6.2 Coil Method:

6.2.1 Magnetising Technique:

Magnetisation shall be accomplished by pressing current through a multiturn coil looped around the part or section of the part to be examined to produce a magnetic field parallel to the axis of the coil.

6.2.2 Magnetising Current:

6.2.2.1 Encircling Coils:

There are four empirical longitudinal magnetization formulas for using encircling coils, the formulas to be used depending on the fill factor.

- 6.2.2.1.1 **Low Fill Factor Coils:** In this case, the cross sectional area of the fixed encircling coil greatly exceeds the cross sectional area of the part (Less than 10% coil inside diameter). The part shall be placed well within the coils and close to the inside wall of the coil. For parts with length over diameter ratio (L/D) between 3 and 15 is calculated from the following equations.

- (1) Parts with low fill factor positioned close to the inside wall of the coil in the center of the coil;

$$= \frac{45,000}{L/D} \text{ Ampere Turns } (\pm 10\%)$$

- (2) Parts with a low fill factor positioned in the center of the coils:

$$= \frac{43,000 \times R}{(6 L/D) - 5} \text{ Ampere Turns } (\pm 10\%)$$



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6. 2. 2. 1.2 Intermediate Fill Factor Coils:

When the cross section of the coil is greater than twice and less than ten times the cross section of part being examined.

$$= (NI) hf (10-4) + (NI) lf (4-2)/8$$

Where

NIhf = Value calculated for high fill factor coils using

$$\frac{35000}{(L/D) + 2} \quad (10\%)$$

NIlf = Value Calculated for low fill factor coils using

$$\frac{43/000 \times R}{(L/D) - 5} \quad (10\%)$$

Where R = Coil Radius

Y = Ratio of the cross sectional area of the coil to the cross section of the part.

For example if the coil has an inside diameter of 24 cm. and part (a bar) has outside diameter of 12 cm.

$$Y = \frac{n(12)^2}{n(6)^2} = 4$$

$$n(6)^2$$

6. 2. 2. 1.3 High Fill Factor Coils:

In this case, when fixed coils or cable wraps used and the cross sectional area of the coil is less than twice the cross sectional area (Including hollow portions) of the part, the coil has a high fill factor.

For parts with in a high fill factor positional coil and for parts with L/D ratio equal or greater than 3.

$$= \frac{35,000}{(L/D)+2} \text{ Ampere turns (+ 10\%)}$$

L/D ratio for a hollow piece: When calculating L/D ratio for a hollow piece, D shall be replaced with an effective diameter Deff. Calculated using.

$$Deff. = [(At - Ah)/n]^{\frac{1}{2}}$$

Where

At = Total cross section area of part

Ah = Cross sectional area of hollow portion(s) of the part.

For a cylindrical piece this is equivalent to

$$Deff. = [(OD)^2 - (ID)^2]^{\frac{1}{2}}$$

Where

OD = Outside diameter of cylinder

ID = Inside diameter of cylinder.

**6.2.2.2 Through Coils:**

For through coils the current specified in para 6.3.2 divided by number of turns shall be used.

6.3 Direct Contact Method:**6.3.1 Magnetising Technique:**

Magnetising shall be accomplished by passing current end to end through the part to be tested to produce a circular magnetic field perpendicular to the current "flow through the part.

6.3.2 Magnetising Current :

Direct or rectified current shall be used at 280 to 360 amperes per centimeter of part for diameter upto 125 mm; 200 to 280 amperes per centimeter of part for diameter greater than 250mm.

(Note: A different means of magnetising shall be used for the second examination to fulfill the requirements specified in Cl.5.4).

6.4 Yoke Method:**6.4.1 Application:**

This method shall be used only to detect surface discontinuities which actually come to the surface.

6.4.2 Magnetising Technique:

6.4.2.1 Alternating current electromagnetic yoke shall be used to magnetise, provided the yoke has a lifting power of at least 4.5 Kg and a pole spacing of 75 to 150 mm.

6.4.2.2 Alternatively direct current electromagnetic or permanent magnetic yoke shall be used to magnetise, provided the yoke has a lifting power of at least 18 kg and a pole spacing of 75 to 150 mm.

