FIRST ANGLE PROJECTION

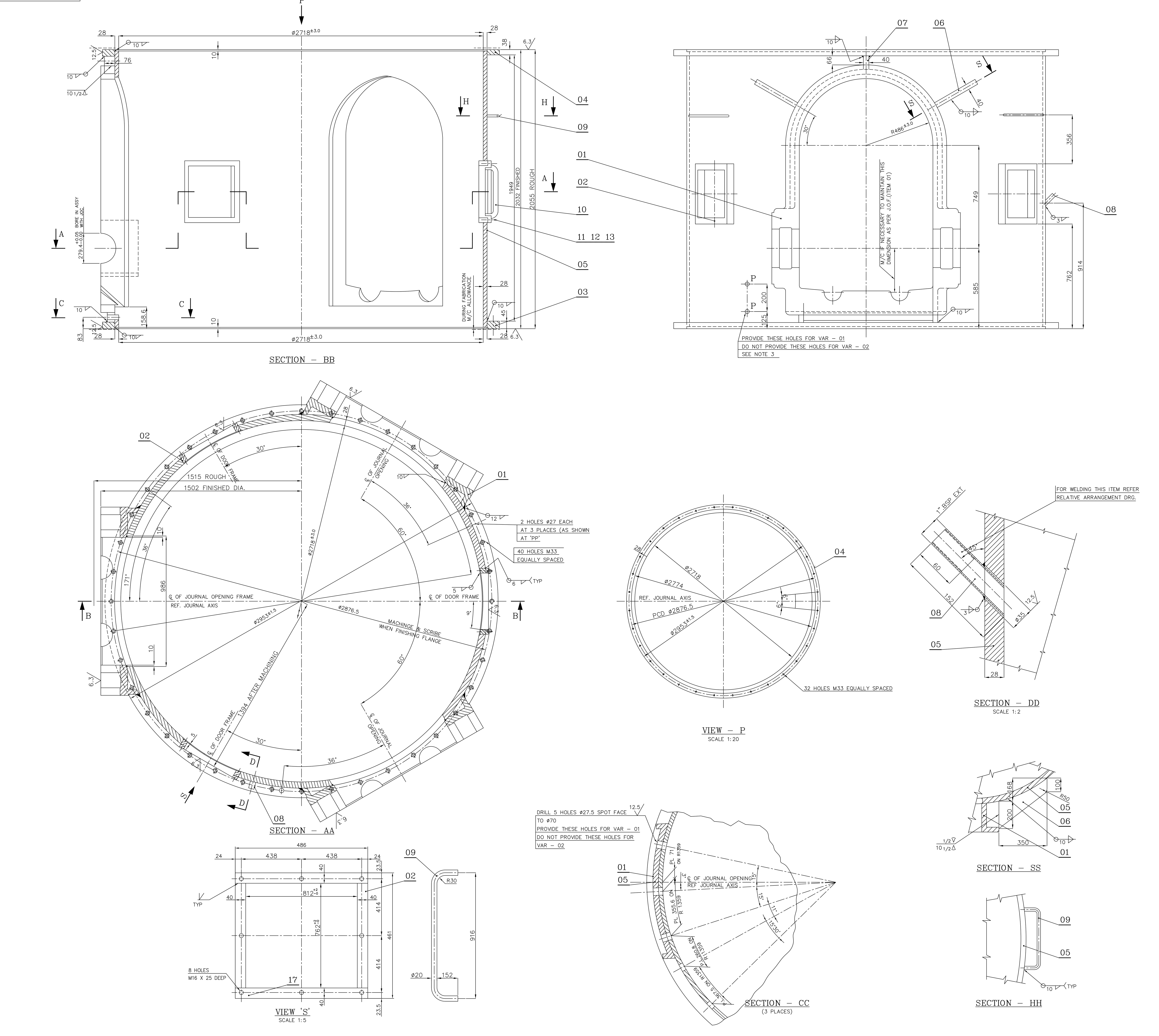
(ALL DIMENSIONS ARE IN mm)

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME 06100016.DWG /652

WPS: WE001

12.5 / 6.3



NOTE :- 1
ADDITIONAL ITEMS REQD. FOR FINISH MACHINING :-

DESCRIPTION	No. OF Pcs./MILL
JRNL. OPENING COVER	3
HT. HEX. SCREW	24.
HT. HEX. SCREW	63.

NOTE :- 2
ITEM NO. 16 IS TO BE FIXED WITH ITEM NO.18 AT A SUITABLE PLACE.

NOTE :- 3
VARIANT – 01 IS FOR WITHOUT VANE WHEEL ASSY
VARIANT – 02 IS FOR WITH VANE WHEEL ASSY.
(HOLES 'PP', AND HOLES IN SECTION CC NOT REQD.)

NOTE :- 4
A. REFER PLANT STD. HY0640763 FOR STRESS RELIEVING.
C. PART No. 3 & 4 TO BE MACHINED AFTER WELDING WITH PART No. 5.
E. ROLLING TOLERANCES TO BE WITHIN 3 MM ONLY ON DIAMETER.
F. REMOVE SHARP EDGES AND CORNERS WHEREEVER REQUIRED.

BILL OF METERIAL

VARIANT NO.	ITEM NO.	DESCRIPTION	DRAWING NO.	ITEM NO. / VAR NO.	MATL. CODE / MATL. SPEC.	A/C	UNIT / D1	UNIT WT / QTY	GS	ZONE
	18	HAMMER DRIVE SCREW			AA7126938020 / AA7126938			0.01 / 4		
	17	PLATE	4-61-280-02262		AA1011819198 / AA10119			8.50 / 6		
	16	COMPANY MONO GRAM PLATE			AA7250101021 / AA7250101			0.12 / 1		
	15	RESERVED								
	14	RESERVED								
	13	PACKING	4-61-376-00109		BA9845414079 / AA21503			0.14 / 3		
	12	HANDLE NUT	4-61-376-00108					0.22 / 24		
	11	STUD M16 x 80			HY7145101653			0.08 / 24		
	10	SEP.ACESS DOOR	3-61-376-00060		BA9110309004 / AA19703			43.00 / 3		
	09	HANDLE	4-61-376-00133		HY1010299107 / HY10199			1.50 / 3		
	08	TUBE	4-61-376-00106		AA1011052555 / AA10152			0.30 / 1		
	07	PLATE 40x66x76			AA1011819198 / AA10119			1.70 / 3		
	06	PLATE 40x350x1135	3-61-380-02349		AA1011819198 / AA10119			125.00 / 1		
	05	PLATE 28x2012x8626			AA1011819163 / AA10119			3190.00 / 1		
	04	FLANGE	3-61-376-00087		AA1011819210 / AA10119			241.00 / 1		
	03	FLANGE	3-61-276-00040		AA1011819228 / AA10119			357.00 / 1		
	02	PLATE 40 X 65 X 381			AA1011819198 / AA10119			7.20 / 6		
	01	JOURNAL OPENING FRAME	1-61-376-00015		AA19511			562.00 / 3		

REV.	DATE	ZONE	ALTERED	CHECKED	APPROVED	DESCRIPTION
19	021299		N.D.S.	S.GHATGE	K.M.RAO	IN SEC-CC SEPARATOR LINER BRACKET BRACKET FIXING HOLES SHIFTED BY 3°(PL 71 ON R1359) WITH REFERENCE TO CENTER LINE OF JOF.
18	071298		N.D.S.	S.GHATGE	K.M.RAO	8 HOLES M16X25 DEEP WAS 8XWELD STUD, MAT CODE WAS BA9617684055.
17	3.6.98	B3	N.D.S.	S.GHATGE	K.M.RAO	ITEM NOS. 02 & 17 WERE SEP DOOR FRAME & RESERVED RESP'LY. DIMS 486,461,40,24&23.5 WERE 482,457,38,22&21.5 RSPLY.
17	3.6.98		N.D.S	S.GHATGE	K.M.RAO	VIEW S CORRECTED. DRAWING REPLOTTED INCLUDING ALL PREVIOUS REVISIONS.

ADDITIONAL INFORMATION
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE
DRN.	acs		
CHD.	N.D.S	[signature]	3.6.98
APPD.	S.G	[signature]	3.6.98

NO.OF VAR. –N.A.–

DEPT. PULV ENGG CODE. 446 | UNTOL. DIMS. GR. C/M/K | SCALE 1:10 1:20 1:5 | WEIGHT (KG) 5844 | REF. TO OLD. DRG. 0-78-130/2 | ITEM NO. –N.A.– | NO.OF ITEMS –N.A.–

TITLE
SEPARATOR BODY ASSY

CARD CODE N.A.
DRAWING NO. 0-61-376-00016
REV. 19
SHT. No 01 NO. OF SHT. 01

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

POORNIMA

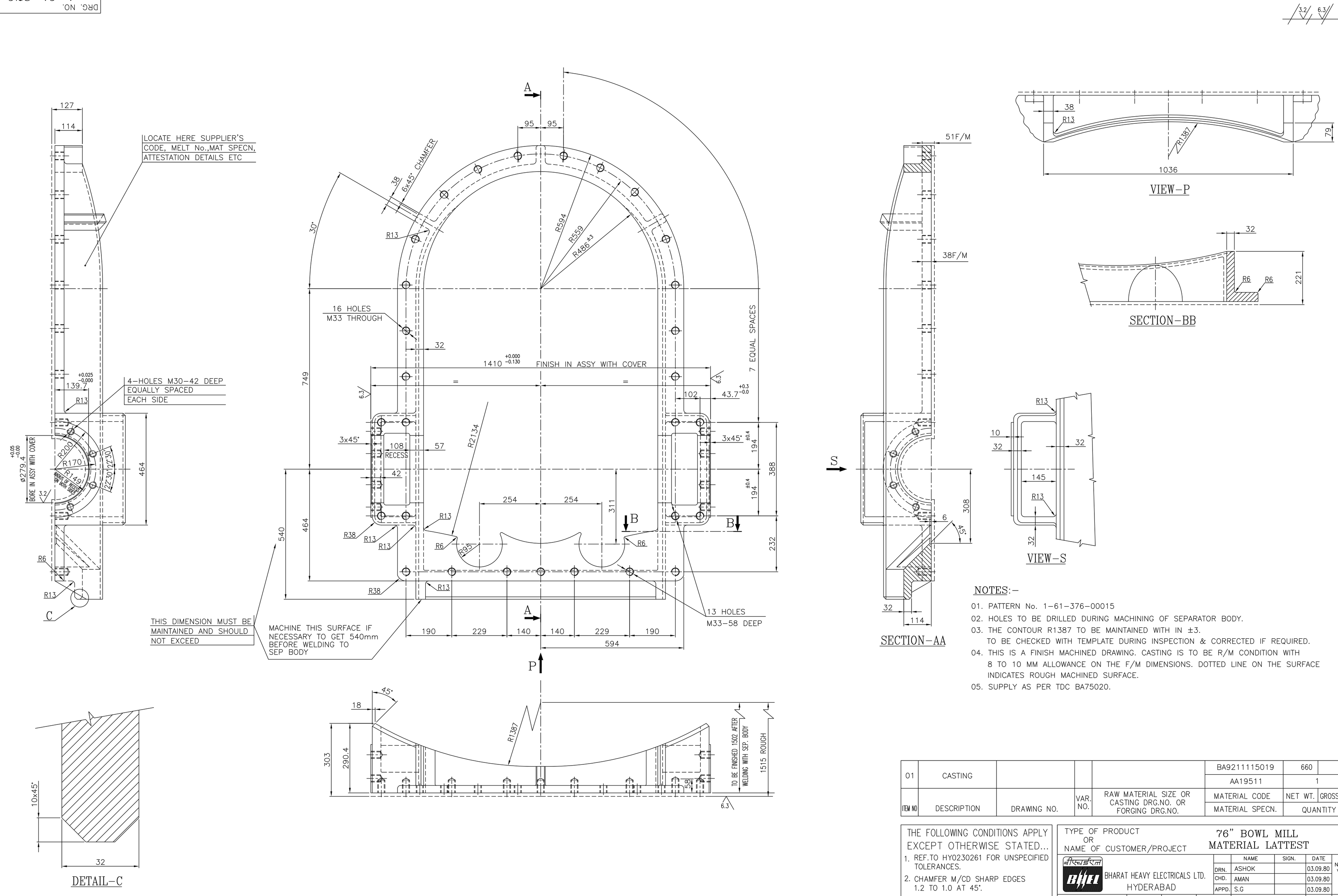
DRG. NO. 1-61-376-00015

COMPUTER FILE NAME : 16100015.DWG

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO.



NOTES:-

01. PATTERN No. 1-61-376-00015
02. HOLES TO BE DRILLED DURING MACHINING OF SEPARATOR BODY.
03. THE CONTOUR R1387 TO BE MAINTAINED WITH IN ±3.
    TO BE CHECKED WITH TEMPLATE DURING INSPECTION & CORRECTED IF REQUIRED.
04. THIS IS A FINISH MACHINED DRAWING. CASTING IS TO BE R/M CONDITION WITH 8 TO 10 MM ALLOWANCE ON THE F/M DIMENSIONS. DOTTED LINE ON THE SURFACE INDICATES ROUGH MACHINED SURFACE.
05. SUPPLY AS PER TDC BA75020.

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	
01	CASTING				BA9211115019	660	
					AA19511	1	

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 LATTEST

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	ASHOK		03.09.80	NA
CHD.	AMAN		03.09.80	
APPD.	S.G		03.09.80	

DEPT.	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
PULV. ENGG	1:7	660			
CODE 4460					

TITLE: JOURNAL OPENING FRAME

DRAWING NO. 1-61-376-00015 REV. 07

SHEET NO. 01 NO OF SHEETS 01

REV.	DATE	ALTERED	CHECKED	APPD.	ZONE
07	15/10/07	DOTTED LINE FOR R/M CASTING , NOTE 3,4,&5 ADDED. DIMS 51, 221, 303 & 127 ADDED. NOTE 2 MODIFIED.			
06	14.05.05	DRAWING REDRAWN ON ACAD AND INCORPORATED ALL PREVIOUS REVISIONS			

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-61-376-00023

COMPUTER FILE NAME 16100023

INVENTORY NO | SIGN. AND DATE | REF. DRG. NO.

CLEAN UP 55 mm WIDE PATH TO PROVIDE UNIFORM FLAT SURFACE FOR DEFLECTOR SHAFT BEARING HOUSING. 6.3

01

02

03

12.5

55

R1147

6.3

+3.00
ø1575 -0.00

+2.6
ø1461 -0.0

ø2953 +1

5

F

12.5

C

32

240

NOTE TO FABRICATOR
PUNCH MARK ON PERIPHERY FOR REF.LINE BY MARKING AT DIST240 FROM SURFACE.Y

NOTE TO MACHINESHOP
DIAL THE PUNCH MARKS FOR LEVELLING BEFORE MACHINING

Y

6.3

MACHINE UPTO DIA 2810

12.5

38 FINISHED

50ROUGH

315

SECTION-AA

28-HOLES TO BE DRILLED TO SUIT WITH INNER CONE (DRUM SECTION) DRG.nO. 2-61-376-0038 (REFER SECTION DD)

SPACING DIMENSION MUST BE WITHIN ±0.13mm.

14 - STUDS M16 X 30 TO BE WELDED WITH ITEM NO-2 AS SHOWN IN DETAIL-C INNER SIDE

28-STUDS M16 X 30 TO BE WELDED WITH ITEM No2 AS SHOWN IN DETAIL-C INNER SIDE.

32- HOLES ø36 12.5 TO BE DRILLED TO SUIT WITH SEP. BODY. (DRG. No.0-61-376-00016)

D

A

22°30'

MACHINE SCRIBE CENTRE LINE OF BOLT HOLES DURING MACHINING OF FLANGE.

12.5

30-HOLES ø27 HOLES EQUALLY SPACED

4 HOLES M33 TO BE TAPPED

12°51'26''

6°25'45''

6°25'45''

263.2 (CHORD)

12°

6°

6°

ø2351

ø1511 ±1

ø2876.5

REF.JOURNAL AXIS

ø2076

ø2317

22°30'

25°42'52''

16°36'52''

3°45'26''

9°6'

12°51'26''

11°15'

5°37'30''

5°37'30''

22°30'

B

A

STUD WELDING

02

03

DETAIL-C

0.8 X 45°

+0.03
ø25.37 -0

6.3

ø16

12.5

12.5

10

3

19

SECTION-DD

+3.0
ø1575 -0.0

15°

R1.5

+2.6
ø1461 -0.0

DETAIL-F

12.5 6.3

WPS-WE001

ø2317

ø2076

ø2351

9°6'

6°25'43''

29 29

56-HOLES M10 TO BE TAPPED DEPTH 20 mm (MAX.) DRILL NOT TO BREAK THROUGH.

CUSTOMER APPROVED QUALITY PLAN TO BE FOLLOWED.

FABRICATION DRG. No.1-61-376-01307

DETAIL-B

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	
03	WELD STUD .M16 X 35				HY7145101661	0.05	
					AA7145101	42	
02	PRESSING (FOR SEPARATOR TOP)	4-61-376-00148				1566.00	
						1	
01	FLANGE	4-61-376-00147				250.00	
						1	

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: 803 XRP BOWL MILL

NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LIMITED HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	E.M.ASHOK		5-06-01	—
CHD.	S.G		5-06-01	
APPD.	K.M.RAO		5-06-01	

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
CODE 446 PULV.	¢/M/f	1:10	1758	—	—	—

TITLE: SEPARATOR TOP ASSY

CARD CODE

DRAWING NO. 1-61-376-00023

REV. 17

SHEET NO. | NO OF SHEETS

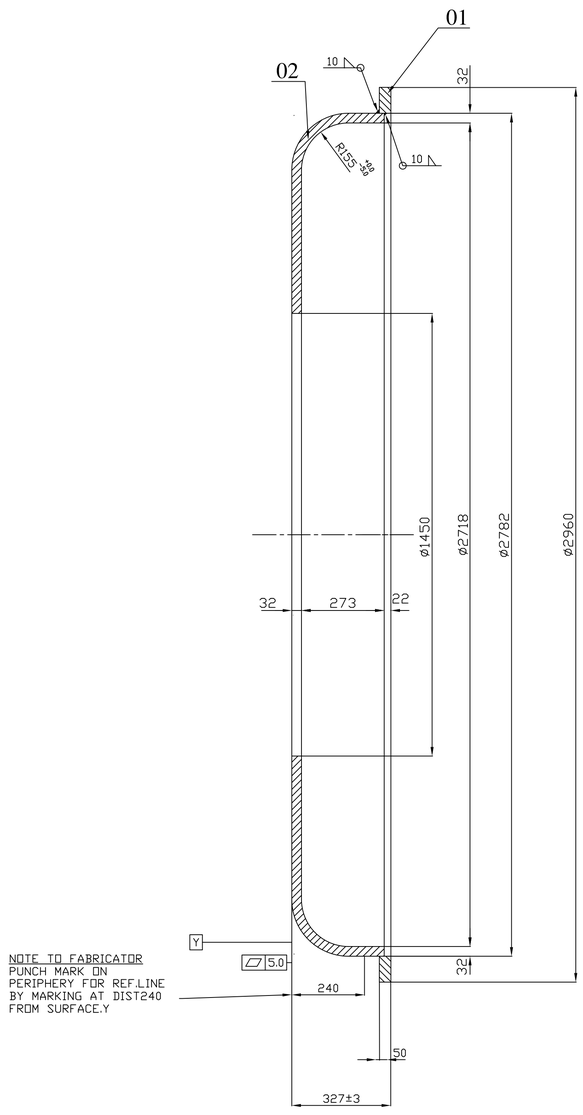
REV.	DATE	ALTERED	CHD./APPD.	ZONE
17	15.3.07	M/C UPTO ø2810 ADDED IN SEC AA. DIM 19 WAS 12.	AS SG	
16	8.11.06	WELD STUD M16X35 WAS M16X30.	AS SG	
15	12.5.06	DIM ø2718 &ø2768 DELETED. WELDING REMOVED. DIM 273, DIM 25 DELETED. WT WAS 1476.	E.M.A AS SG	
14	5.8.01	DRG. REDRAWN ITEM 03 MAT CODE WAS BA9617684047 FABRICATION DRG No. ADDED.	E.M.A S.G K.M.R	

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

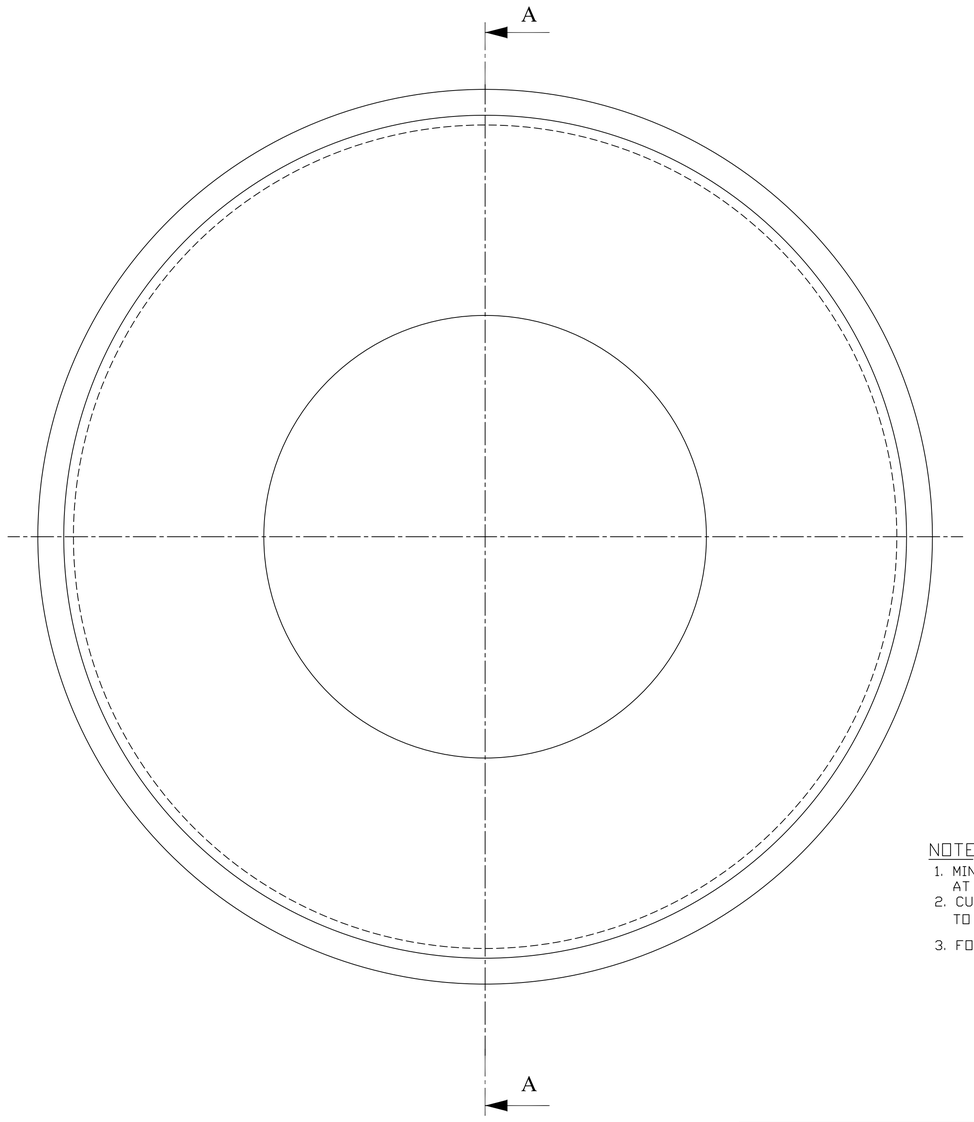
DRG. NO. 1-61-376-01307

WPS-WE001



NOTE TO FABRICATOR
PUNCH MARK ON
PERIPHERY FOR REF.LINE
BY MARKING AT DIST240
FROM SURFACE.Y

SECTION-AA



NOTE:
1. MINIMUM ABSOLUTE THICKNESS OF 32 PLATE AT ANY POINT AFTER PRESSING SHOULD NOT BE LESS THAN 28.5 mm
2. CUSTOMER APPROVED QUALITY PLAN TO BE FOLLOWED.
3. FOR MACHINING REF DRG NO: 1-61-376-00023/1-61-380-01447.

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	
02	PRESSING (FOR SEPARATOR TOP)	4-61-376-00148				1566.00	
						1	
01	FLANGE	4-61-376-00147				312.00	
						1	

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
803 XRP BOWL MILL

BHARAT HEAVY ELECTRICALS LIMITED
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	E.M.ASHOK		5-06-01	—
CHD.	S.G		5-06-01	
APPD.	K.M.RAO		5-06-01	

DEPT.	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
446	¢/M/f		1:10	1878.0	—	—	—

CODE: PULV.

TITLE: SEPARATOR TOP FABRICATION

CARD CODE

DRAWING NO. 1-61-376-01307

REV. 01

SHEET NO. | NO OF SHEETS

REV.	DATE	ALTERED	CHD./APPD.	ZONE
01	13.6.05	DIMS 2782, 327±3 &32 WERE 2768, 320±3 & 25 RESPLY. WT WAS 1540.		

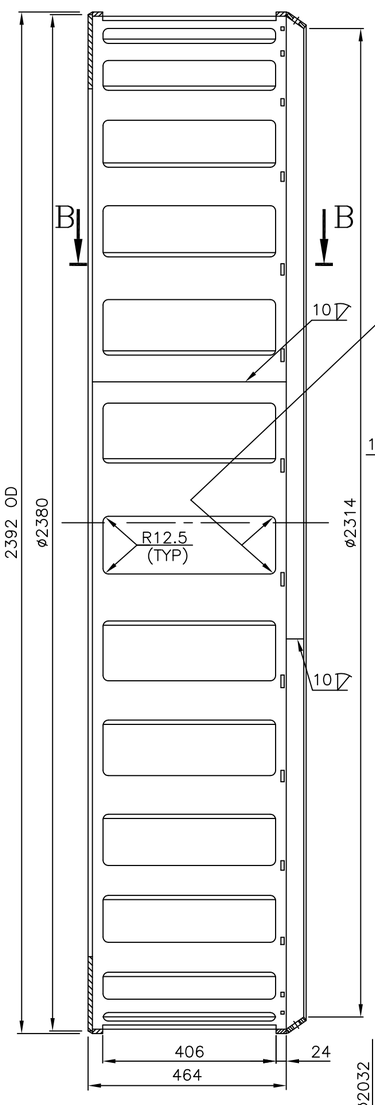
COMPUTER FILE NAME 16101307

INVENTORY NO | SIGN. AND DATE | REF. DRG. NO.

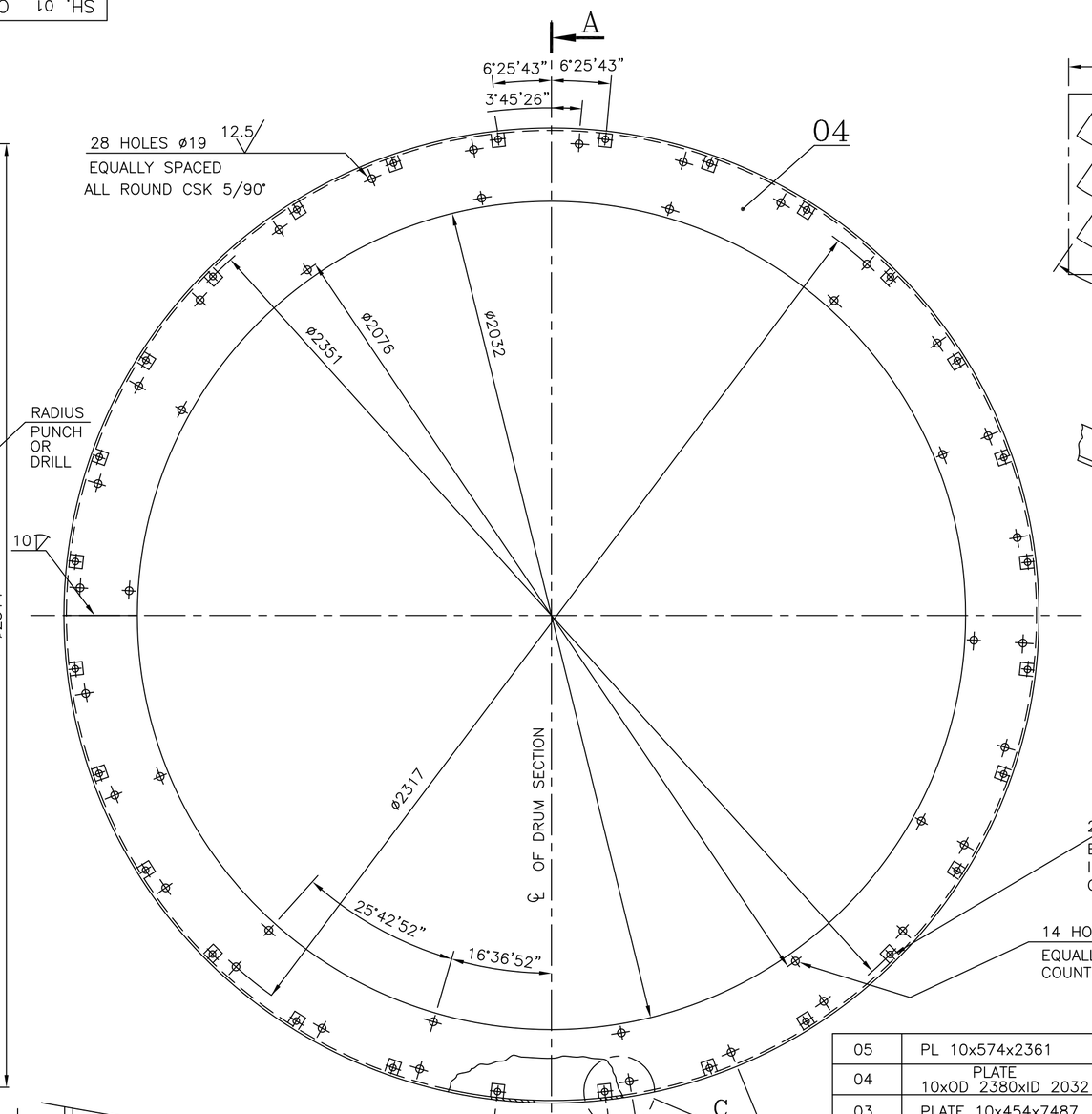
FIRST ANGLE PROJECTION

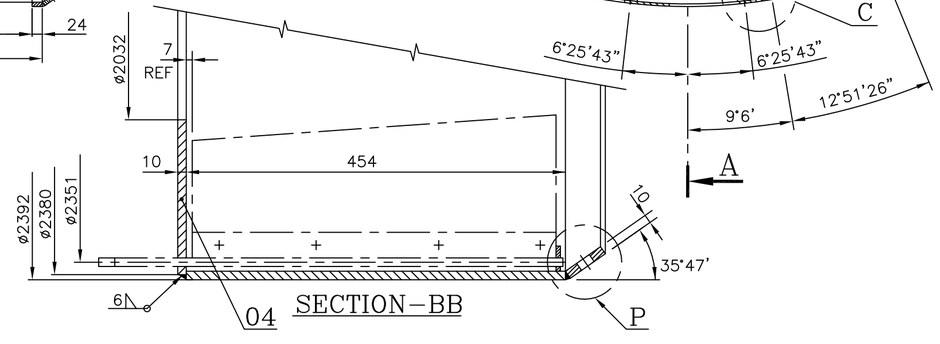
(ALL DIMENSIONS ARE IN mm)

DRG. NO. 2-61-376-00038 | SH. 01 OF 01

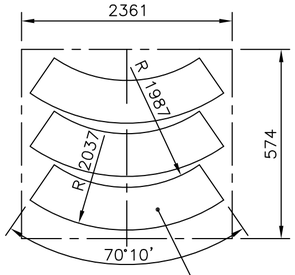


SECTION–AA





SECTION–BB



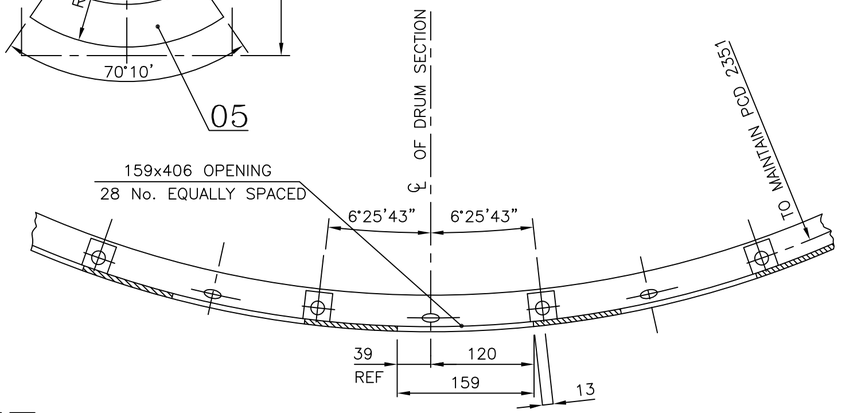
WPS	WELD SYMBOL	ELECTROD SPEC.	WELD LENGTH
WE006	6 ◺	E44 RNX	
WE006	10 ◺	E44 RNX	

12.5

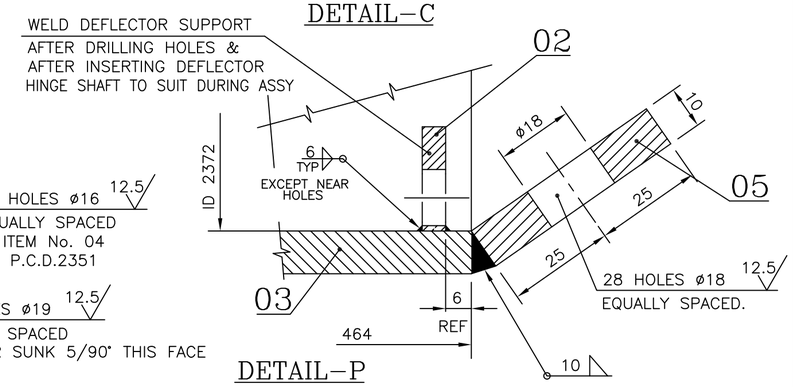
NOTES:–

01. REMOVE ALL SHARP EDGES

02. INSIDE & OUTSIDE OF WELDS MUST BE SMOOTH



DETAIL–C



DETAIL–P

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	
05	PL 10x574x2361				AA1011819074	29.70	106.00
					AA10119	1	
04	PLATE 10xOD 2380xID 2032				AA1011819074	95.00	
					AA10119	1	
03	PLATE 10x454x7487				AA1011819074	125.00	
					AA10119	1	
02	DEFLECTOR SUPPORT	4-61-376-00088			AA1011808030	0.03	
					AA10108	28	
01	DEFLECTOR ASSEMBLY	2-61-376-000357				7.66	
					ASSY.	28	

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.

REV.	DATE	ALTERED	APPD.
ZONE		CHD.	
09	10.04.97	ALTERED UC	
ZONE		CHD.	

Wt. WAS 465.02 Kg
DRG. REPLOTTED.

TYPE OF PRODUCT

NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LIMITED
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	UNIC		10.04.97	
CHD.	B.M.R		26.07.97	
APPD.	B.RAMANNA		26.07.97	

DEPT.	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
PULV ENGG. CODE 446	℄/M/#		1:10	250.54	20-F-002-003/A		05

TITLE

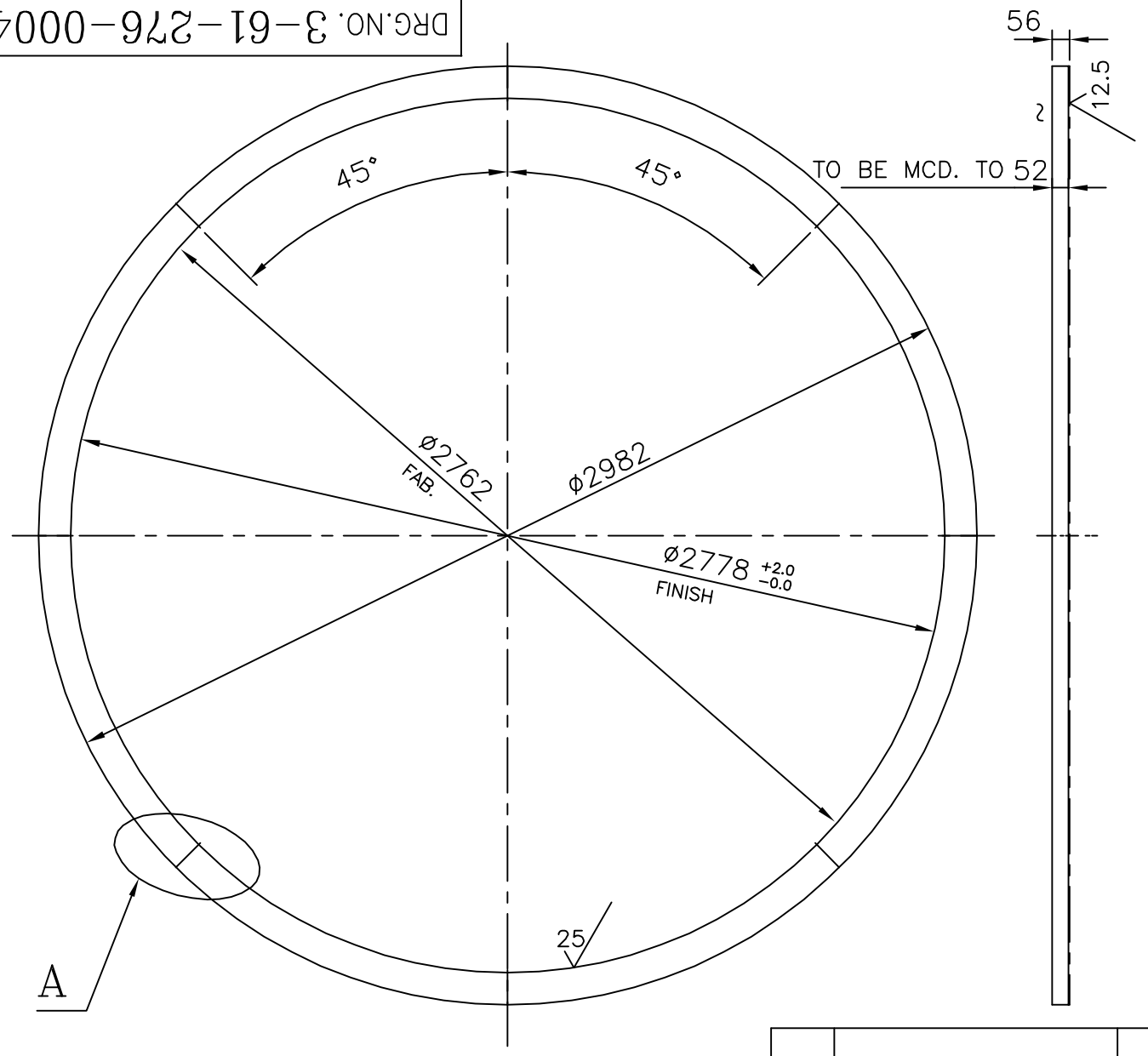
INNER CONE (DRUM SECTION)