6.5 Threading Bar and Coil Technique:

6.5.1 If the part is hollow, flaws in a longitudinal direction may be detected by passing the magnetising current through a bar or cable held within the bore of the part. Alternatively a threading coil may be used.

6.5.2 The current strength shall be equivalent to not less than 10500 ampere turns (a.c; r.m.s value) or 15000 ampere turns (d.c.) per metre of the maximum distance of the bar cable from the surface of the bore of the part.



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- 6.5.3 Because of limitations of the equipment, it may be necessary to magnetise the part at several positions within the bore, with the bar or cable lying on the bore surface, in which case the distance between spacing of the conductor or coil for successive checks shall not be greater than 100 mm.

Note: Magnetising particle field indicator shall be used to establish adequacy of the magnetic field.

7.0 CALIBRATION:

Calibration of the ammeter shall be done as per BHEL Standard AA 085 01 59.

8.0 EVALUATION OF INDICATIONS & INTERPRETATION:

- 8.1 If the indication is caused by the surface discontinuity the particles are usually tightly held to the surface by a relatively strong magnetic leakage field. The line of particles will be sharp and well defined.
- 8.2 If the indication is caused by surface discontinuity, the particles are held in a broad fuzzy accumulation rather than being sharp and well-defined.
- 8.3 Non-relevant indications are caused by distortion of magnetic field resulting from magnetic writing, cold working, hard and soft spots, boundaries of heat affected zone, abrupt change of section, etc. Care shall be taken to identify and eliminate them as they may mask the actual defect.
- 8.4 Relevant indications are those which result from mechanical discontinuities. Linear indications are those in which the length is more than three times the width. Rounded indications are indications in which are circular or* elliptical with the length less than three times the width.

9.0 REFERRED STANDARDS (Latest Publication Including Amendments):

1. ASTM E 70

2. BHEL CS AA 085 01 59



ACCEPTANCE STANDARDS FOR INDICATIONS REVEALED DURING MAGNETIC PARTICLE EXAMINATION OF STEEL FORGINGS

1.0 SCOPE:

This standard gives the acceptance norms for indications revealed during the magnetic particle inspection of steel forgings used for general applications.

2.0 PROCEDURE:

The procedure, requirement of equipment, consumables and personnel shall be as per BHEL standard AA 085 01 33 which is generally based on ASTM E 709.

3.0 ACCEPTANCE NORMS:

Following defects are unacceptable.

Category I:

- i) Any cracks/linear indication.
- ii) Rounded indication larger than 3mm size.
- iii) Groups of rounded indications with individual size of 3mm or less and separated by a distance of less than 2 times the largest defect.

Category II:

- i) Any cracks/linear indication.
- ii) Rounded indication larger than 6mm size.
- iii) Groups of rounded indications with individual size of 6mm or less and separated by a distance of less than 2 times the largest defect.

4.0 REFERRED STANDARDS(Latest Publications Including Amendments):

1. BHEL CS AA 085 01 33

2. ASTM E 709

Revision:			Approved: INTERPLANT STANDARDIZATION COMMITTEE-WG (WG-NDT)		
Rev.No.	Amd.No.	Reaffirmed	Prepared SSTP TRICHY	Issued CORP. R&D	Dt. of 1st issue 1-12-96
Dt.	Dt.	Year:			



CORPORATE PURCHASE SPECIFICATION

AA 193 32

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CARBON STEEL FORGINGS, CLASS-3

↑

1.0 GENERAL:

This specification governs the quality requirements of Carbon Steel Forgings, class 3.

↑

2.0 APPLICATION:

Suitable for general engineering purposes.

3.0 CONDITION OF DELIVERY:

Normalised/Normalised and tempered.

Rough machining of the forgings shall be carried out, unless otherwise specified in the BHEL order/drawing.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The forgings shall comply, in general with the requirement of the following National standards and also meet the requirements of this specification.

IS::2004: 1991 (RA-2006) } Carbon Steel Forgings For General Engineering
Gr: 3 (30C8), } Purposes.