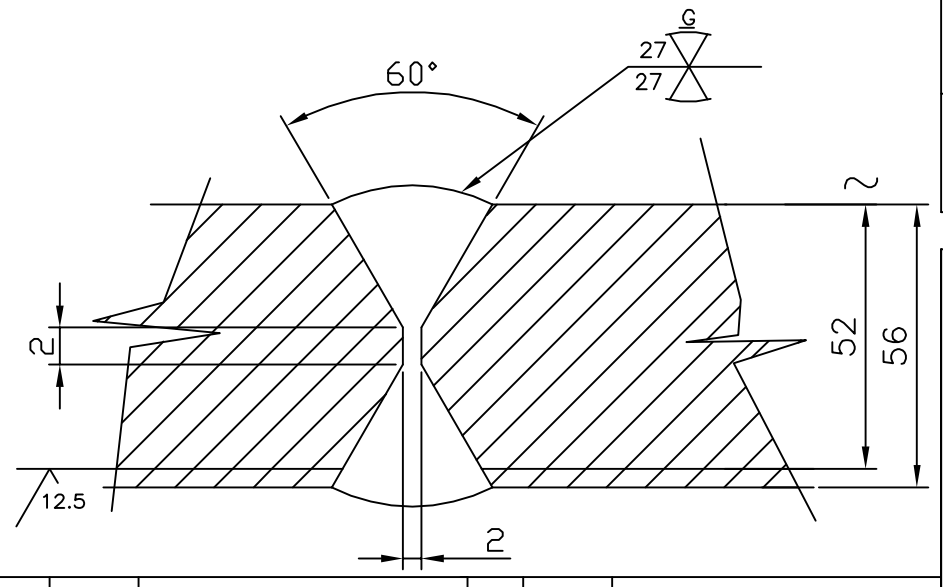
CARD CODE	DRAWING NO.	REV.
U01	2-61-376-00038	09
	SHEET NO. 01	NO OF SHEETS 01

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG.NO. 3-61-276-00040



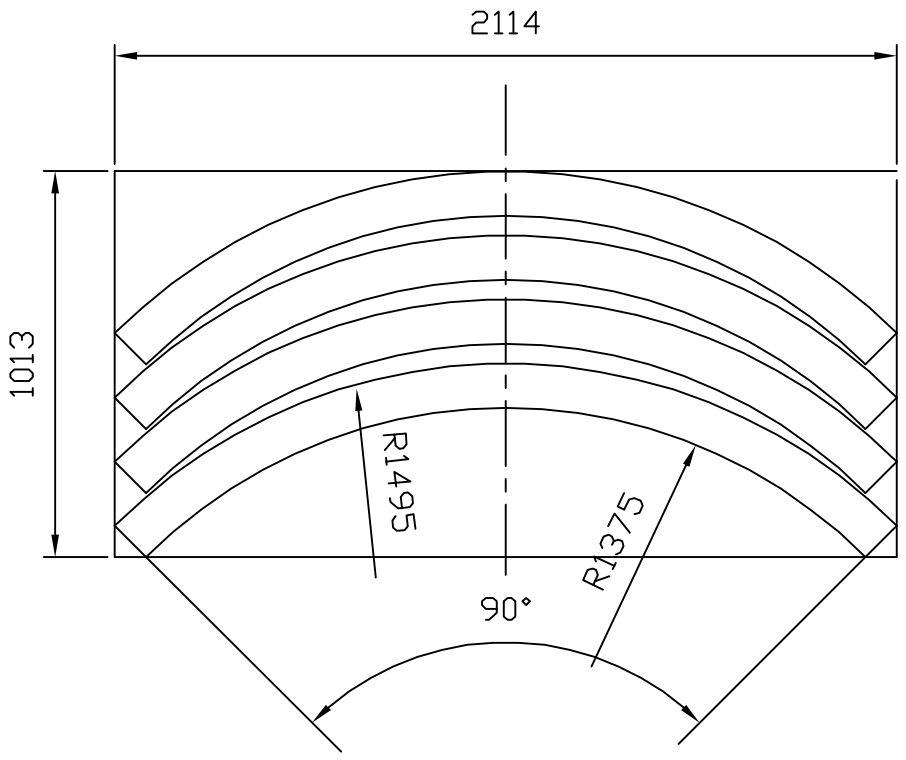


NOTES:-

01. FLATNESS ± 3 mm AFTER FABRICATION.
03. BOTH INSIDE AND OUTSIDE SURFACES TO BE SMOOTH.

12.5 25 ~

WPS:WE001



ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
	PL. 56x1013X2114				AA1011819228	377.00	
					AA10119		
					MATERIAL SPECN.	QUANTITY	

REV.	DATE	ALTERED	CHD.	APPD.
06	11032k	WELDING CHANGED FROM DOUBLE U TO DOUBLE V.		
05	240998	WPS TABLE DELETED. CUTTING PLAN ADDED. RAW MATERIAL SIZE & VIEW CORRECTED.WPS GIVEN.		

ZONE

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

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	NDS		971002	
CHD.	S.GHATGE		971002	
APPD.	K.M.R		971002	

DEPT.	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
PULV ENGG.	1:20	377.00			
CODE 446					

TITLE

FLANGE
(UNFINISHED & FABRICATED)

DRAWING NO. 3-61-276-00040 REV. 06

SHEET NO. 01 NO OF SHEETS 01

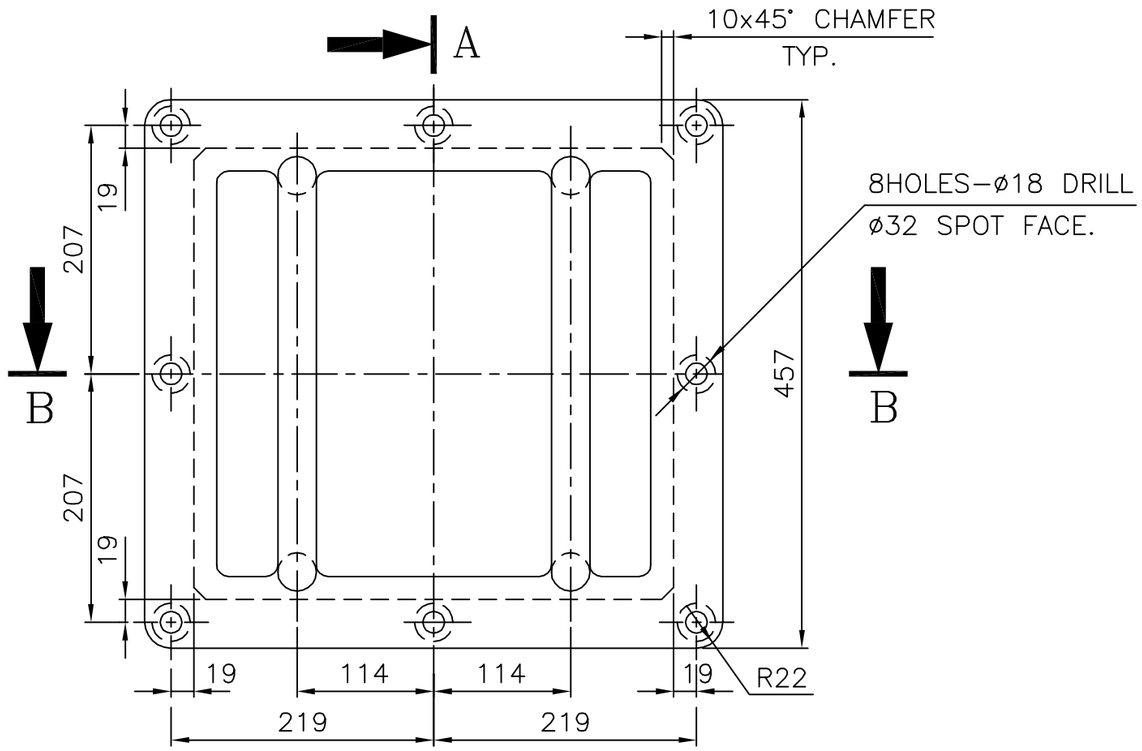
INVENTORY NO. | REF.DRG.NO. | FILE NAME: 36100040.DWG

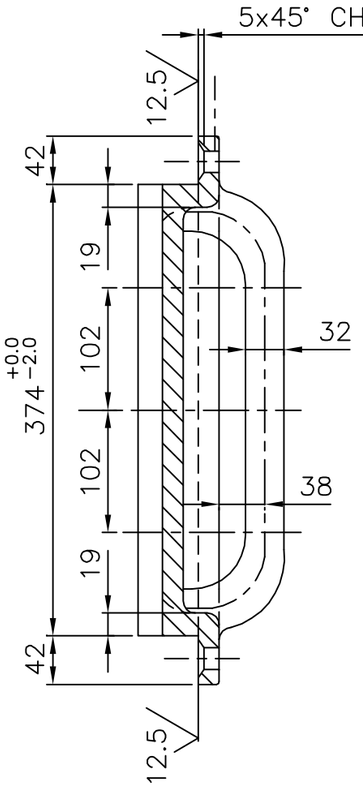
TD-151/REV. 03 SIZE A3

FIRST ANGLE PROJECTION

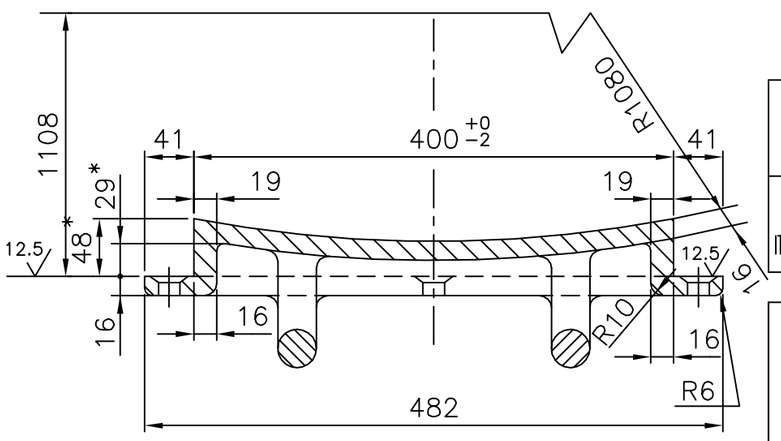
(ALL DIMENSIONS ARE IN mm)

DRG.NO. 3-61-376-00060





SECTION-AA



SECTION-BB

NOTES:-

~~01. CASTING DRG. No. 90-F-100-043~~

~~02. PATTERN ON 3-61-396-00060~~

* MAINTAIN WHEN MACHINING.

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
01	CASTING				BA9110309004	43.00	
					AA19703		
					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.

REV.	DATE	ALTERED	CHD.	APPD.
ZONE				
05	23.10.97	ALTERED UC	CHD.	APPD.
ZONE		DRAWING REDRAWN BY INCORPORATING ALL PREVIOUS REVS.		

TYPE OF PRODUCT
OR
NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	UNIC/BMR		23.10.97	
CHD.	NDSAMUEL		23.10.97	/
APPD.	S.GHATGE		23.10.97	

DEPT. PULV ENGG.	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
CODE 446	1:5	43.00	B-RJ-1106-0	/	/

TITLE

SEPARATOR ACCESS DOOR

DRAWING NO. 3-61-376-00060 REV. 05

SHEET NO. 01 NO OF SHEETS 01

INVENTORY NO.

REF.DRG.NO.

36100060.DWG FILE NAME

FIRST ANGLE PROJECTION

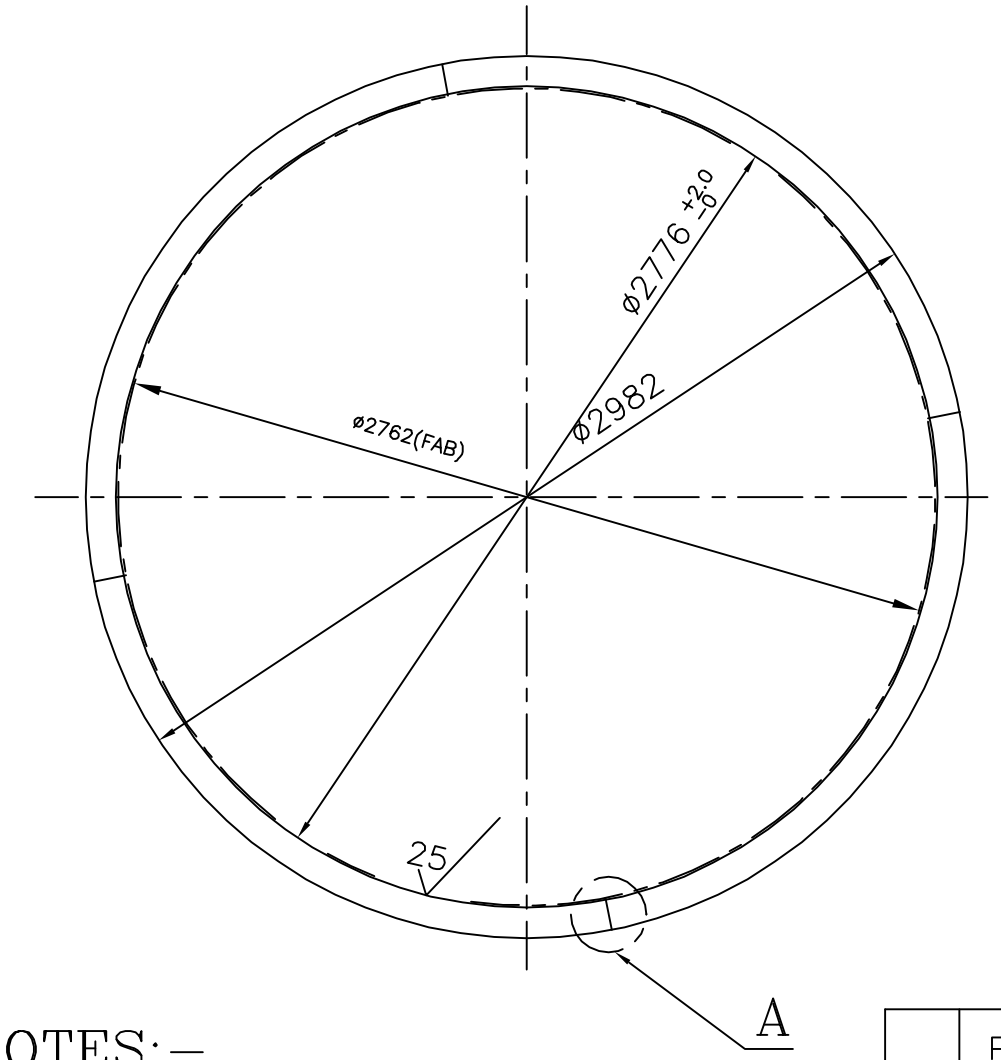
(ALL DIMENSIONS ARE IN mm)

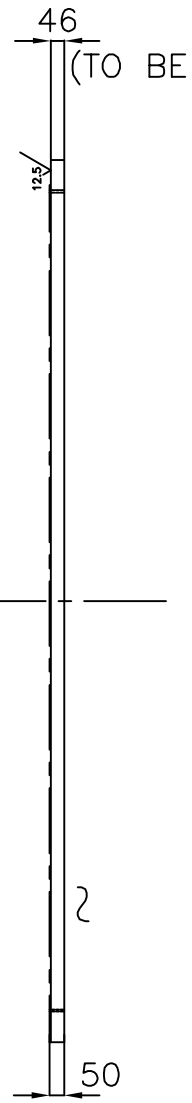
DRG.NO. 3-61-376-00087

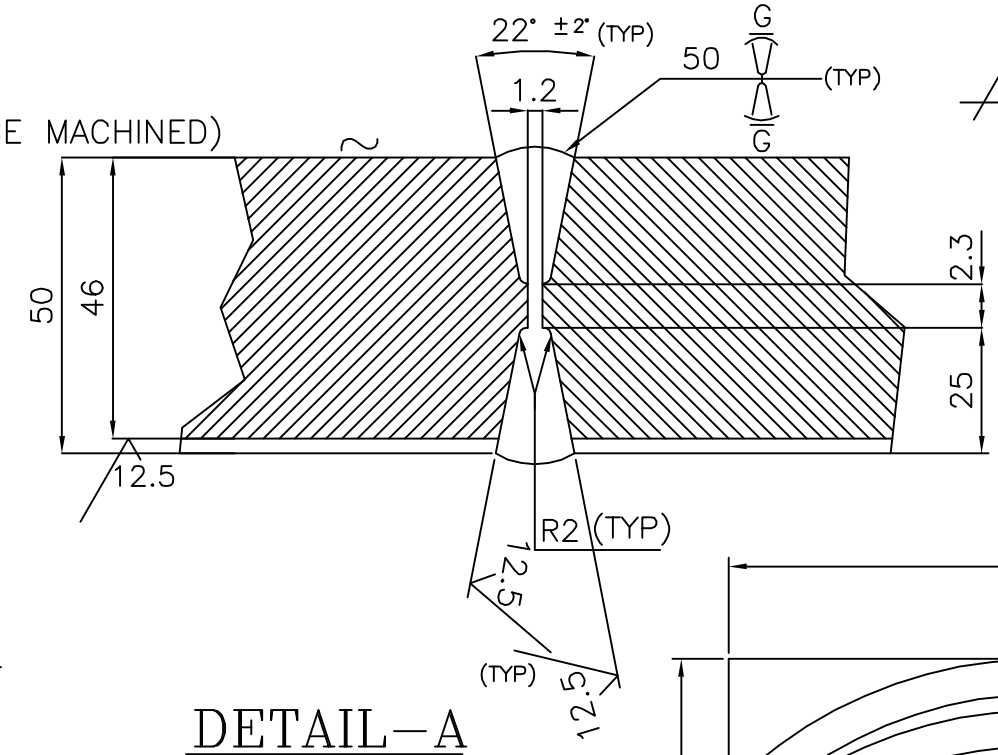
3613760087.DWG FILE NAME

REF.DRG.NO.

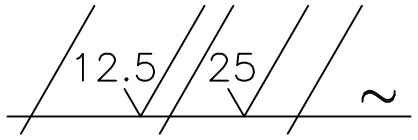
INVENTORY NO.



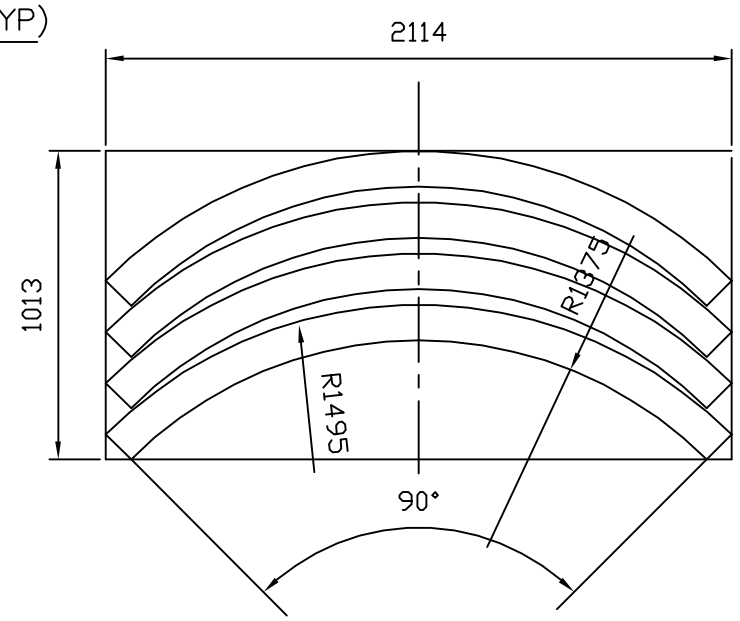




DETAIL–A



WPS:WE001



NOTES:–

01. FLATNESS ±3mm AFTER FABRICATION.
02. BOTH INSIDE AND OUTSIDE SURFACES TO BE SMOOTH.
03. ONE FLANGE REQD. PER MILL.

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
	PLATE 50xø2982xø2762				AA1011819210	308.00	
					AA10119	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.

REV.	DATE	ALTERED	CHD.	APPD.
04	1.1.04	ZONE 32 HOLES M33 DELETED CUTTING PLAN ADDED. WPS CORRECTED. NOTE 2 DELETED.		
03	971001	ZONE DRG. REDRAWN BY INCORPORATING THE PREVIOUS REV.	UC	

TYPE OF PRODUCT
OR
NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	UNIC		971001	
CHD.	B.M.R		971002	
APPD.	K.M.R		971002	

DEPT. PULV ENGG.	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
CODE 446	1:25	308.00	30–F–0024		

TITLE

UNFINISHED FABRICATED FLANGE

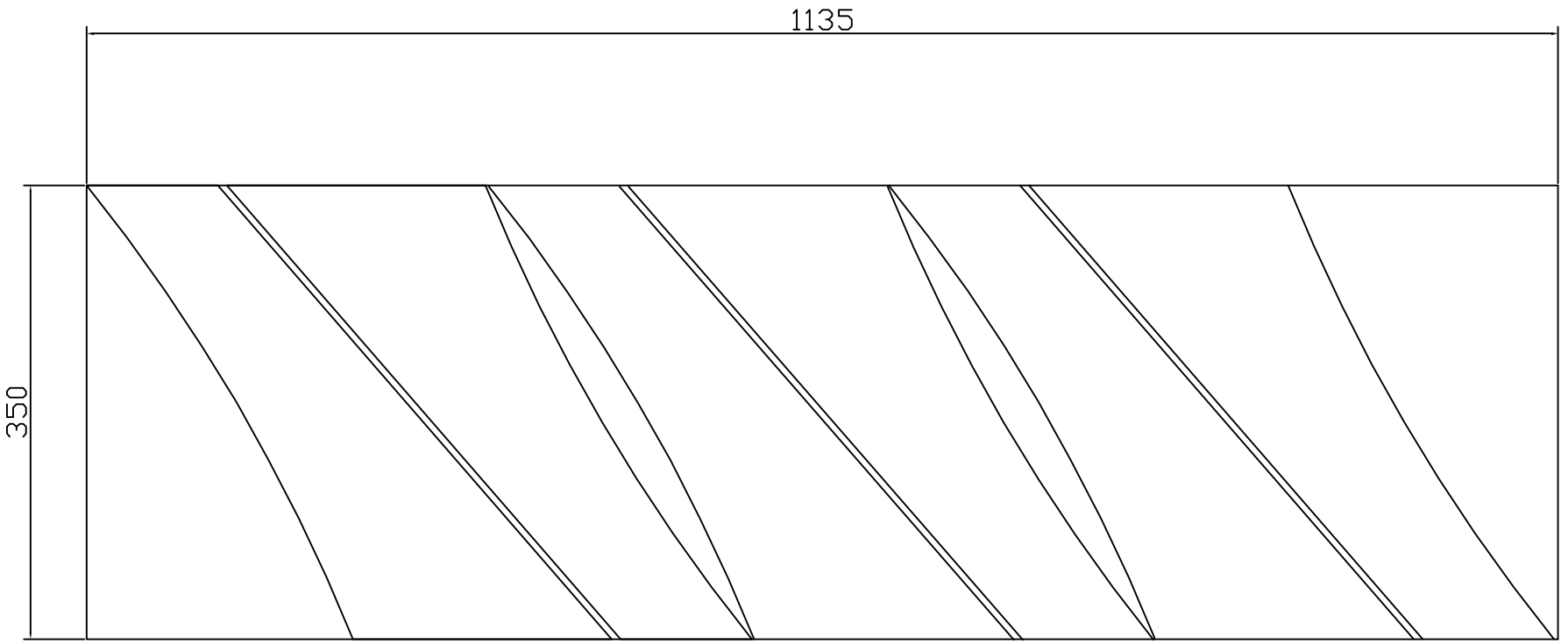
DRAWING NO. 3–61–376–00087 REV. 04

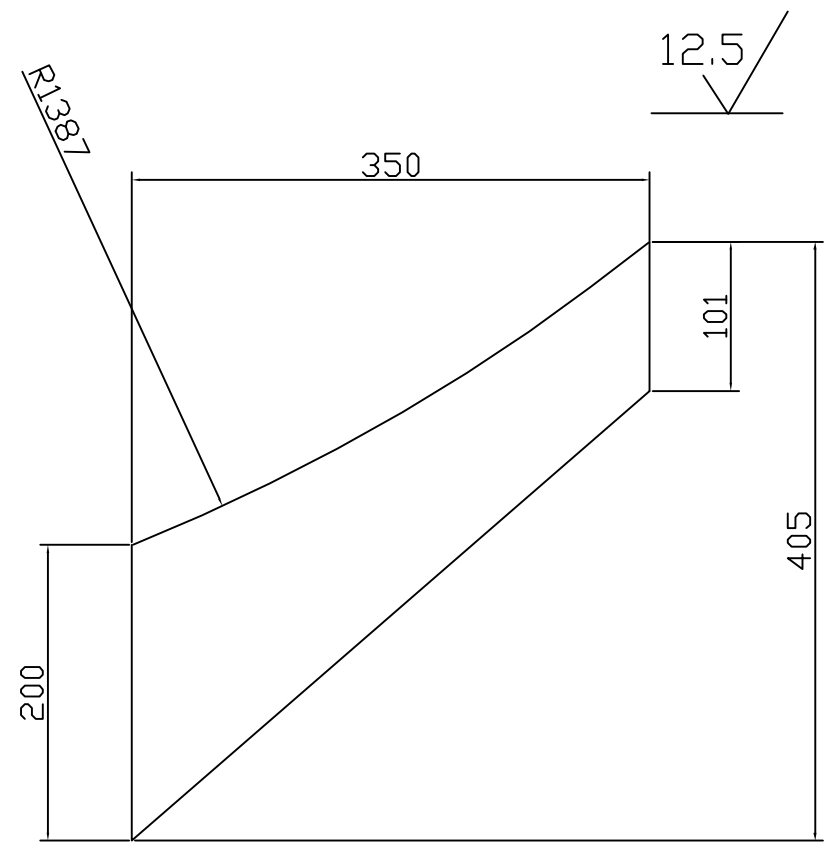
SHEET NO. 01 NO OF SHEETS 01

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG.NO.3-061-380-02349





MARKING DETAIL FOR 1 PIECE

CUTTING PLAN FOR 6 PIECES (PER MILL)

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	
01	PLATE			40 X 350 X 1135	AA1011819198	125.00	
					AA10119	1	

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.

REV.	DATE	ALTERED	CHD.	APPD.
ZONE				
01	4.9.06	E.M.ASHOK	CHD. AMAN	APPD. S.G
ZONE		DRG REDRAWN IN AUTOCAD		

TYPE OF PRODUCT
OR
NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	E.M.ASHOK		04.09.06	
CHD.	AMAN			
APPD.	S.G			

DEPT.	PULVE.ENGG	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
CODE	446	1:5	125.0	0-61-376-00016	06	18

TITLE: PLATE

DRAWING NO. 3-61-380-02349 REV. 01

SHEET NO. 01 NO OF SHEETS 01

INVENTORY NO. | REF.DRG.NO. | 36002349 FILE NAME

FIRST ANGLE PROJECTION

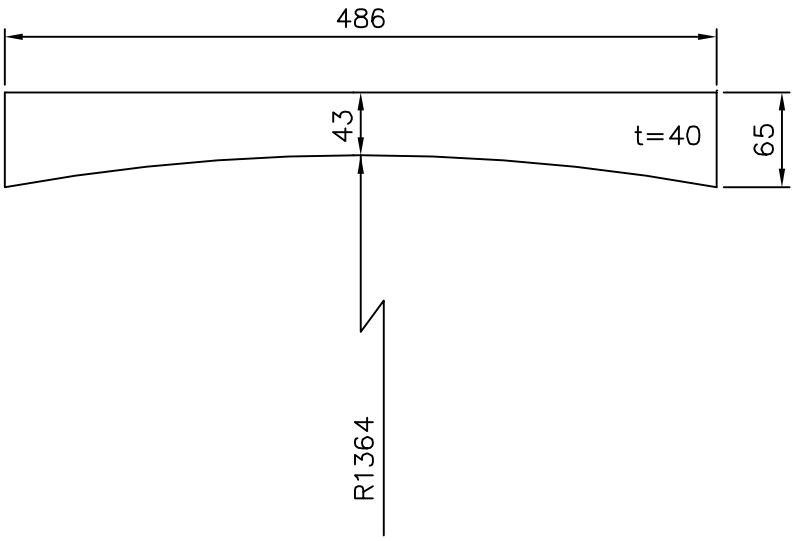
(ALL DIMENSIONS IN mm)

REV.	DATE	ALTERED / CHECKED / APPROVED	REV.	DATE	ALTERED / CHECKED / APPROVED	ADDITIONAL INFORMATION / STATUS OF DRAWING / DISTRIBUTION OF PRINTS

REF. DRG. NO. 0-61-280-00024

COMPUTER FILE NAME 46102262.DWG

INVENTORY NO.



GENERAL DIMENSIONS, LIMITS, FITS & TOLERANCES AS PER PS HY0230261.

ITEM NO.	DESCRIPTION	DRAWING NO.	MATL. CODE / MATL. SPECN.	UNIT WT. / QTY
	PL. 40x486x65 (PROFILE)		AA1011819198 / AA10119	9.919 / 2

BHEL BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN	DATE	NO.OF VAR.
DRN.	UNIC		97.11.05	/
CHD	B.M.R		97.11.05	
APPD.	K.M.R		97.11.05	

DEPT.	GRADE OF TOL. DIM	SCALE	WEIGHT(K.G.)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEMS
PULV.ENGG CODE 446	¢/M/F	1:5	9.919	0-61-280-00024	18	20

TITLE

PLATE

CARD CODE

DRAWING NO. 4-61-280-02262 REV. 00

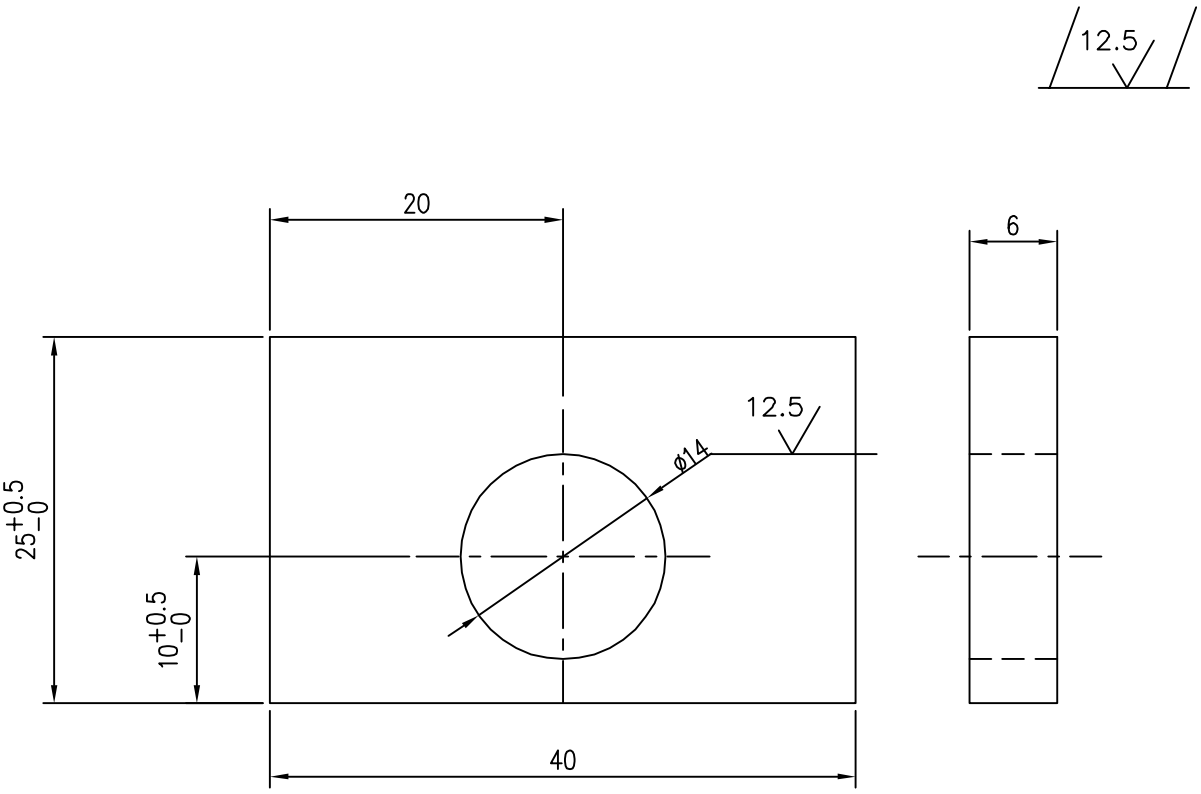
SHEET NO. 01 NO. OF SHEETS 01

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN mm.

DJC

REV.	DATE		REV.	DATE		REV.	DATE	
03	15.09.98	ALTERED CHECKED APPROVED	04	31.01.08.	ALTERED CHECKED APPROVED			ALTERED CHECKED APPROVED
DRAWING REDRAWN ON CAD INCORPORATING ALL THE PREVIOUS REVISIONS.			DIMS 40, 20,10 & 25 WERE 32,16,10.5 &26 RESPLY. MODIFIED BASED ON SHOP FEEDBACK.					



REMOVE ALL SHARP EDGES

PLATE		6 x 25 x 40	AA1011808030	0.04
			AA10108	1
DESCRIPTION & DRG. No.	VAR No.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATL. CODE	NET.WT. / GROSS WT
			MATL. SPECN.	QTY.

TYPE OF PRODUCT OR
NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN	DATE
DRN.	D.S.N		13.4.98
CKD.	S.G		15.9.98
APPD.	K.MRAO		15.9.98

NO.OF VAR. –

DEPT.	GRADE OF TOL. DIM.		SCALE	WEIGHT(K.G.)	REF.TO ASSY.DRG.	ITEM No.	No.OF ITEM
PULV. ENGG.	¢/M/F		2:1	0.04		–	–
CODE 446							

TITLE

DEFLECTOR SUPPORT

DRAWING No. 4-61-376-00088

REV. 04

SHT. No. 1 | No. OF SHT. 1

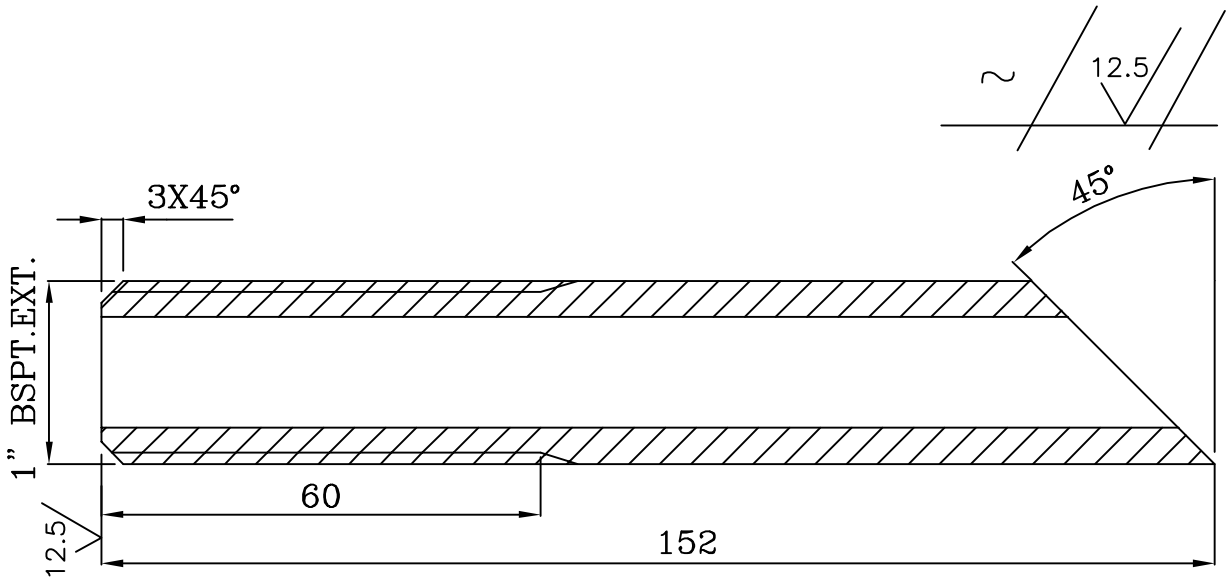
REF. TO HY0230261 FOR UNSPECIFIED TOLERANCES.

SIGN. & DATE | REF. DRG. No. | COMPUTER No. 46100088.DWG

INVENTORY NO.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)

REV.	DATE	ALTERED	APPD.	REV.	DATE	ALTERED	APPD.	ADDITIONAL INFORMATION
02	96.07.15	B.M.R		03	03.03.2012	BGK		STATUS OF DRAWING
		CHECKED N.S.D	K.M.R			CHECKED		DISTRIBUTION OF PRINTS
DRG. REDRAWN BY INCORPORATING THE PREVIOUS REV.				NET WEIGHT, GROSS WEIGHT ADDED				



NOTE:–

BREAK ALL SHARP EDGES AND CORNERS.

ITEM NO	DESCRIPTION	DRAWING NO.	MATL. CODE / MATL. SPEN.	NET WT	GROSS WT / QTY.
	ERW TUBE (NB25(H)) OD 34.2x4.05t–155LG.		AA1011052555 / AA101152	0.3	0.3 / 1

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	B.M.R		96.07.14	
CHD.	N.S.D		96.08.06	\
APPD.	K.M.R		97.08.06	

DEPT.	GRADE OF TOL.DIM.		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
PULV.ENGG	¢/M/F		1:1	0.3	0–61–388–00706	10	11
CODE 446							

TITLE: TUBE (SEP. BODY)

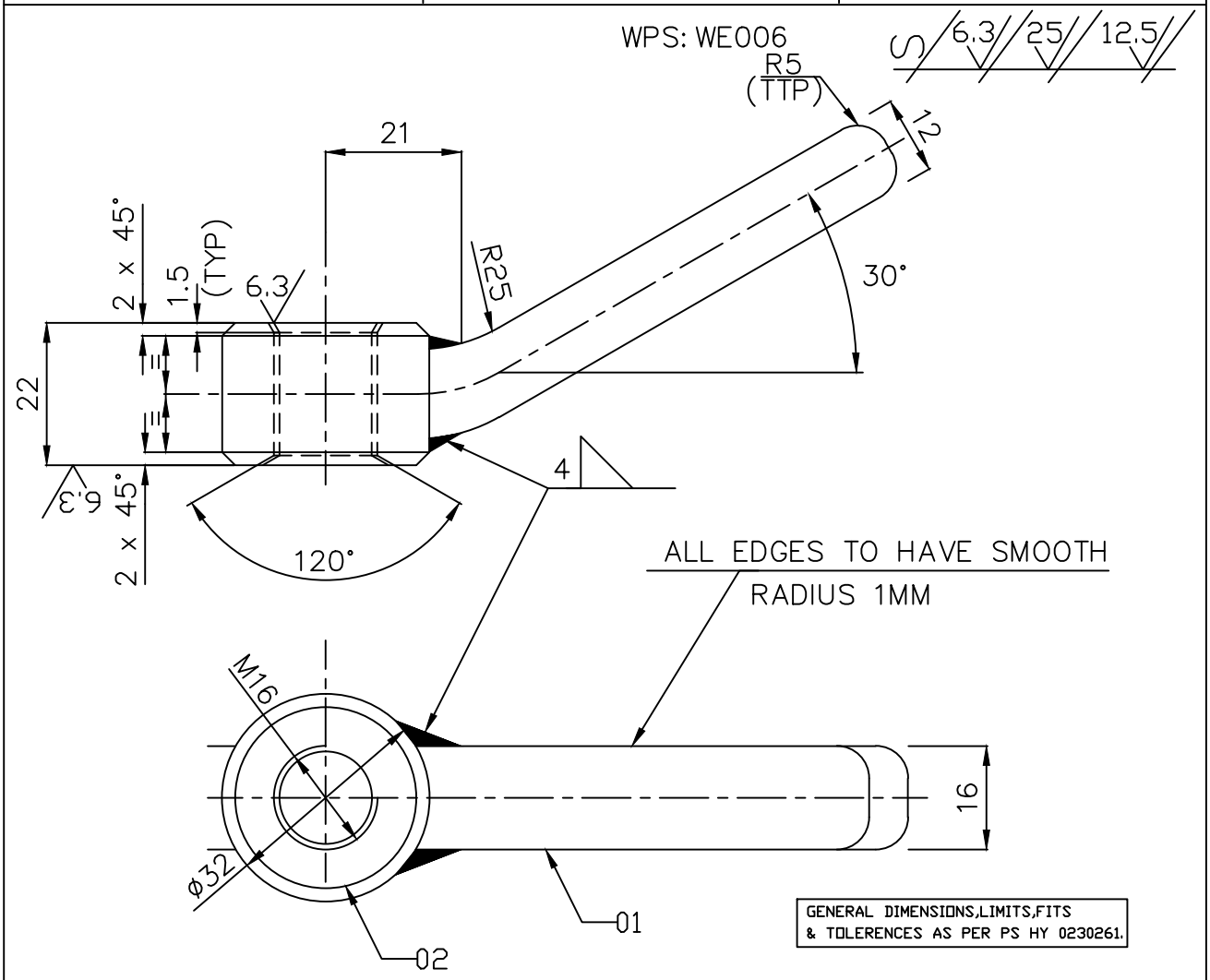
CARD CODE: \

DRAWING NO. 4–61–376–00106 REV. 03

SHEET NO. 01 NO OF SHEETS 01

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)

REV.	DATE	ALTERED / CHECKED	REV.	DATE	ALTERED / CHECKED	ADDITIONAL INFORMATION / STATUS OF DRAWING / DISTRIBUTION OF PRINTS
02	10-6-96	ALTERED E.M.ASHOK CHECKED GHATGE	03	17.08.13	ALTERED ASHOK REDDY CHECKED S.GHATGE	ADDITIONAL INFORMATION STATUS OF DRAWING DISTRIBUTION OF PRINTS
DRAWING REDRAWN BY INCORPORATING PRIVIOUS REV. R5 ADDED.			1.GROSS WT ADDED 2.CUTTING ALLOWANCW ADDED FOR RAW MATERIAL			



GENERAL DIMENSIONS,LIMITS,FITS & TOLERENCES AS PER PS HY 0230261.