↑

5.0 DIMENSIONS AND TOLERANCES:

The dimensions and tolerances shall be as specified in the order/ drawing. Wherever these are not specified, specified, the machining allowances and tolerances shall be as specified below:

For finish machined drawings : 3 ± 1 mm

For rough machined drawings : ± 1 mm

Revisions : 36th MOM OF MRC FCF+HTM

APPROVED :
INTERPLANT MATERIAL RATIONALISATION
COMMITTEE-MRC (FC&F+HTM)

Rev. No. 10

Amd.No.

Reaffirmed

Prepared

Issued

Dt. of 1st Issue

Dt. 23.01.2007

Dt :

Year:04-11-2011

HARDWAR

Corp. R&D

JANUARY 1978

**6.0 MANUFACTURE:**

Forgings shall be manufactured from steel produced by the open hearth, electric or such other [↑] process as may be agreed to between BHEL and the manufacturer.

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. The forgings shall not be overheated.

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

For sizes above 250 mm ruling section, the minimum reduction ratio shall be 3.5:1

Note: Raw material like Ingots/Blooms/Billets required for forgings should be procured from BHEL approved sources along with test certificate."

7.0 HEAT TREATMENT:

Forgings shall be normalised / normalised and tempered at suitable temperature to achieve [↑] the mechanical properties specified.

Test pieces shall also be heat treated along with the forgings they represent.

8.0 FINISH:

As mentioned in the drawing.

9.0 FREEDOM FROM DEFECTS:

The forging shall be free from defects, such as cracks, fold, flakes, seams, segregation, nonmetallic inclusions and other defects which may affect the utility of the forging.

10.0 CHEMICAL COMPOSITION:

The melt analysis of steel and permissible variation in the composition of the forgings from the melt analysis shall be as follows:

Element	Melt analysis, percent		Permissible variation, percent
	Min.	Max.	
Carbon	0.25	0.35	± 0.03
Silicon	0.15	0.35	± 0.03
Manganese	0.60	0.90	± 0.04
Sulphur	---	0.040	+ 0.005
Phosphorus	---	0.040	+ 0.005



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Notes:

1. Elements not quoted above shall not be added to the steel, other than for the purpose of finishing the heat and shall not exceed the following limits:

Element	Percent, max.
Nickel	0.30
Chromium	0.30
Copper	0.25
Molybdenum	0.15
Vanadium	0.05
Tin	0.05
Boron	0.0003

2. When steel is aluminium killed or killed with both aluminium and silicon, the requirements of minimum silicon content shall not apply. For aluminium killed steel the total aluminium content shall be within 0.02 to 0.05 percent.
3. $Mo \leq 0.15\%$, limiting to meeting conditions of $Cr + Mo + Ni = 0.5\%$.

11.0 TEST SAMPLES:

- 11.1 Unless otherwise specified in the order/drawing, test samples shall be taken from each melt and each heat treatment batch. Test samples should be cut from the heat treated forgings by cold process only and shall not have further heat treatment.

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

The samples shall be cylindrical or rectangular in shape and cut at a distance of 12.5mm below the heat treated surface.

- 11.2 When integral test pieces are not called for, a test sample, having similar reduction ratio and heat treatment, as the forgings it represents, shall be provided per heat, per heat treatment batch, for check testing at BHEL, along with the forgings. The samples shall be properly identified and correlated with the Heat/Heat treatment Batch No./ Test Certificate No. Test samples shall be taken, at a distance of 12.5mm below the heat-treated surface.
- 11.3 Test samples shall generally be taken in the longitudinal direction. However, for economic reasons or where the size/ configuration does not permit the same, test samples may be taken in the transverse or radial direction.

12.0 MECHANICAL PROPERTIES:

The test pieces, after being heat treated as per clause 7.0 above, shall show the following properties upto a limiting ruling section of 800 mm. Properties for thicker sections shall be subject to agreement between BHEL and the manufacturer. Test methods are specified below:

- 12.1 Tensile test : IS:1608
- 12.2 Hardness test (Brinell) : IS:1500
- 12.3 Charpy Impact Value (2mm U-Notch) : IS:1499

This test applicable for forgings of sizes above 16mm only.