GROSS WT=0.33 KG

ITEM NO	DESCRIPTION	DRAWING NO.	MATL. CODE / MATL. SPEN.	NET WT. / QTY.	GROSS WT.
02	ROD ø32 X 30		HY1010299140 HY10199	0.11 01	0.19
01	PLATE 12 X 21 X 73		AA1011819090 AA10119	0.11 01	0.14

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REF. DRG. NO.

COMP.FILE NAME 46100108

INVENTORY NO

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	E.M.ASHOK		28.12.96	
CHD.	GHATGE		28.12.96	
APPD.	K.M.RAO		28.12.96	

DEPT.	GRADE OF TOL.DIM.		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
PULV.ENGG	c/M/f		1:1	0.22	0-61-388-00577	55	67
CODE 446							

TITLE: HANDLE NUT M16 (SEP. BODY)

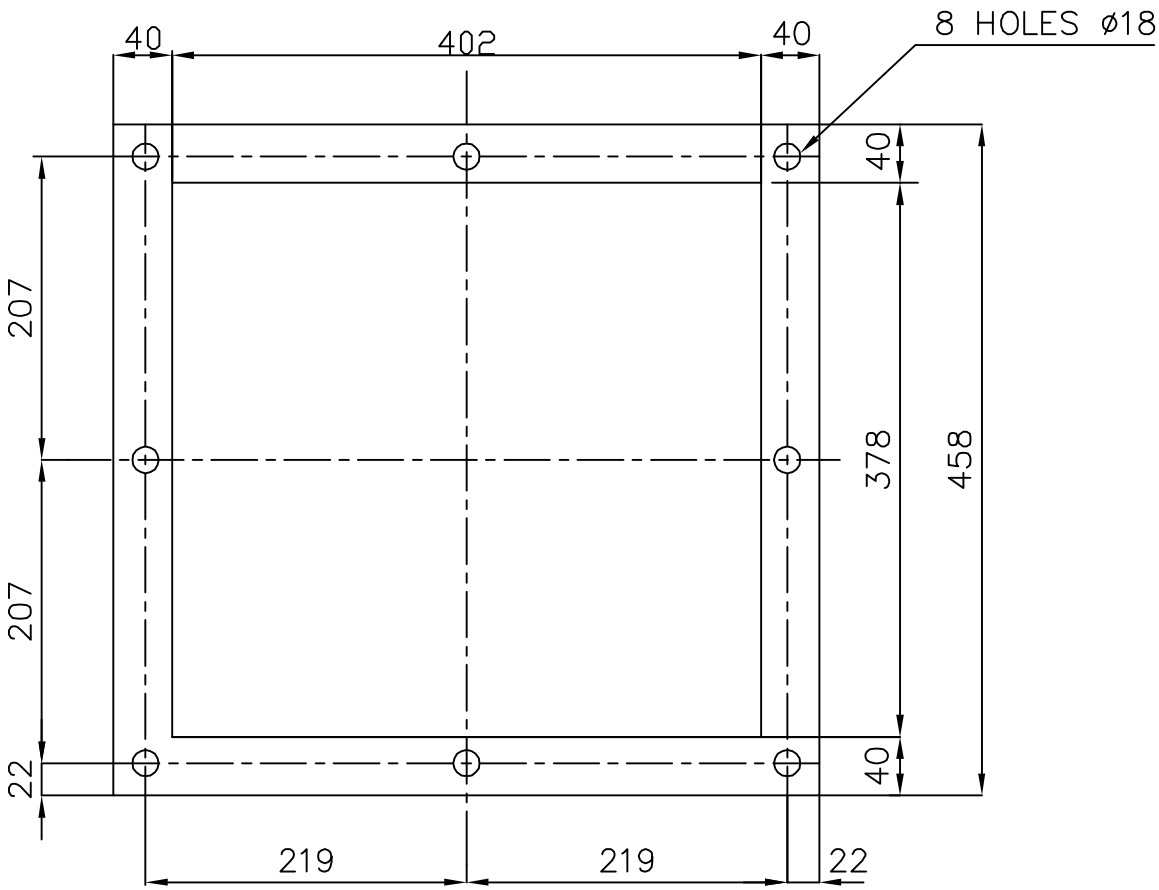
CARD CODE

DRAWING NO. 4-61-376-00108 REV. 03

SHEET NO. 01 NO OF SHEETS 01

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)

REV.	DATE	ALTERED UC		REV.	DATE	ALTERED		ADDITIONAL INFORMATION
03	96.06.10	CHECKED				CHECKED		STATUS OF DRAWING
DRG. REDRAWN BY INCORPORATING ALL PREVIOUS REV.								DISTRIBUTION OF PRINTS



GENERAL DIMENSIONS,LIMITS,FITS & TOLERENCES AS PER PS HY 0230261.

	SH. 1.5x458x482		BA9845414079	0.14
			AA21503	
ITEM NO	DESCRIPTION	DRAWING NO.	MATL. CODE	UNIT Wt.
			MATL. SPEN.	QTY.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	UNIC		96.06.10	
CHD.	S.G.		97.08.27	
APPD.	K.M.R		97.08.27	

DEPT.	GRADE OF TOL.DIM.		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
PULV.ENGG	C/M/F		1:5	0.14	(FA-002-093)		
CODE 446							

TITLE: PACKING (SEP.BODY)

CARD CODE:

DRAWING NO. 4-61-376-00109 REV. 03

SHEET NO. 01 NO OF SHEETS 01

INVENTORY NO COMP.FILE NAME 46100109.DWG REF. DRG. NO.

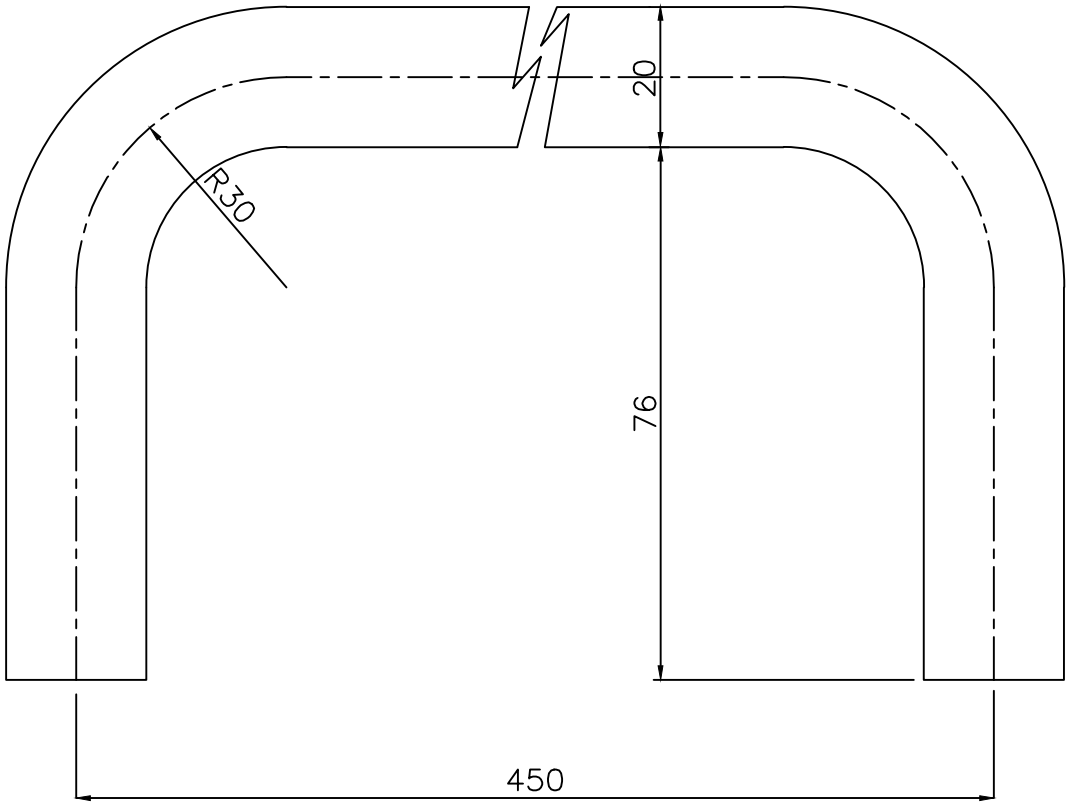
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN mm.

REV.	DATE	ALTERED / CHECKED / APPROVED	REV.	DATE	ALTERED / CHECKED / APPROVED	REV.	DATE	ALTERED / CHECKED / APPROVED
01	26.9.98	ALTERED CHECKED APPROVED	02	29.06.13	ALTERED SHARIFF CHECKED AMAN APPROVED S.GHATGE			ALTERED CHECKED APPROVED

DRG. REDRAWN

RAW MATL SIZE WAS ø20 X 596
WT CORRECTED ACCORDINGLY



DEVELOPED LENGTH : 576 MM

ROD		ø20 X 580	HY1010299107	1.42 / 1.43
			HY10199	1
DESCRIPTION & DRG.NO.	VAR NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATL. CODE	NET.WT. / GROSS WT
			MATL. SPECN.	QTY.

TYPE OF PRODUCT OR
NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN	DATE
DRN.	N.D.S.		26.9.98
CKD.	S.G		26.9.98
APPD.	K.M.R		26.9.98

NO.OF VAR. —

DEPT.	SCALE	WEIGHT(K.G.)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEM
BMD	1:1	1.42		—	—
CODE 446					

TITLE

HANDLE

DRAWING NO. 4-61-376-00133

REV. 02

SHT.NO. 1 NO.OF SHT. 1

REF. TO HY0230261 FOR UNSPECIFIED TOLERANCES.

SIGN. & DATE

REF. DRG. NO.

COMPUTER NO. 46100133

INVENTORY NO.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN mm.

REV.	DATE			REV.	DATE			REV.	DATE		
03	12.6.01	ALTERED	E.M.ASHOK	04	8.12.04	ALTERED		05	12.5.06	ALTERED	
		CHECKED	S.G			CHECKED	S.G			CHECKED	S.G
		APPROVED	K.M.RAO			APPROVED	S.G			APPROVED	S.G
DRG.REDRAWN IN AUTOCAD.				ø2774 WAS ø2770. ø2964 WAS ø2960				ø2788 WAS ø2774.			

COMPUTER NO. 4610O147

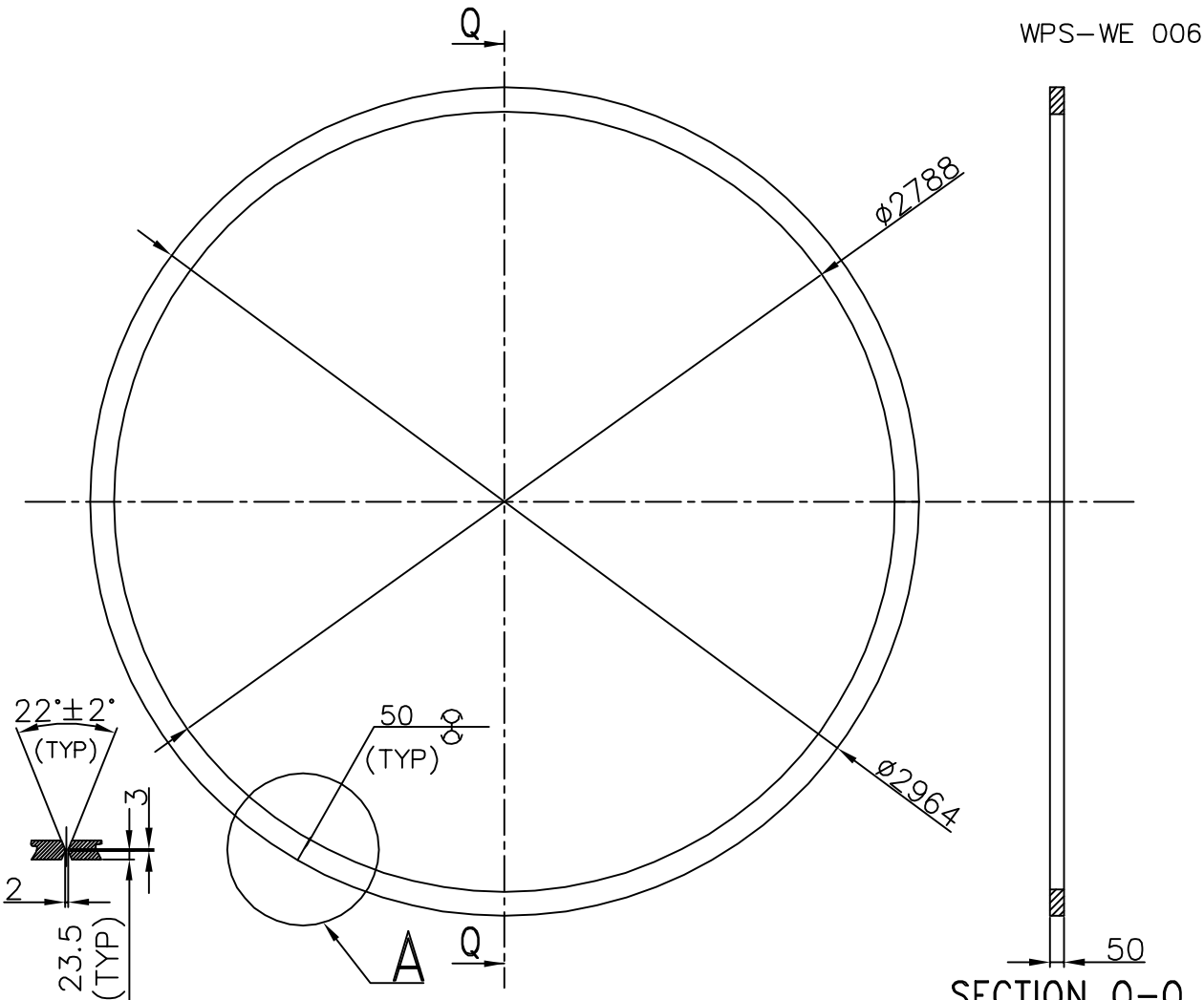
REF. DRG. NO.

SIGN. & DATE

INVENTORY NO.

REF. TO HY0230261 FOR UNSPECIFIED TOLERANCES.

WPS–WE 006



DETAIL–A

TYP 4 JOINTS 90° APART.

NOTE :–SEVERAL MILLS REQUIRMENT CAN BE CLUBBED TO SAVE MATERIAL

PLATE		50 X 880 X 2100 FOR 4 SEGMENTS	HY1018819886 AA101019	312 1	725.0
DESCRIPTION & DRG.NO.	VAR NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATL. CODE MATL. SPECN.	NET.WT. QTY.	GROSS WT

TYPE OF PRODUCT OR
NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN	DATE	NO.OF VAR.
DRN.	E.M.ASHOK		19-06-01	NA
CKD.	AMAN SURIN		19-06-01	
APPD.	S.GHATGE		19-06-01	

DEPT.	SCALE	WEIGHT(K.G.)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEM
PULVE ENGG	1:25	312.0	NA	NA	NA
CODE 446					

TITLE

FLANGE

DRAWING NO. 4-61-376-00147

REV. 05

SHT.NO. 01 NO.OF SHT. 01

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN mm.

REV.	DATE			REV.	DATE			REV.	DATE		
04	10-6-01	ALTERED	E.M.ASHOK	05	8.12.04	ALTERED		06	12.05.06	ALTERED	
		CHECKED	S.S			CHECKED	AMAN			CHECKED	AMAN
		APPROVED	K.M.RAO			APPROVED	S.GHATGE			APPROVED	S.GHATGE
DRG. RETRACED				ø2768 WAS 2718.				ø2782 WAS ø2768. PL THK WAS 25. MAT CODE WAS AA1011819155.			

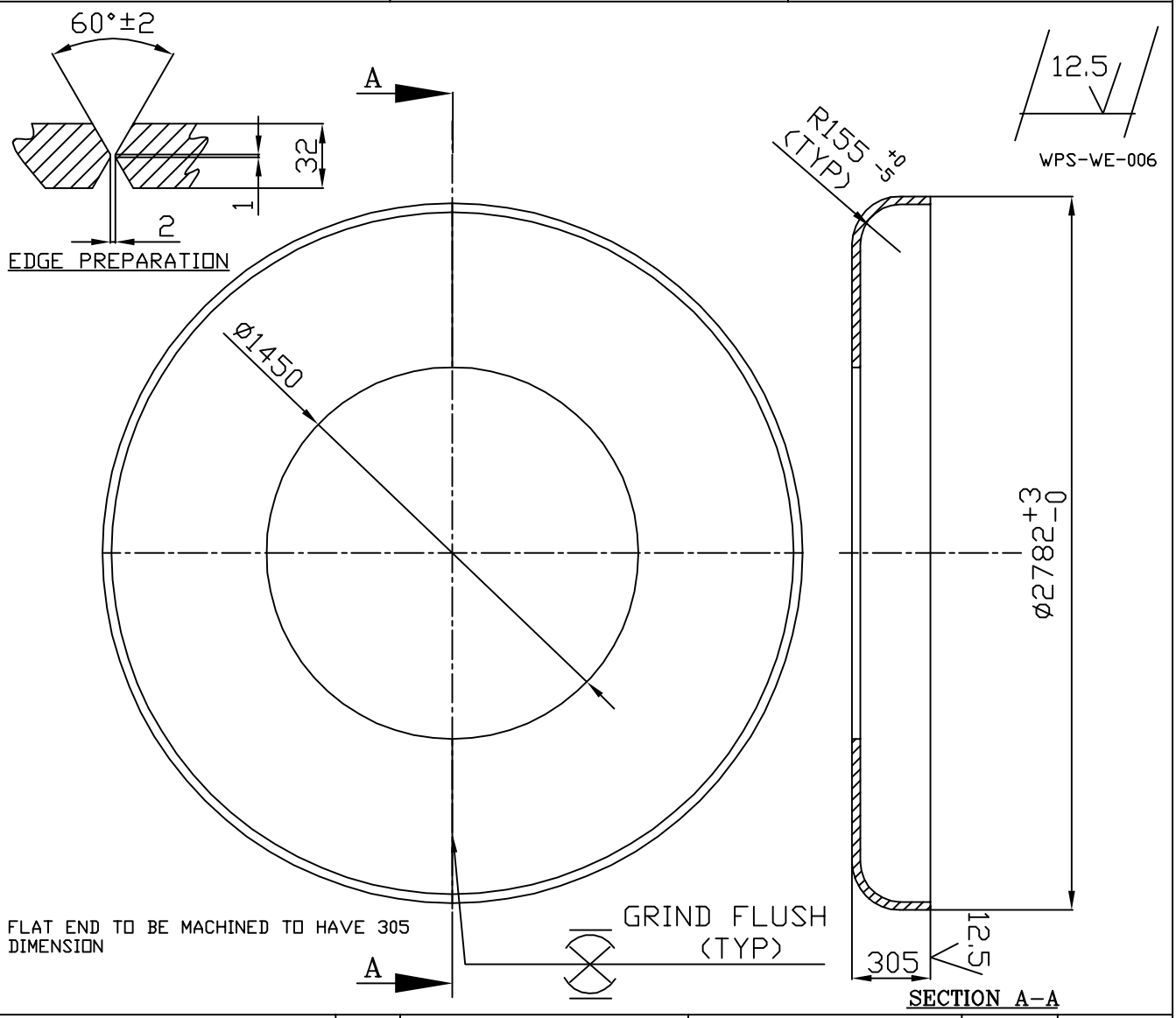


PLATE		32X3300X3300	HY1018819932	1566 / 2735
			AA10119	1
DESCRIPTION & DRG.NO.	VAR NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATL. CODE	NET.WT. / GROSS WT
			MATL. SPECN.	QTY.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN	DATE
DRN.	E.M.ASHOK		7-3-2001
CKD.	S.G		7-3-2001
APPD.	K.M.R		7-3-2001

NO.OF VAR. /

DEPT.	SCALE	WEIGHT(K.G.)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEM
PULV.ENGG	1:25	1566.0	NA	/	/
CODE 446					

TITLE

PRESSING

DRAWING NO. 4-61-376-00148

REV. 06

SHT.NO. 01 NO.OF SHT. 01

REF. TO HY0230261 FOR UNSPECIFIED TOLERANCES.