Property	Sample (See Cl.11.3)	Limiting ruling section, mm			
		Upto & incl 100	>100 & upto 300	> 300 & upto 500	>500 & upto 800
Tensile strength N/mm ²	Longitudinal/	490	470	450	450
	Transverse/ Radial/Tangential	490	470	450	450
Yield strength min, N/mm ²	Longitudinal/	270	245	230	220
	Transverse/ Radial/Tangential				
Elongation on 5.65 $\sqrt{S_0}$ gauge length percent, min	Longitudinal	21	19	18	17
	Transverse	10	9	8	7
	Radial	14	12	11	10
	Tangential	16	14	13	12
Reduction in area, percent min.	Longitudinal	42	40	35	32
	Transverse	25	24	22	20
	Radial	27	26	24	22
	Tangential	34	32	32	30
*Hardness, Brinell, HB	—	140-192	140-192	135-190	135-190
Charpy Impact Value (2mm, U-Notch) min., Joules	Longitudinal	35	31	27	23
	Transverse	18	16	14	12
	Radial	21	19	17	15
	Tangential	26	23	20	17

Note: 1. Unless otherwise stated on the order/drawing, small forgings of non-critical nature weighing less than 300kg shall be accepted on the basis of chemical composition and hardness.

* 2. Hardness test can be conducted only, when tensile test can not be performed.



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13.0 ULTRASONIC TESTS:



- 13.1 For forgings ordered by BHEL, Hyderabad: Unless other wise specified on the drawing, ultrasonic test shall be carried out as per BHEL standard AA 085 01 18 and norms of acceptance shall be as per category 2.
- 13.13.2 For forgings ordered by other units: If specified on the drawing/order, ultrasonic test shall be carried out as per BHEL standard AA 085 01 18 and norms of acceptance shall be as per category 2, unless otherwise specified.

14.0 ADDITIONAL TESTS:

If specified in the drawing/order, the following tests shall be conducted:

14.1 Bend Test (Longitudinal):

The test pieces (230mm long and 32 mm square with edges rounded off, where the dimensions permit) shall be capable of being bent cold by direct pressure without fracture, until the sides are parallel, round a mandrel having a diameter of 44 mm when tested as per IS:1599.

14.2 Magnetic particle test.

14.3 Any other tests: Norms of acceptance shall be as specified in the drawing/order.

15.0 SCOPE OF THIRD PARTY INSPECTION:

Wherever, separate quality plan is not attached, the scope of third party inspection shall be as follows:

1. Review of supplier's declared chemical composition.
2. Selection of test samples for mechanical tests and witness of mechanical tests.
3. Witness of Non-destructive tests as applicable.
4. Review of HT charts.
5. Dimensional inspection.

16.0 TEST CERTIFICATE:

Three copies of test certificates shall be supplied unless otherwise stated in the order, preferably in the 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 documents to facilitate quick clearance of the material.

The following details shall be furnished in the test certificate:

- i) Reduction ratio
- ii) Dimensional Inspection.
- iii) Chemical composition including trace elements.
- iv) Results of mechanical tests.
- v) Results of Ultrasonic test
- vi) Details of heat treatment
- vii) Results of additional tests called for in the drawing/order.

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17.0 PACKING & MARKING:

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

Machined surfaces shall be properly protected with anticorrosive compounds.

Each package or forging (when supplied separately) shall be legibly marked with the following information:

AA 193 32 : Carbon Steel Forgings, Class 3 ↑

BHEL Order No.

Suppliers Name

Consignment/ Identification No.

Batch No.

Weight.

18.0 REFERRED STANDARDS (Latest publications Including Amendments):

1) AA 085 01 18	2) IS:1499	3) IS:1500	4) IS:1599
5) IS: 1608	6) 2004		



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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. Deoxidisation Process:							13. Test Bar Size & Nos.						
6. Forging Method:							14. Supplier of the ingot/billet/ Bloom and TC reference.						
7. BHEL's Reference for Approval of Bloom													
8. 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 Chart, Whenever called for)													
Condition		Heating Rate, °C/hr.		Temp. °C		Soaking Time, Hrs.		Cooling Rate, °C/hr		Cooling Medium			
18. MECHANICAL PROPERTIES													
		T.S. N/mm ²	Y.S. 0.5/0.2% Proof N/mm ²	% Elongation 5.65√So GL	%R.A. Min.	Hardness BHN (Min.3 values)	Impact Value Joules	Bend Test					
								Angle of bend	Dia of mandrel	Result			
As Per Specn.		Min.											
		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:						
INSTRUCTIONS													
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.													

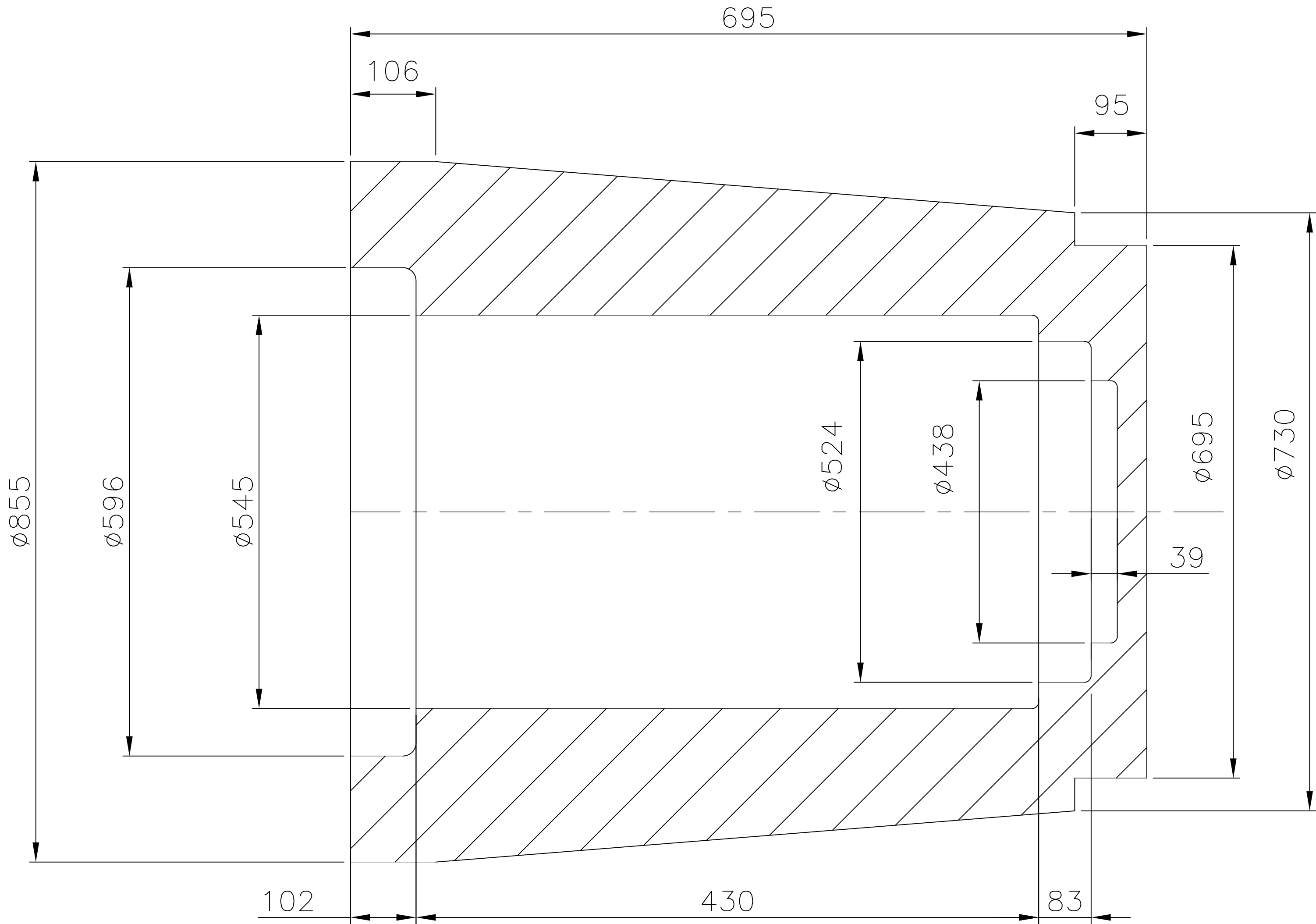
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

HY-312.A.02.F
FILE NAME

HERP MADE DRG
LOCATION:

INVENTORY NO.	REV.	DATE	ALTERED		REV.	DATE	ALTERED	
	ZONE		CHD.	APPD.	ZONE		CHD.	APPD.