SIGN. & DATE

REF. DRG. NO.

COMPUTER NO. 46100148

INVENTORY NO.

ACCEPTANCE STANDARDS FOR LIQUID PENETRANT EXAMINATION OF WELDS

1.0 SCOPE:

1.1 This standard covers the "Acceptance Standards For Liquid Penetrant Eamination Of Wleds' .

1.2 The procedure for liquid penetrant examination shall be as per Corporate Standard AA 085 01 31: Procedure For Liquid Penetrant Examination.

1.3 This standard is based on ASME Section 8, Division 1, Appendix 8.

2. DEFINITION OF IHDICATIONS:

Relevant indications are those which result from mechanical discontinuities. Indications with major dimensions greater than 1.6 mm only shall be considered relevant.

2.1 Linear indications are those indications in which the length is more than three times the width.

2.2 Rounded indications are those indications which are circular or elliptical with the length equal to or less than 3 times the width.

2.3 Any questionable or doubtful indications shall be retested to verify whether or not they are relevant.

2.4 Localised surface imperfections, such as may occur from machining marks, surface conditions or incomplete bond between base metal and cladding may produce similar indications which are not relevent to the detection of unacceptable discontinuities.

3. ACCEPTANCE STANDARDS:

All surfaces to be examined shall be free from:

a) relevent linear indications.

b) relevent rounded indications greater than 4.8 mm.

c) four or more rounded defects in line separated by 1.6 mm or less (edge to edge) except where the specification for the material establishes different requirements for acceptance so far as defects are concerned.

PROCEDURE FOR LIQUID PENETRANT EXAMINATION

1.0 **SCOPE:**

1.1 This standard details the procedure for liquid penetrant examination of non-porous ferrous and non-ferrous and non-metallic materials such as ceramics, plastics, glass, etc.

1.2 Typical surface discontinuities detectable by this method are cracks, seams, laps, cold shuts, porosity, laminations, etc.

1.3 This standard conforms substantially with ASTM E 165 ~~—1980 (Reapproved 1988)~~ and ASME code section V, Article 6. (01)

2.0 **PERSONNEL REQUIREMENT:**

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

3.0 **DESCRIPTION:**

In principle a liquid penetrant is applied to the surface to be examined and allowed to enter discontinuities, excess penetrant removed, the part dried and a developer applied. The developer functions both as a blotter to absorb penetrant that has been trapped in discontinuities and as a contrasting back ground to enhance the visibility of penetrant indications.

4.0 **APPROVED METHODS & MATERIALS:**

4.1 Either a colour contrast or fluorescent penetrant method may be used. Any one of the following penetrants shall be used:

(a) Solvent Removable
(b) Post Emulsifying
(c) Water Washable

4.2 For nickel base alloys and/or for stainless steel materials used in nuclear components the penetrant materials, cleaner, penetrant developer, etc., used shall not contain sulphur or halogen above 1% by weight.

4.3 Selection of liquid penetrant material shall be from the same family (brand). Inter-mixing of family of liquid penetrant materials is not allowed.

5.0 **PROCEDURE:**

5.1 **Surface Preparation:**

5.1.1 Surface preparation by grinding or machining or other method may be employed where surface irregularities may mask indications of unacceptable discontinuities.

5.1.2 The surface to be examined and all adjacent areas within at least 25 mm shall be dry and free from any dirt, lint, scale, rust, welding flux, weld spatter, grease, oil or other extraneous matter that could obscure surface openings or otherwise interfere with examination.

5.1.3 The surface to be examined shall be cleaned with detergents, organic solvents, descaling solutions or paint removers. Degreasing and ultrasonic cleaning may be employed to increase cleaning efficiency. Cleaning method employed is an important part of the examination procedure. Cleaning solvents shall meet the requirements of Cl.4.2

Caution: Blasting with shot or dull sand, rotofinishing, buffing, wire brusing the soft material or machining with dull tools shall not be used as they may peen the discontinuities at the surface.

5.2 **Drying:**

Drying, after cleaning the surface to be examined, shall be accomplished by normal evaporation or with forced hot air, as appropriate. A minimum period of time shall be established to ensure that the cleaning solution has evaporated prior to application of the penetrant.

5.3 **Application Of Penetrants:**

5.3.1 The penetrant shall be applied by dipping, brushing or spraying. If the penetrant is applied by spraying using compressed air type apparatus, filters shall be placed at the air inlet to preclude contamination of penetrant by oil, water or dirt sediment that may have collected in the lines. Spraying should only be performed in a booth equipped with exhaust system.

5.3.2 The length of penetration time is critical and depends upon the material being inspected, the process through which it has passed and the type of discontinuities expected. The recommended penetration time is given in Table 1.

5.3.3 The temperature of the penetrant and the surface of the part to be examined shall not be below 10°C(50°F) nor above 50°C(125°F) throughout the examination period. Local heating or cooling is permitted provided the temperatures remain in the range of 10 to 50°C during the examination. Where it is not practical to comply with these temperature limitations, other temperatures and times shall be used provided the procedures are qualified as described in Annexure-I.

5.4 **Removal Of Excess Penetrant:**

After the penetration time specified in the procedure has elapsed, any penetrant remaining on the surface shall be removed, taking care to minimise removal of penetrant from discontinuities.

5.4.1 **Postemulsifying Penetrants:**

The emulsifier shall be applied by spraying or dipping. The emulsifying time shall not exceed 5 minutes. After emulsification, the mixture shall be removed by water spray.

5.4.2 **Solvent Removable Penetrants:**

Excess penetrant shall be removed by wiping with a cloth or absorbent paper repeating the operation until most tracesof penetrants have been removed. The remaining traces shall be removed by wiping the surface lightly with cloth or absorbent paper moistened with solvent.

Caution: Care shall be taken to avoid excess solvent as this may remove penetrants from discontinuities. Flushing the surface with solvent following the application of the penetrant and prior to developing is prohibited.

5.4.3 **Water Washable Penetrants:**

Excess water washable penetrant shall be removed with a water spray. The water pressure shall not exceed 0.35 N/mm² (50 Psi) and the water temperature shall not exceed 43.3°C (110°F).

5.5 **Drying:**

Surface shall be dried before the application of developer.

5.5.1 a) If postemulsifying or water washable method is used, the surface shall be dried by blotting with clean materials or by using circulating warm air, provided the temperature of the surface is not raised above 50°C (125°F).

b) For solvent removable method, the surface may be dried by normal evaporation, blotting, wiping or forced air.

5.6 **Application Of Developer:**

The developer shall be applied as soon as possible after the removal of the excess penetrant. Two types of developer, dry or wet,shall be used with fluorescent penetrant. With colour contrast penetrants, only wet developer shall be used.

5.6.1 **Application Of Dry Developer:**

Dry developer shall be applied by a soft brush, a hand operated powder bulb or a powder gun or other means provided the powder is dusted evenly over the entire surface being examined.

5.6.2 **Application Of Wet Developer**

Prior to applying suspension type wet developer to the surface, the developer must be thoroughly agitated to ensure adequate dispersion of suspended particles.

(a) **Aqueous Developer Application:**

Aqueous developer may be applied to either a wet or dry surface. It shall be applied by dipping, spraying or other means provided a thin coating is obtained over the entire surface being examined. Drying time may be decreased by using warm air, provided the surface temperature of the part is not raised above 50°C.

(b) **Non-aqueous Developer Application:**

Non-aqueous developer shall be applied only on a dry surface. It shall be applied by spraying, except where safety or restricted access preclude it. Under such conditions developer may be applied by brushing. Drying shall be by normal evaporation.

6.0 **EXAMINATION:**

Observe the surface during the application of the developer to detect nature of any indications which tend to bleed out profusely. Final examination shall be done between 7 minutes at the earliest and 30 minutes at the latest after application of the developer. The nature of discontinuities corresponding to the indications shall be defined depending upon the method of setting, appearance, direction, shape and dimensions of the same. If the bleed out does not alter the examination results, longer periods are permitted. If the surface to be examined is large enough to preclude complete examination within the prescribed time the surface shall be examined in increments.

6.1 **Colour Contrast Penetrants (Visible Dye Penetrants):**

6.1.1 With colour contrast penetrants the developer forms a reasonably uniform coating. Surface discontinuities are indicated by bleeding out of the penetrant which is normally of a deep red colour. Indication with a light pink colour may indicate excessive cleaning. Inadequate cleaning may leave an excessive background making interpretation difficult.

6.1.2 Adequate illumination is required to ensure no loss of the sensitivity in the examination. Examination shall be done under natural or suitable light (illumination level shall be in the order of 500 LUX).

6.2 **Fluorescent Penetrants:**

Examination of the surface shall be carried out with a high intensity black light in a darkened area or booth. Black light shall have a wave length of 3650 A°. The bulbs shall be allowed to warm up for not less than 5 minutes prior to use in the examination. The black light intensity shall be at least of 800 uW/cm^2 on the surface of the part being examined and the light source being kept at a distance of at least 375 mm from the surface being examined. The operator should allow his eyes to become accustomed to the darkness of the inspection booth for at least 5 minutes before inspecting the parts. He should avoid looking directly into the black light and also avoid going from the darkness to

the light and back again without allowing sufficient time for his eyes to adjust to the darkness. The intensity shall be measured at least once every 8 hours and whenever the work station is changed.

7.0 EVALUATION OF INDICATIONS & INTERPRETATION:

7.1 As the developer dries to a smooth, even white coating, indications will appear at the locations of discontinuities. Depth of surface discontinuities may be correlated with the richness of colour and speed of bleeding out. However, localised surface imperfections such as may occur from machining marks or surface conditions may produce similar indications which are non-relevant.

7.2 Usually, a crack or similar opening will show a line and light cracks or partially welded lap will show a broken line. Gross porosity may produce large indications covering an entire area. Very fine porosity is indicated by random dots.

7.3 Any non-relevant indication shall be regarded as a defect until the indication is either eliminated by surface conditioning or it is Proved non-relevant by other NDT methods.

7.4 Linear indications are those indications in which the length is more than three times the width. Rounded indications are indications which are circular or elliptical with the length less than three times the width.

7.5 All indications shall be evaluated in terms of the acceptance standards of the referencing documents.

8.0 ACCEPTANCE STANDARDS:

8.1 For castings - Refer Corporate Standard AA 085 01 32.

8.2 For Austenitic Forgings - Refer Corporate Standard AA 085 01 30.

8.3 For Welds - Refer Corporate Standard AA 085 01 29.

9.0 POST EXAMINATION CLEANING:

Surfaces examined shall be cleaned after evaluation of the test with dry cotton rag with or without water rinse.

TABLE - 1 (Clause 5.3.2)

Suggested Penetration Time For Post-emulsified And Solvent Removable Penetrants

Material	Form	Type of discontinuity	*Penetration time (min.)
Aluminium	Castings	Porosity	5
		Cold shut	5
	Extrusions & Forgings	Laps	10
		Lack of fusion	5
	Welds	Porosity	5
	All forms	Cracks	10

CS-257

TABLE - 1 (Clause 5.3.2) Contd.

Material	Form	Type of discontinuity	*Penetration time (min.)
Magnesium	Castings	Porosity	5
		Cold shut	5
	Extrusions & Forgings	Laps	10
		Lack of fusion	10
	Welds	Porosity	10
	All forms	Cracks	10
Steel	Castings	Porosity	10
		Cold shut	10
	Extrusions & Forgings	Laps	10
		Lack of fusion	20
	Welds	Porosity	20
	All forms	Cracks	20
Brass & Bronze	Castings	Porosity	5
		Cold shut	5
	Extrusions & Forgings	Laps	10
		Lack of fusion	10
	Brazed parts	Porosity	10
	All forms	Cracks	10
Plastics	All forms	Cracks	5
Glass	All forms	Cracks	5
Carbide tipped tools	All forms	Lack of fusion	5
		Porosity	5
		Crack	20
Titanium & high temperature alloys	All forms		20 to 30
Ceramic	All forms	Cracks	5
		Porosity	5

* For lower temperatures, penetration time should be increased.

ANNEXURE - 1 (Clause 5.3.3)

PROCEDURE FOR NON-STANDARD TEMPERATURES

A.1 **General:**

When it is not practical to conduct a liquid penetrant examination within the temperature range of 15.6 to 51.6°C (60 to 125°F), the examination procedure at the proposed lower or higher temperature range requires qualification. This shall require the use of a quench cracked aluminium block, which is designated as 'Liquid Penetrant Comparator Block'.

A.2 **Liquid Penetrant Comparator Block:**

The liquid penetrant comparator block shall be made of aluminum, ASTM B209, Type 2024 or SB-211. Type 2024, 10 mm (3/8 in.) thick, and shall have approximate face dimensions of 50 mm x 75 mm (2 in. x 3 in.). At the centre of each face, an area approximately 25 mm in diameter shall be marked with a 510°C (950°F) temperature indicating crayon or paint. The marked area shall be heated with a blow torch, a Bunsen burner or similar device to a temperature between 510°C (950°F) and 524°C (975°F). The specimen shall then be immediately quenched in cold water which produces a network of the fine cracks on each face. The block shall then be dried by heating to approximately 149°C (300°F). After cooling, the block shall be cut into two halves. One half of the specimen shall be designated block 'A' and the other block 'B' for identification in subsequent processing. Figure 1 illustrates the comparator blocks "A" and "B". As an alternate to cutting the block in half to make blocks "A" and "B", separate blocks 50 mm x 75 mm (2 in. x 3 in.) can be made using the heating and quenching technique as described above. Two comparator blocks with closely matched crack patterns may be used. The blocks shall be marked "A" and "B".

A.3 **Comparator Application:**

(a) If it is desired to qualify a liquid penetrant examination procedure at a temperature of less than 15.6°C (60°F) the proposed procedure shall be applied to block "B" after the block and all materials have been cooled and held at the proposed examination temperature until the comparison is completed. A standard procedure which has previously been demonstrated as suitable for use shall be applied to block "A" in the 15.6 to 51.6°C (60 to 125°F) temperature range. The indications of cracks shall be compared between blocks "A" and "B". If the indications obtained under the proposed condition on block "B" are essentially the same as obtained on block "A" during examination at 15.6 to 51.6°C (60 to 125°F), the proposed procedure shall be considered qualified for use.

(b) If the proposed temperature for the examination is above 51.6°C (125°F), block "B" shall be held at this temperature throughout the examination. The indication of cracks shall be compared as described in T-647.3(a) while block "B" is at the proposed temperature and block "A" is at the 15.6 to 51.6°C (60 to 125°F) temperature range.

(c) A procedure qualified at a temperature lower than 15.6°C (60°F) shall be qualified from that temperature to 15.6°C (60°F).

(d) To qualify a Procedure for temperatures above 51.6°C (125°F), the upper and lower temperature limits shall be established and the procedure qualified at these temperatures.

(e) As an alternate to the requirements of (a) and (b) when using color contrast penetrants, it is permissible to use a single comparator block for the standard and non-standard temperatures and to make the comparison by photography.

CS-757

CORPORATE STANDARD

(f) When the single comparator block and photographic technique is used, the processing details (as applicable) described in (a) and (b) above shall apply. The block shall be thoroughly cleaned between the two processing steps. Photographs shall be taken after processing at the nonstandard temperature and then after processing at the standard temperature. The indication of cracks shall be compared between the two photographs. The same criteria for qualification as (a) above shall apply.

(g) Identical photographic techniques shall be used to make the comparison photographs.

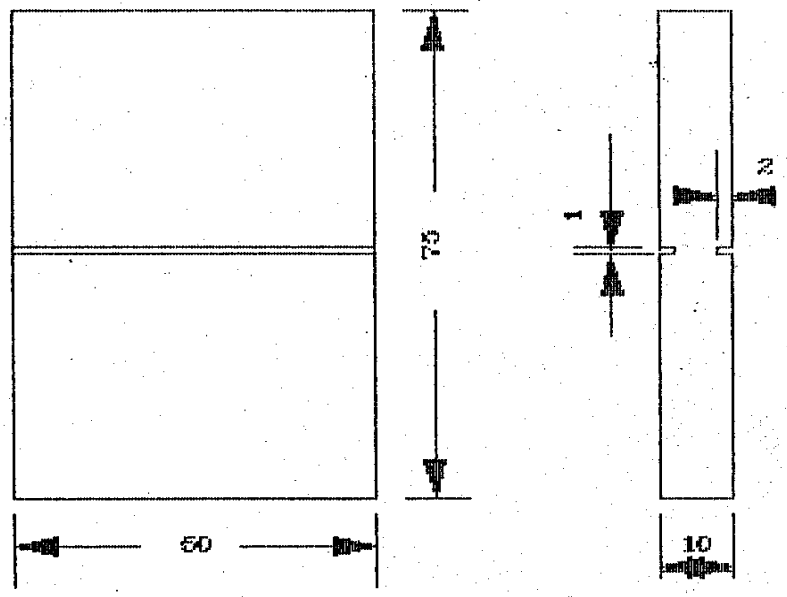


FIGURE: 1-LIQUID PENETRANT COMPARATOR BLOCK

STRUCTURAL STEEL-STANDARD QUALITY

(PLATES, SECTIONS, STRIPS, FLATS & BARS)

(ORDERING DESCRIPTION)

1.0 GENERAL:

This specification governs the quality requirements of structural steel plates, strips, flats, bars and sections such as angles, beams, channels and tees etc. of IS: 2062 – 2011, Gr: E250, Quality A

2.0 APPLICATION:

For general engineering purpose.

3.0 CONDITION OF DELIVERY:

Plates, Bars & Sections: Hot rolled in straight lengths without twists & Bends

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

Material shall comply with the requirements of IS: 2062 – 2011, Gr: E250, Quality A

Material offered to EN 10025-2:2004 Gr. S275JR is also acceptable. The tolerance on dimensions for plates shall comply with EN 10029.

5.0 DIMENSIONS AND TOLERANCES:

5.1 DIMENSIONS:

5.1.1 Sizes

Material shall be supplied to the dimensions specified on BHEL Order.

5.1.2 Length

Unless otherwise specified, hot rolled bars and sections shall be supplied in 3 to 6 metres length.

5.2 Tolerances:

5.2.1 The tolerances on hot rolled material shall comply with IS: 1852. However, no plate shall be under the specified thickness at any point.

5.2.2 Straight for hot rolled bars:

Unless otherwise specified, the permissible deviation in straightness shall not exceed 5 mm in any 1000 mm length.