DRG.NO. HY-312.A.02.F



NOTES:-

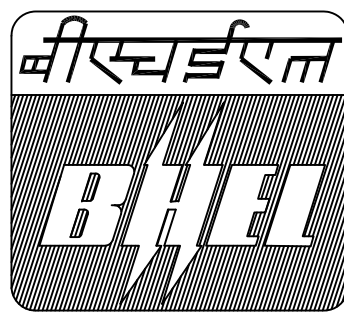
1. FORGING SHOULD BE AS PER SPECN. AA19332
2. CHAMFER SHARP CORNERS TO R2 & FILLET RADIUS TO R3
3. TOLERANCE ON DIAMETER AND LENGTH ± 1 mm
4. TEST ULTRASONICALLY AS PER SPEC AA 0850118 CAT2

01	FORGING					1475	
					AA19332	1	
ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT XRP-1003 MILL KORBA & RAMAGUNDEM



BHARAT HEAVY ELECTRICALS LTD.
VARANASI

DEPT. PULV ENGG.		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS	
CODE 446		1:4	1475	16100000375	/	/	
TITLE L.J.HOUSING R/MCD FORGING				DRAWING NO. HY-312.A.02.F		REV. 00	
				SHEET NO. 01			NO OF SHEETS 01



**PLANT PURCHASING
SPECIFICATION
HYDERABAD**

HY193 69

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**ALLOY STEEL FORGINGS –H &T
GRADE : 40 Ni Cr Mo 65**

1.0 GENERAL:

This specification governs the quality requirements of alloy steel forgings of grade 40 Ni Cr Mo 65.

2.0 APPLICATION:

Forgings are suitable for main vertical shaft and general engineering purposes requiring high tensile strength and good ductility.

3.0 CONDITION OF DELIVERY:

The forgings shall be supplied in hardened & tempered condition. Final stress relieving shall be performed if mentioned in the drawing. Forgings shall be rough machined unless otherwise specified.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The forgings shall in general comply with the requirements of BS PD – 970: 2001, Gr. 817 M40.

5.0 DIMENSIONS AND TOLERANCES:

The dimensions shall be as per the ordering drawing and tolerances shall be as follows.

- a) For finish machined component drawings the extra allowance of 3 mm/ surface shall be provided for finish machining at BHEL.
- b) For rough machined forging drawings necessary finish machining allowance is included in the dimensions. Extra allowance is not required.
- c) The tolerance on rough machined surface shall be ± 1 mm dimension, unless otherwise specified in the drawing.

Revisions:

Cl. 13.1 is modified.

Issued :

**STANDARDS ENGINEERING
DEPARTMENT**

Rev. No

Rev. Date:

Revised:

Prepared:

Approved:

Date:

04

12.10.2004

Matls Engg.

Matls Engg.

AGM(Engg)

May, 1983.

6.0 MANUFACTURE:

The method of steel manufacture shall be at the discretion of the supplier. However, mixed air open hearth & bessemer processes are not permitted.

The steel shall be fully killed. Sufficient discard shall be made from the ingot, if used as forging stock, to ensure freedom from piping, segregation and other defects.

The amount of hot working shall be sufficient to ensure uniform working throughout the cross-section.

Reduction ratio shall be minimum 4:1 for ingots and 1.5:1 for rolled /forged stock.

7.0 HEAT TREATMENT:

The forgings shall be heat-treated to attain the mechanical properties specified.

The recommended heat-treatment shall be as given below. Hardening in oil at a temperature of 820-850°C. Tempering at the temperature upto 700°C max.

However tempering between 280-500°C shall be avoided as it leads to temper embrittlement.

8.0 FINISH:

Surface finish of the forgings shall be 6.3 microns (r.m.s) to carryout ultrasonic test.