6.0 HARDNESS (BRINELL):

When tested in accordance with IS: 1500, the material shall show a brinell hardness in the range of 120-156 HB.

Note: Hardness test shall be conducted only when tensile test cannot be performed.

7.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied.

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

The test certificate shall bear the following information.

AA10108 Rev.11 / IS:2062 Grade: E250 Quality A / EN 10025-2 Gr. S275JR,

BHEL order no., Melt no. Size, Results of chemical analysis and Mechanical tests, Supplier's name, Identification no. TC no., Signature of competent authority etc.

8.0 PACKING AND MARKING:

Plates shall be transported suitably to avoid damage during transit.

For plates below 10 mm thick, each pile (preferably of 16 plates) and each plate 10 mm thick & over shall be marked with melt no. AA10108, BHEL order no., Supplier's name, Identification no., Size & weight on any one corner and encircled with paint preferably of white colour.

9.0 REFERRED STANDARDS (Latest publications including amendments):

1) IS: 1500 2) IS: 1852 3) EN 10029

STRUCTURAL STEEL - WELDABLE QUALITY
(PLATES, SECTIONS, STRIPS, FLATS AND BARS)

ORDERING DESCRIPTION

1.0 GENERAL:

The material shall conform to IS 2062 – 2011, E250-Gr.BR (with mandatory Impact Test) or DIN EN 10025-2:2005, Gr. S275JR and comply with following additional requirements.

2.0 APPLICATION:

For general engineering purposes, suitable for welding.

3.0 CONDITION OF DELIVERY:

3.1 Bars & Sections shall be supplied in Hot rolled in straight lengths without twists and bends.

3.2 The material shall be supplied as per IS: 2062 – 2011, E250 Gr.BR (with mandatory Impact Test) or as per DIN EN 10025-2:2005 Gr. 275JR.

3.3 Any other additional requirement as per BHEL Purchase order.

4.0 DIMENSIONS AND TOLERANCES:

4.1 Sizes:

Material shall be supplied to the dimensions specified in BHEL Order.

4.2 Tolerances:

The tolerances on hot rolled material shall comply with IS: 1852 or any other equivalent national standard.

4.3 Straightness for hot rolled bars:

Unless otherwise specified, the permissible deviation in straightness shall not exceed 5 mm in any 1000 mm length.

5.0 TEST SAMPLES:

The selection of test pieces for all tests like Chemical, Mechanical etc. shall be as per IS: 2062, E250-Gr.BR or DIN EN 10025-2, Gr. S275JR.

CORPORATE PURCHASING SPECIFICATION

6.0 ULTRASONIC EXAMINATION:

Plates shall be ultrasonically examined in accordance with BHEL standard AA0850120 (or ASTM-A435) as detailed below and shall comply with the acceptance standards specified therein.

6.1 For plates above 40 mm thick:

Shall be ultrasonically examined unless when otherwise specified in order.

7.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied.

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

The test certificate shall bear the following information:

AA10119 - Rev.No.15/ IS: 2062-Gr: BR (with mandatory Impact test) or DIN EN 10025-2, Gr. S275JR,

BHEL order No.

Melt No, Size & Quantity, Batch No with heat treatment details, Results of Chemical analysis,

Mechanical tests & NDT, Supplier's name, Identification No, TC No, Signature of Competent Authority, etc.

8.0 PACKING AND MARKING:

Plates shall be transported suitably to avoid damage during transit.

Each plate shall be marked with Melt No. Material grade and specification, BHEL Order No, Supplier's Name Identification No, Size & weight, on any one corner and encircled with paint preferably of white colour.

9.0 REJECTION AND REPLACEMENT

If the material does not comply with the requirements of this specification during receipt inspection at BHEL or if any defect is found during further processing of material, BHEL reserves the right to reject the whole consignment and the supplier shall replace the material free of cost. The rejected material shall be taken back by the supplier after fulfilling the commercial terms and conditions.

10.0 REFERRED STANDARDS (Latest publications including amendments):

1) IS: 1852 2) ASTM - A435 3) AA0850120

26/6/14

CS-721

STEEL TUBES – ELECTRIC RESISTANCE WELDED / SUBMERGED ARC WELDED

1.0 GENERAL:

This specification governs the quality requirements of light, medium and heavy grades of Electric Resistance Welded/Submerged Arc Welded steel tubes with plain ends in ungalvanized and galvanized condition in the range of 60mm to 150mm NB.

2.0 APPLICATION:

For general purpose, suitable for bending, welding and screwing for flanges and fittings. Not suitable for steam services.

3.0 CONDITION OF DELIVERY:

Tubes shall be supplied with plain ends.

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

Unless otherwise specified, tubes shall be supplied in ungalvanized condition.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply with the requirements of the following National standard and also meet the requirements of this specification.

IS: 1239(part 1) – 2004: Steel Tubes, Tubular and other Wrought Steel Fittings
Gr: ERW.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes:

BHEL order shall clearly state the maximum outside diameter, and wall thickness of the tube.

5.2 Tolerances:

5.2.1 Thickness:

Light tubes	+ not limited − 8 percent
Medium and Heavy tubes	+ not limited − 10 percent

5.2.2 Weight:

Single tube (light series)	+ 10 percent − 8 percent
Single tube (medium and heavy series)	± 10 percent
For quantities per load of 10 tonnes, min (light series)	+ 7.5 percent − 5 percent
For quantities per load of 10 tonnes, min (medium and heavy series)	± 7.5 percent

5.2.3 Internal Weld Fin:

Height of the internal weld fin shall not be greater than 60 percent of the specified thickness.

5.2.4 Length:

5.2.4.1 Random Length:

Tubes shall be supplied in random lengths of 4 to 7 meters, unless otherwise specified and in the line with IS: 1239, Part 1.

5.2.4.2 Exact Length:

When exact lengths are called for, the tolerances shall be + 6 mm, − 0 mm of the specified length.

6.0 MANUFACTURE:

Tubes shall be made from tested quality steel manufactured by any approved process and shall be fully killed.

Tubes shall not be manually welded.

7.0 FREEDOM FOR DEFECTS:

Tubes shall be cleanly finished and reasonably free from injurious defects. They shall be reasonably straight. The ends shall be cut cleanly and reasonably square with the axis of the tube.

8.0 CHEMICAL COMPOSITION:

The melt analysis of steel shall be as follows:

Element	Percent max.	Permissible variation over specified limit, ± max
Carbon	0.20	0.02
Manganese	1.30	0.04
Sulphur	0.040	0.005
Phosphorus	0.040	0.005

9.0 GALVANIZING:

When galvanized tubes are ordered, the Zinc coating on the tubes shall be in accordance with IS: 4736

10.0 TEST SAMPLES:

All tubes bearing the same designation and manufactured under a single process shall be grouped together to constitute a lot. Each lot shall be sampled separately in accordance with IS: 4711

11.0 MECHANICAL PROPERTIES:

11.1 Tensile:

The tensile strength of strips cut form selected tubes, when tested in accordance with IS: 1608 shall be as follows:

Tensile strength : 320 N/mm^2, min.

Elongations on $5.65\sqrt{S_o}$ gauge length:

Up to and including. 25 mm NB : 12 percent, min.
Over 25 mm up to including150 mm NB : 20 percent, min.

Note:

1. For welded tubes, the strip tensile test specimen shall not contain the weld.
2. For galvanized tubes, zinc coating may be removed by stripping prior to tensile test.

11.2 Bend Test (On tubes up to and including 50mm nominal bore):

When tested in accordance with IS: 2329, the tubes shall be capable of withstanding the bend test without showing any signs of fracture or failure.

Tubes shall be bent with the weld at 90^o to the plane of bending. The tubes shall not be filled for this test.

Ungalvanised tubes shall be capable of being bent cold without cracking, through 180^o around a former having a radius at the bottom of groove in the plane of bending equal to at least six times the outside diameter of the tube.

Galvanized tubes shall be capable of being bent cold without cracking of the steel, through 90^o round a former having a radius at the bottom of the groove equal to at least eight times the outside diameter of the tube.

11.3 Flattening Test (On tubes above 50mm nominal bore):

Rings not less than 40mm in length, cut form the end of each selected tubes shall be flattened between parallel plates with the weld at 90^o(point of maximum bending) in accordance with IS:2328. No opening shall occur by fracture in the weld until the distance between the plates is less than 75 percent of the original outside diameter of the tube and no cracks or breaks on the metal elsewhere than in the weld shall occur until the distance between the plates is less than 60 percent of the original outside diameter.

Test rings may have the inner and outer edges rounded.

11.4 Hydraulic Test / Eddy Current Test:

Each tube shall withstand a test pressure of 5 N/mm^2 without showing leakage defects of any kind. The pressure shall be applied and maintained for a minimum period of 3 seconds for proof and inspection.

Note: Eddy current test may be done in place of Hydrostatic test as per the procedure in Annexure – B of IS: 1239, Part-1.

CORPORATE PURCHASING SPECIFICATION

12.0 TEST CERTIFICATES:

Three copies of test certificates shall be supplied, unless otherwise stated on the order.

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

The test certificate shall bear the following information:

AA10152: Rev. No.07: Steel Tubes – ERW/SAW
BHEL order No:

Supplier's Reference:
Name
Identification No.
Melt No.

Results of Tests:
Results of Chemical, Mechanical tests and Hydraulic/Eddy Current test.

13.0 PROTECTIVE COATING:

The tubes shall be protected with a rust preventive coating of varnish, externally throughout the length.

14.0 PACKING AND MARKING:

Each tube shall be plugged at both ends by means of tight fitting end caps.

The tubes shall be suitably packed in bundles/packages to prevent corrosion and damage during transit.

Each bundle/package shall bear the following information:

AA10152: Steel Tubes – ERW/SAW
BHEL Order No.
Consignment/Identification No.
Outside Diameter and Wall Thickness.
Supplier's Name

15.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1) IS: 1608 2) IS: 2328 3) IS: 2329

4) IS: 4736 5) IS: 4711

CARBON STEEL CASTINGS-FUSION WELDING QUALITY

1.0 GENERAL

This specification governs the quality requirements of Carbon Steel Castings-Fusion Welding Quality.

2.0 APPLICATION

For pressure containing parts for high temperature service and of quality suitable for assembly with other castings or wrought steel parts by fusion welding.

3.0 CONDITION OF DELIVERY

Normalised / Normalised & tempered

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

Castings shall not be painted

4.0 COMPLIANCE WITH NATIONAL STANDARDS

There is no Indian standard covering this material. However, assistance has been derived from ASTM A 216-1993, Gr: WCC, in preparing this specification.

5.0 DIMENSIONS AND TOLERANCES

The castings shall be true to the pattern/drawing.

Holes for machining up to and including 50 mm in diameter are to be cast solid, unless otherwise stated in BHEL order/drawing.

Unless otherwise specified in BHEL order/drawing, untoleranced dimensions for the castings shall be as per tolerance class 4 of BHEL standard AA 023 04 02.

6.0 MANUFACTURE

The steel for the castings shall be made by basic electric furnace process or such other process as may be agreed to between BHEL and the manufacturer.

The steel shall be fully killed.

7.0 HEAT TREATMENT

Heat treatment shall be carried out at suitable temperatures to give the properties specified.

Any flame or arc cutting which may have to be done, shall be carried out before heat treatment.

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

8.0 FINISH

All castings shall be properly fettled and dressed and all surfaces shall be thoroughly cleaned.

Machined surfaces shall have the surface finish as indicated in the drawing

9.0 FREEDOM FROM DEFECTS

Castings shall be free from defects such as porosity , blow holes, sand inclusion, shrinkage, cavities, hard spots, cold shuts, cracks, etc., which may adversely affect machining and utility of castings.

When it is necessary to remove risers by flame cutting, care shall be taken to make the cut at a sufficient distance from the body of the casting so as to prevent any defect being introduced into the casting due to local heating.

10.0 CHEMICAL COMPOSITIION

The melt analysis of steel and the permissible variation in the composition of the castings from the melt analysis shall be as specified below:

Element	Melt analysis, Percent, max	Permissible Variation, percent
*Carbon	0.25	0.02
Silicon	0.60	0.05
*Manganese	1.20	0.06
Sulphur	0.045	0.008
Phosphorus	0.040	0.008

Note: 1. In the interest of uniform welding, the concentration of the unspecified alloying elements shall not exceed the limits specified below. Whenever specified in the enquiry/order, the test results of these elements shall also be included in the test certificate. However, the manufacture shall ensure that these elements are within the limits specified.

Element	Percent, Max.
Copper	0.30
Nickel	0.50
Chromium	0.50
Molybdenum	0.20
Vanadlum	0.03
1. Total content of these unspecified elements	1.00

2. For each reduction of 0.01% below the specified maximum carbon content, an increase of 0.04% Mn above the maximum specified will be permitted up to a maximum of 1.40%.

11.0 TEST SAMPLES

Manufacturers shall carryout mechanical testing as per following sampling plan.

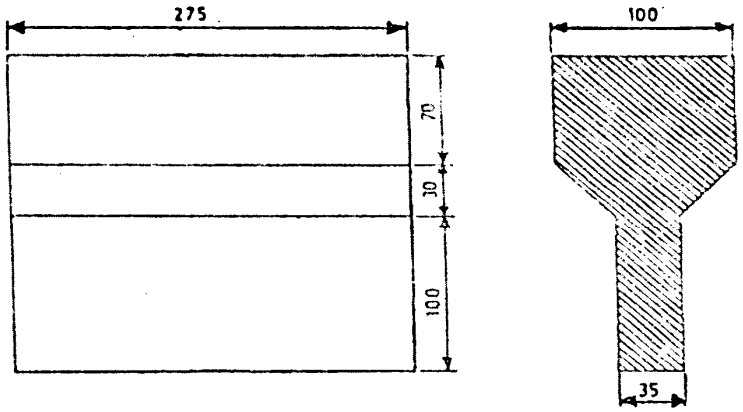
11.1 Unless otherwise specified for castings weighting up to 500 kg. piece weight one keel block, separately cast per melt per heat treatment batch shall be supplied according to the sketch given below:

11.2 Unless otherwise specified castings weighing more than 500 kg shall be provided with integrally cast keel block.

11.3 Retests shall be carried out as per IS : 8800

11.4 Keel blocks with proper identification and representative of the castings shall be supplied along with the consignment for testing at BHEL works.

DETAIL OF KEEL BLOCK



ALL DIMENSIONS IN mm

12.0 MECHANICAL PROPERTIES:

The test pieces, after being heat treated as per clause Cl.7.0 above, shall show the following properties:

12.1 Tensile

The test pieces shall show the following properties when tested in accordance with ASTM A 370

Tensile strength	:	485 - 655 N/mm^2
Yield strength	:	275 N/mm^2, min.
Elongation on 50mm gauge length	:	22 percent, min.
Reduction in area	:	35 percent, min.

12.2 Hardness (Brinell): for information only:

150 - 205 HB.

13.0 NON-DESTRUCTIVE TESTS:

The following tests shall be conducted:

1) Ultrasonic examination to BHEL standard AA 085 01 04 / AA 085 01 05
2) Liquid penetrate examination to BHEL standard AA 085 0131.
3) Magnetic particle examination to BHEL standard AA 085 01 33 and norms of acceptance as per BHEL standard AA 085 01 34.

Norms of acceptance shall be as specified in BHEL order/drawing

14.0 REPAIR OF CASTINGS

The manufacturer without the prior permission of BHEL shall not carry out repair of castings.

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 CERTIFICATES

Three copies of test certificates shall be supplied unless otherwise stated in BHEL 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 test certificate shall bear the following information:

i) Dimensional inspection.

ii) Detail of heat treatment

iii) Chemical composition & unspecified alloying elements whenever called for

iv) Results of mechanical tests

v) Results of NDT tests.

17.0 PACKING AND MARKING

Castings shall be suitably packed to prevent corrosion and damage during transit. Machined surfaces shall be properly protected with anticorrosive compounds. Each package or casting (when supplied separately) shall be legibly marked with the following information.

AA 195 11: C.S. Castings - F.W. Quality
BHEL Order No.
Consignment/Identification No.
Melt No.
Weight
Supplier's Name

18.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1. AA 023 04 02	2. AA 085 01 04	3. AA 085 01 05	4. AA 085 01 31
5. AA 085 01 34	6. ASTM A 216	7. ASTM A 370	8. IS : 8800

ANNEXURE 1 - RECOMMENDED TEST CERTIFICATE FORMAT FOR CASTINGS

SUPPLIERS'S NAME AND ADDRESS

1. Customer :
2. TC No. & Date :
3. PO No. :
4. Process of Melting :
5. Deoxidisation Process
6. Cast No. & Date :
7. Batch No. :
8. Heat Code :
9. Spec.. No. :
10. Test Bar Size

II. CASTING COVERED BY T.C.

Sl. No.	Drawing No. & Item No.	Description	Quantity & Weight

12. CHEMICAL COMPOSITION (PERCENT)

Element	C	Si	Mn	S	P										
As per Min.															
Spec. Max..															
Actual Values.															

13. HEAT TREATMENT
(To be accompanied by Recorder Chart, wherever called for)

Condition	Temp.°C	Soaking Time, Hrs..	Cooling Medium

14. MECHANICAL PROPERTIES

	T.S. N/mm2	Y.S. 0.5/0.2% Proof N/mm2	% E on GL 5.65 SO	% R.A. Min	Hardness BHN Min. 3 Values	Impact Value, Joules	Bend	
As per Min.								
Spec. Max.								
Actual Values.								

15. Surface Finish (When called for in the order/drg)	
16. DIMENSIONAL INSPECTION	

17.NON-DESTRUCTIVE TESTS

Nature of Test	Acceptance Level	Instrument used	Range	Results	Any other details
Ultrasonic					
Radiographic					
Dye Penetrant/ Magnetic Particle					

18. OTHER TESTS, IF ANY (MICRO-Scopic, Hydraulic, Etc.)	
19. IDENTIFICATION ON CASTING AS PER CPS.	

We hereby certify that the items mentioned above have been tested and inspected in our presence and are found to be in accordance with the drawings, specifications and purchase order.

Signature & Seal of the Inspecting Officer (Purchase Representative)

Date :

Signature and Seal of the Chief of Quality Control Chief Metallurgist of the Supplier.

Date :

INSTRUCTION:

a) If steel is produced by LD or Oxygen process, Nitrogen content should be furnished and shall not exceed 0.009%
b) Test Certificates are to be furnished as per Purchase Order and Specifications, in A4 Size transparent paper.
c) All the entries including signature should be in black ink.
d) If testing is done by outside agencies, the original TCs shall be furnished.
e) The actual Test Certificate may run into more than one A4 size paper, if needed, to facilitate filling up of details.

GREY IRON CASTINGS - Gr: FG 260

1.0 GENERAL

This specification governs the quality requirements of Grey Iron Castings having a tensile strength of 260 N/mm^2.

2.0 APPLICATION

Suitable for general engineering purposes.

3.0 CONDITION OF DELIVERY

As cast or cast and stress relieved or rough machined or rough machined and stress relieved as specified in BHEL order/drawing.

Castings shall not be painted.

4.0 COMPLIANCE WITH NATIONAL / INTERNATIONAL STANDARD

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

IS: 210-1993 : Grey Iron Castings
Gr: FG 260

5.0 DIMENSION AND TOLERANCES

Castings shall be true to the pattern / drawing.

Holes for machining up to and including 50mm in diameter are to be cast solid, unless otherwise stated in BHEL order / drawing.

Unless otherwise specified in BHEL order/ drawing, untoleranced dimensions for the casings shall be as per tolerance class 5 of BHEL standard AA 023 04 02.

6.0 MANUFACTURE

The castings shall be cast from the metal melted or refined in any suitable metallurgical plant other than an iron ore smelting furnace.
All castings above five tonnes shall be mould cooled. Under mould cooling process, the mould should not be disturbed until the hottest portion of the casting cools down to 300^{0}C.

7.0 HEAT TREATMENT

Castings shall be artificially aged (stress relieving) by heating in a furnace to a temperature of 520 to 580^{0}C (recommended), whenever specified.