9.0 FREEDOM FROM DEFECTS:

Forgings shall be free-from cracks, flakes, seams segregation and other defects which may affect the utility of the forgings.

10.0 CHEMICAL COMPOSITION:

The melt analysis of the steel shall be as follows:

Element		C	Si	Mn	Ni	Cr	Mo	S	P
Melt Analysis	% Min.	0.36	0.10	0.45	1.30	1.00	0.20	-	-
	% Max.	0.44	0.40	0.70	1.70	1.40	0.35	0.040	0.030
Permissible variation in product Analysis		±0.02	±0.03	±0.03	±0.05	+0.05 -0.04	±0.02	+0.003	+0.003

11.0 TEST SAMPLES:

11.1 Test coupons shall be taken from each melt and each heat treatment batch/size unless integral test coupons are called for in the drawing/purchase order.



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SPECIFICATION
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The test coupons shall be heat treated along with the forgings. In case of integral test coupons, the test pieces shall be cut from the forgings only after heat treatment. However the remaining integral test coupon after at supplier's end shall be kept integral with the forging and sent to BHEL.

Sufficient test material shall be sent to BHEL for cross-check where necessary.

11.2 Test samples shall be cut at as given unless other wise specified in the ordering drawing.

- a) For Solid forgings: Distance of 1/3 radius or 1/6 diagonal from the outer surface.
- b) For hollow forgings: Midway between the inner and outer surface of the wall thickness.

12.0 MECHANICAL PROPERTIES:

The test pieces shall have the following mechanical properties.

Ruling section min	Tensile Strength N/mm ² Min	0.2% proof Strength N/mm ² Min	% Elongation (L=5d) Min		Charpy Impact Strength (ISO-V) J, min	
			L	T	L	T
150	850-1000	680	13	10	50	37
>150-250	850-1000	650	13	10	35	26
>250-450	775-925	585	11	8	20	15

NOTE: a) Mechanical tests shall be performed preferably on tangential test samples. If the forging configuration does not allow for taking tangential test samples, longitudinal ones shall be used. L&T in the above table indicate values for longitudinal and transverse samples.

- b) Tensile test shall be performed as per IS :1608 or any reputed National Standard.
- c) The charpy impact test shall be performed on a 2mm ISO V-Notch, as per IS:1757 or any reputed National Standard.

The impact values indicated above are average of 3 values. All the 3 values shall be reported. Only one value can be lower than the minimum specified value but not less than 2/3 of the same.

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13.0 NON-DESTRUCTIVE TESTS:

The following test shall be conducted on the forgings.

13.1 Ultrasonic test: Shall be performed as per AA0850118 with both longitudinal and shear waves and following shall be unacceptable defects, unless otherwise specified in the drawing.

- i) Cracks, flaks, seams and laps
- ii) Defects giving indications larger than that from a 4mm diameter equivalent flaw.
- iii) Groups of defects with maximum indication less than that from a 4mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%.
- iv) Defects giving indication of 2 to 4mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws.

13.2 Magnetic particle test: MPI shall be conducted as per ASTM-A275:

Cracks and laps are not acceptable.

14.0 RETESTS:

If any of the selected test specimens fail to meet the specified requirement due to some mechanical reasons, another specimen may be taken for testing.

In the event of failure due to material heat-treatment, two more reheat-treatments shall be permitted. However, retempering is not considered as reheat-treatment.

15.0 INSPECTION AT SUPPLIER'S WORKS:

BHEL representative shall have free entry & access to all the areas of the where the manufacture of the forgings is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

BHEL representative shall be given sufficient advance intimation shall be given to the representative to witness the various process, tests etc. Punching & Identification of test coupons & forging and execution of various tests shall be done in the presence of BHEL representative.

16.0 TEST CERTIFICATE:

16.1 The supplier shall furnish three copies of the test certificate (English) with containing the following details.



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HY 19369

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1. HY 19369 Rev.04
2. BHEL Order No.
3. Item Description
4. Drawing No.
5. Supplier's Name.
6. Melt No.
7. Serial No. of the forging.
8. Heat treatment Details
9. Result of all test stipulated in this specification.

16.2 The test certificate shall be attested by the chief of Inspection /Chief Metallurgist of the Supplier and also by BHEL representative.

17.0 MARKING AND PACKING:

17.1 The following details shall be punched clearly on each forging and the same shall be encircled by paint:

- 1) HY 19369 Rev.04
- 2) BHEL Order No.
- 3) Melt No.
- 4) Serial No. of the forging
- 5) Drawing No.
- 6) BHEL Inspector's stamp
- 7) Supplier's Name.

The forgings shall be suitably packed to prevent damage and corrosion during transit. In the case of overseas supplies, the packing shall be seaworthy.

18.0 REJECTION AND REPLACEMENT:

In the event of the forging proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance.

The supplier shall replace the rejected forgings at his own cost, and the rejected forgings shall be returned after all the commercial conditions are satisfied.



BHEL-HERP, VARANASI
QUALITY PLAN

AA-19332

Rough Machined Forging

Sl.No.	Component/ Operation	Characteristic Checked	Type/Method of Check	Extent of Check	Reference Documents	Acceptance Norm	Format of Record	Agency			Remarks	
								P	W	V		
1	Ingot/Billet/Blooms	i. Material Identification ii. Composition	Visual i. Chemical Analysis	100% 1 Sample per melt	--- AA19332	--- AA19332	I.R. T.C.	3 3	- -	- 2	Review of Mill TC	
2	Forging	i. Heat Treatment ii. Test Piece Marking (Integral Test Piece) iii. (a) Mechanical Properties (b) Composition	H.T.Chart Transfer of Marking Mechanical Test on identified test piece Chemical Analysis	1 Sample per H.T.batch -do- -do- -do-	AA19332 --- AA19332 -do-	AA19332 --- AA19332 -do-	HT Chart Q.C.Record T.C. -do-	3 3 3 3	- 2 2 -	- - - 2		
3	In Process (After Rough Machining)	i. Dimensions ii. Soundness of Forging after skin cut	Measurement Ultrasonic Testing	100% 100% (Refer Remark)	Drawing Tech.Spec. AA0850118	Drawing Tech.Spec. AA0850118	D.R. U.T.Report	3 3/2	- 2	- -		100% UT as per Cat.2 to be witnessed for Critical forging like UJ Housing, LJ Housing, Journal Shaft and Trunnion shaft. In case of Shafts, UST to be carried out before Centre thru hole drilling. Rest of the other forging, random 10% UT as per Cat.2 to be witnessed by BHEL representative.
		iii. Surface / Sub surface cracks	M.P.I.	100% (Refer Remark)	Tech.Spec. AA0850133	AA0850136 CAT-II	I.R.	3/2	2	-		
4	Final Inspection	i. Cleanliness ii. Identification & Marking iii. Prevention (from rust)	Visual Punching Heat No. Inspector Seal Visual	100% 100% 100%	--- --- ---	--- --- ---	I.R. I.R. I.R.	3 3 3	2 2 2	- - -	100% MPI to be witnessed for Critical forging like UJ Housing, LJ Housing, Journal Shaft and Trunnion shaft. Rest of the other forging, random 10% MPI to be witnessed by BHEL representative.	
Q.P.No.	RV/C&F/21 Rev.10	Approved by	PK Prajapati	Approved by	SK Tiwari	Legend P=Perform W=Witness V=Verify 3=Vendor/Supplier						TC=Test Certificate HT=Heat Treatment DR=Dimension Report IR=Inspection Report
Date	06-04-2019	Signature & Date		Signature & Date								
Page No.	1 of 1											

प्रदीप कुमार प्रजापति / P.K. Prajapati
उप० प्रबंधक (अ० एवं वि०) / Dy. Manager (E&M)
भारत हेवी इलेक्ट्रिकल्स लि० / BHEL-HERP
तरना, शिवपुर, वाराणसी / Tarna, Shivpur, Varanasi

Rev-08 BHEL approved sources and Review of Mill TC added for Ingot/Billet/Blooms
Rev-09 clause for UST test of Shaft to be done before centre thru hole drilling added
Rev-10 BHEL approved sources for Ingot/Billet/Blooms deleted and remark of UT and MPI modified.