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

8.0 FINISH

All castings shall be properly fettled and dressed and all surfaces shall be thoroughly cleaned. Whenever specified, the machined surfaces shall have the surface finish as indicated in the drawing.

9.0 FREEDOM FROM DEFECTS

Castings shall sound, clean, free from defects such as porosity, blow holes, sand inclusions, shrinkage's, cavities, hard spots, cold shuts, cracks, etc. which may adversely affect machining and utility of castings.

10.0 CHEMICAL COMPOSITION

The composition of iron is left to the discretion of the manufacturer. (But limit of sulphur and phosphorus may be specified by BHEL, if desired).

In case of special castings, the detailed chemical composition shall be as agreed between BHEL and the manufacturer.

11.0 TEST SAMPLES:

11.1 Provision of Test Bars :

All the test bars shall be cast separately in sand moulds and the number of test bars required shall be as specified in clause 11.2 below. They shall be cast at the same time and from the same melt as the castings they represent..

The test bar material shall be identifiable with that of the castings represented.

When castings are subjected to heat treatment and the test bars shall be heat treated together with the castings they represent.

11.2 Frequency Of Testing:

The number of tests required for each melt or batch of castings shall be as laid in table 1 below.

Table 1: Number of Tests

Group	Mass of Individual Castings	Test Requirements	Test Samples
* 1	upto 12.5 kg	One test for every 500kg of castings or part thereof.	3
* 2	over 12.5 kg and upto 50 kg	One test for every 1 tonne of castings or part thereof.	3
* 3	over 50 kg and upto 500 kg	One test for every 2 tonnes of castings or part thereof.	3
* 4	over 500 kg and upto 1 tonne	One test for every 3 tonnes of castings or part thereof.	3
5	over 1 tonne	One test for every 4 tonnes of castings or part thereof or one test for every casting weighing 4 tonnes or more.	3

* In group 1, 2, 3 & 4 all castings represented by one test shall be poured from the same ladle or same heat as the bars provided for the test.

11.3 **Size of Test Bars:**

A test bar from which the tensile test piece is machined shall be cast as a uniform cylindrical bar of 30mm diameter. The tolerance on the diameter shall be + 2mm, - 0 mm.

The minimum length of the test bar shall be 230mm.

11.4 **Dimensions of Test Pieces:**

Test pieces shall conform to the dimensions as per IS:210.

Note: Test bars as specified above with proper identification and representative of the castings shall be supplied along with the consignment for testing at BHEL works.

12.0 MECHANICAL PROPERTIES

12.1 Tensile:

The test pieces prepared in accordance with clause 11 shall show a tensile strength of 260 N/mm^2, minimum, when tested in accordance with IS:1608.

12.2 Hardness (Brinell)

Hardness shall be measured on actual casting at three different places. The castings shall have a Brinell Hardness in the range of 180 to 230 HB, when tested in accordance with IS 1500.

13.0 OPTIONAL TESTS

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

13.1 Non-destructive test

Magnetic Particle Inspection:

Magnetic Particle Inspection as per BHEL standard AA 085 01 33 and norms of acceptance as per AA 085 01 34 at level 2.

13.2 Hydraulic:

Hydraulic test shall be conducted by the manufacturer. In case hydraulic testing as prescribed on the BHEL order/drawing is not carried out at the manufacturer's works, the same shall be carried out by BHEL after necessary machining. However, the manufacturer shall guarantee against any leakage when tested at BHEL's end.

Test pressure and duration of test shall be as specified in BHEL order/drawing.

14.0 RETEST

Retest shall be done as per IS:210.

15.0 REPAIR OF CASTINGS

Repair of castings shall not be carried out by the manufacturer without the prior permission of BHEL.

CS-655

16.0 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.

17.0 TEST CERTIFICATES

Three copies of test certificates shall be supplied unless otherwise stated on 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 alongwith their dispatch documents to facilitate quick clearance of the material.

The following details shall be furnished in the test certificate:

1. Dimensional inspection
2. Detail of heat treatment
3. Hardness value
4. NDT
5. Optional tests called for in the drawing/order.

18.0 PACKING AND MARKING

Castings shall be suitably packed to prevent corrosion and damage during transit. Machined surfaces shall be properly protected with anticorrosive compounds. Each package or casting (when supplied separately) shall be legibly marked with the following information.

AA 19703: Grey Iron Castings-Gr: FG 260
BHEL Order No.
Consignment/Identification No.
Melt No.
Weight
Supplier's Name

19.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1. IS: 210 2. IS:1500 3. IS:1608 4. AA 023 04 02

4. AA 085 01 33 5. AA 085 01 34

ANNEXURE 1 - RECOMMENDED TEST CERTIFICATE FORMAT FOR CASTING

SUPPLIERS'S NAME AND ADDRESS

1. Customer :
2. TC No. & Date :
3. PO No. :
4. Process of Melting :
5. Deoxidisation Process
6. Cast No. & Date :
7. Batch No. :
8. Heat Code :
9. Spec., No. :
10. Test Bar Size

II. CASTING COVERED BY T.C.

Sl. No.	Drawing No. & Item No.	Description	Quantity & Weight

12. CHEMICAL COMPOSITION (PERCENT)

Element	C	Si	Mn	S	P										
As per Min.															
Spec. Max..															
Actual Values.															

13. HEAT TREATMENT
(To be accompanied by Recorder Chart, wherever called for)

Condition	Temp.°C	Soaking Time, Hrs..	Cooling Medium

14. MECHANICAL PROPERTIES

	T.S. N/mm2	Y.S. 0.5/0.2% Proof N/mm2	% E on GL 5.65 SO	% R.A. Min	Hardness BHN Min. 3 Values	Impact Value, Joules	Bend	
As per Min.								
Spec. Max.								
Actual Values.								

15. Surface Finish (When called for in the order/drg)	
16. DIMENSIONAL INSPECTION	

17.NON-DESTRUCTIVE TESTS

Nature of Test	Acceptance Level	Instrument used	Range	Results	Any other details
Ultrasonic					
Radiographic					
Dye Penetrant/ Magnetic Particle					

18. OTHER TESTS, IF ANY (MICRO-Scopic, Hydraulic, Etc.)	
19. IDENTIFICATION ON CASTING AS PER CPS.	

We hereby certify that the items mentioned above have been tested and inspected in our presence and are found to be in accordance with the drawings, specifications and purchase order.

Signature & Seal of the Inspecting Officer (Purchase Representative)

Date :

Signature and Seal of the Chief of Quality Control Chief Metallurgist of the Supplier.

Date :

INSTRUCTION :

a) If steel is produced by LD or Oxygen process, Nitrogen content should be furnished and shall not exceed 0.009%
b) Test Certificates are to be furnished as per Purchase Order and Specifications, in A4 Size transparent paper.
c) All the entries including signature should be in black ink.
d) If testing is done by outside agencies, the original TCs shall be furnished.
e) The actual Test Certificate may run into more than one A4 size paper, if needed, to facilitate filling up of details.

KEVLAR SHEETS (MEDIUM PRESSURE OIL) Î

1.0 GENERAL:

This specification governs the quality of Kevlar sheets for medium pressure oil application. Î

2.0 APPLICATION:

Suitable for use with oil in steam turbine and industrial applications at maximum operating pressure of 7.0 N/mm² and temperature of 425°C.

3.0 DIMENSIONS AND TOLERANCES:

3.1 Dimensions: The material shall be supplied to the dimensions specified on the order.

3.2 Thickness: The thickness of sheets shall preferably be selected from the following:

0.40, 0.50, 0.75, 1.00, 1.50, 2.00, 3.00 mm.

3.3 Tolerances: Maximum permissible deviation on nominal thickness of sheets shall be as follows:

Nominal Thickness mm		Permissible deviation from nominal thickness ± mm	Max. deviation between points not more than 250 mm apart, ± mm
Above	Upto & incl.		
-	0.50	0.05	0.05
0.50	1.00	0.10	0.10
1.00	2.00	0.15	0.10
2.00	3.00	0.20	0.15

4.0 MATERIAL:

The sheets shall consist mainly of Kevlar material. Î

5.0 FREEDOM FROM DEFECTS:

The Kevlar sheets shall be of uniform texture, smooth on both sides without any crack and free from irregularities. Î

6.0 TEST SAMPLE:

Supplier shall supply a test sample to BHEL for acceptance before regular supplies. Î

7.0 PROPERTIES:

When tested the material shall show the following properties:

7.1 Flexibility after accelerated ageing: Shall show no visual sign of cracking.

7.2 Compressibility and recovery test:
7.2.1 Compressibility: 6 to 14%
7.2.2 Recovery: 40% minimum

7.3 Tensile strength: 7 N/mm² minimum

7.4 Oil absorption: The percentage ingress in thickness and mass shall not exceed the value given below.

7.4.1 Oil: Ingress in thickness/mass for 5 hours at 150 ±2°C – 50% maximum.

7.4.2 Petrol: Increase in thickness for 5 hours at 20 to 30°C : 50% maximum.
Increase in mass for 5 hours at 20 to 30°C : 30% maximum.

7.5 Water absorption: Increase in mass : 10% maximum.

7.6 Tensile strength: For 0.4 mm up to and including 1.0 mm thick : 9.0 N/mm²
Above 1.0 mm thick : 12.0 N/mm²

7.7 Stress relaxation: Residual stress : 17.5 N/mm² minimum.

8.0 TYPE APPROVAL:

Samples for type approval testing shall be accepted only from those manufacturers whose manufacturing and testing facilities are considered satisfactory, to ensure continuous supply of good product.

9.0 TEST CERTIFICATES:

Unless otherwise stated, three copies of the test certificate shall be supplied along with each consignment, giving the following information.

AA 21503 Rev.No.02 : Kevlar sheet for medium pressure oil application. Î
BHEL Order No.
Manufacturer's/Supplier's Name.
Trade Mark, if any.
Batch/Lot No.
Date of manufacture.
Quantity supplied.
Test results of Clauses 3 and 7. Î

10.0 PACKING AND MARKING:

Unless otherwise stated, the material shall be supplied either flat or in rolls suitably packed to prevent damages during transit.

Manufacturer's name and grade shall be clearly marked on a piece of 300x300 mm cut from any position of the sheet.

Each package shall be legibly marked with the following information:

AA 21502 Rev. No.02 : Kevlar sheet for medium pressure oil application. Î
BHEL Order No.
Manufacturer's/Supplier's Name.
Trade Mark, if any.
Batch/Lot No.
Date of manufacture.
Quantity supplied

11.0 Probable Supplier Î
M/s. V.J. Industries,
Kumarpuram, Chrompet
Chennai – 600044.

RUST PREVENTIVE HARD FILM, BLACK (TRP)

1.0 GENERAL:

This specification governs the quality requirements of temporary rust preventive (TRP), coating a hard film on drying. The material consists of film forming ingredients dissolved in solvents to give a low viscous liquid at room temperature. On evaluation of solvents, a thin though abrasion resistant film capable of being handled without damage shall be obtained. Normally this material gives protection upto six months and thereafter requires inspection and reapplication, if necessary.

2.0 APPLICATION:

Depending upon components and their sizes, the rust preventive can be applied by brush, dip or spray. Two liberal coats are desirable for adequate protection. The surface to be coated with anti rust solution should be absolutely clean and free from rust.

3.0 REMOVAL:

This TRP can be removed by cotton cloth soaked in white spirit to BHEL specification AA 56701.

4.0 COLOUR : Steel Black.

5.0 COMPLIANCE WITH NATIONAL STANDARDS:

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

IS: 1153 - 2000:RA-2005 Temporary Corrosion Preventive, Fluid, Hard Film, Solvent deposited,

6.0 COMPOSITION:

The composition shall be based on asphalt, mineral oil and inhibitive pigments with suitable additives.

7.0 TEST SAMPLES:

Half a litre of sample shall be taken for testing and approval.

8.0 PROPERTIES:

When tested in accordance with the relevant clauses of BHEL standard AA 085 00 01, the test sample shall show the following properties:

8.1 Consistency : 90 ± 10 seconds in Ford Cup No.4 at 27± 0.5^{0}C.

8.2 Drying Time : Tack free: Within one hour
Hard dry : 16 hours

8.3 Flash Point : 32^{0}C, min.

8.4 Weight : 11 ± 0.5 kg per 10 litres.

8.5 Non-volatile Matter : 58 ± 2% by mass.

8.6 Test for Adhesion : To pass the test

8.7 Spreading Capacity : 8.0 sq.meter/litre, minimum

8.8 Protection against corrosion at high temperature and humidity:

To pass the test for 360 hours, minimum..

9.0 TYPE TESTS:

Whenever specified, the following tests shall be carried out, as per the methods mentioned against each:

i) **Protection against corrosion under conditions of condensation (IS:101, part 6/sec.1):**

No sign of corrosion on the surface after 21 days of exposure.

10.0 TEST CERTIFICATES:

Three copies of test certificates shall be supplied alongwith each consignment, giving the following information:

In addition, the supplier shall ensure to enclose one copy of the test certificate alongwith the despatch documents to facilitate quick clearance of the material.

AA 551 54, Rev. 03 : Rust preventive hard film, black (TRP)
BHEL Order No.
Batch / Lot No.
Supplier's/ Manufacturer's Name and Trade mark, if any
Date of manufacture and expiry
Test results of clause 8.0 & 9.0.

11.0 KEEPING PROPERTY:

When stored in a covered dry place in the original sealed containers under normal temperature conditions, the material shall retain the properties prescribed in this specification for a period of not less than 12 months after the date of manufacture which shall be subsequent to the date of placing the order.

12.0 PACKING & MARKING:

Unless otherwise specified, the material shall be supplied in 4 kg steel containers, which shall be leak free, dry and clean.

Each container shall marked with the following information:

AA 551 54: Rust preventive hard film, black (TRP)
BHEL Order No.
Supplier's / Manufacturer's Name and Trade mark, if any
Batch No./Lot No.
Date of manufacture and expiry
Quantity supplied

8.0 ENVIRONMENTAL REQUIREMENTS:

The supplier shall furnish Material Safety Data Sheet **(MSDS)** covering all information relating to human safety and environmental impacts of the hazardous materials particularly during their transportation, storage, handling and disposal alongwith each supply.

Each container shall be marked with corresponding symbol and minimum worded cautionary notice for flammable / corrosive / toxic / harmful / irritant and oxidizing etc. as applicable

13.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1. AA 085 00 01 2. AA 56701 3. IS: 1153

RUST PREVENTIVE, DRYING TYPE – PIGMENTED (TRP)

1.0 GENERAL:

This specification governs the quality of pigmented drying temporary hard film TRP coating. The material consists of a film forming synthetic resin, inhibition pigment (zinc chromate/ zinc phosphate) and suitable additives. This bright yellow pigmented preservative gives long term preservation at medium and high ambient upto one year and needs inspection and reapplication, if necessary.

2.0 APPLICATION:

Depending upon the components and their size, the rust preventive can be applied by brush, spray or dip. Two liberal coats are desirable for adequate protection.
The surface to be coated with rust solution should be scrupulously clean and devoid of rust.

3.0 COLOUR:

Yellow.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

There is no Indian standard covering this material.

5.0 CHEMICAL COMPOSITION:

The composition shall be based on synthetic resin inhibitive pigment (zinc chromate/zinc phosphate) with suitable additives.

6.0 TEST SAMPLES:

Half a litre of sample shall be taken from each consignment for testing and approval.

6.1 To draw a representative sample, the contents of the container selected for sampling shall be mixed as thoroughly as possible by shaking or stirring or both or by rolling, so as to bring all portions into uniform distribution.

6.2 The samples shall be taken in a suitable, clean, dry air-tight glass bottle of one liter capacity. It should be almost but not completely filled by the sample.

6.3 In case of failure of first sample, two samples shall be drawn from other two drums of the same consignment at random and failure of the second sample in complying with the specification will lead to the rejection of the whole consignment.

7.0 PROPERTIES:

When tested in accordance with test methods mentioned against each, the test sample shall show the following properties:

7.1 Consistency (AA 085 00 01):

60 – 70 seconds in cup No. 4 to IS: 3944 -1982, RA-2005at 27± 0.5^0 C.

7.2 Drying Time (AA 085 00 01):

Touch dry : within one hour

Hard dry : 16 hours

7.3 Weight in kg per 10 litres (AA 085 00 01):

14.0 ± 0.5

7.4 Non-volatile Content (AA 085 00 01):

73 ± 2% by mass.

7.5 Test for Adhesion (AA 085 00 01):

To pass the test.

7.6 Protection Against Corrosion at High Temperature and Humidity (AA 085 00 01):

No sign of corrosion under the film.

7.7 Scratch Hardness (IS: 1153):

To pass the test.

8.0 REMOVAL:

This shall be removable by using white spirit to BHEL specification AA 567 01.

9.0 TYPE TESTS:

9.1 Flash Point (AA 085 00 01):

Above 35^0 C.

9.2 Spreading capacity (AA 085 00 01):

6.5 sq.m per litre. minimum.

9.3 Salt spray Test for 7 days (IS:2074):

No sign of corrosion underneath the paint film.

10.0 TEST CERTIFICATES

Three copies of test certificates shall be supplied alongwith each consignment, giving the following information:

In addition, the supplier shall ensure to enclose one copy of the test certificate alongwith the despatch documents to facilitate quick clearance of the material.

AA 5551 55, Rev. 02 : Rust preventive, drying type-pigmented (TRP)
BHEL Order No.
Batch / Lot No.
Supplier's/ Manufacturer's Name and Trade mark, if any
Date of manufacture and expiry
Test results of clause 7.0.

11.0 KEEPING PROPERTY:

When stored in a covered dry place in the original sealed containers under normal temperature conditions, the material shall retain the properties prescribed in this specification for a period of not less than 12 months after the date of manufacture which shall be subsequent to the date of placing the order.

12.0 PACKING & MARKING

Unless otherwise stated, the TRP shall be supplied in 4 kg steel containers.

Each container shall bear the following information:

AA 551 55: Rust preventive, drying type-pigmented (TRP)

BHEL Order NO.
Supplier's / Manufacturer's Name
Trade mark, if any
Date of manufacture and expiry
Batch No.
Quantity supplied

13.0 ENVIRONMENTAL REQUIREMENTS:

The supplier shall furnish Material Safety Data Sheet **(MSDS)** covering all information relating to human safety and environmental impacts of the hazardous materials particularly during their transportation, storage, handling and disposal alongwith each supply.

Each container shall be marked with corresponding symbol and minimum worded cautionary notice for flammable / corrosive / toxic / harmful / irritant and oxidizing etc. as applicable

14.0 REFERRED STANDARDS (Latest Publications Including Amendments)

1. AA 085 00 01
2. AA 567 01
3. IS: 1153
4. IS 2074
5. IS 3944

ANTI-CORROSIVE PRIMING PAINT

1.0 GENERAL:

This specification governs the quality requirements of air drying Anti Corrosive ready mixed Red oxide Zinc phosphate priming paint which shall be capable of being brushed, sprayed by conventional methods. The priming paint shall be suitable to be thinned with MTO/white spirit conforming to BHEL specification AA56701.

The paint shall be compatible with high quality full glossy outdoor finishing paint to BHEL specification AA56126 (IS: 2932), when surfaces primed with this paint are coated with 2 coats of finishing paint.

2.0 APPLICATION:

The material shall be intended for use as a primer coat in the painting system for protection of steel surfaces against corrosion for outdoor and indoor application on Electrical equipment. Normally, for best performance the surface to be coated shall be ensured free from oil, loose rust/dust etc., followed by blast cleaning to Sa 2 1/2.

This shall be followed by application of two coats of the priming so as to achieve dft of 30 microns, min.

3.0 COMPLIANCE WITH NATIONAL STANDARDS:

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

IS: 12744 – 1989 (Reaffirmed 2004): Ready Mixed Paint, Air Drying, Red Oxide-Zinc Phosphate Priming-Specification.

4.0 COLOUR: The colour of the material shall be that of red oxide.

5.0 FINISH: Smooth and Matt to Egg shell flat

6.0 FREEDOM FROM DEFECTS:

The priming paint shall remain free from defects like hard settling of pigments, thick and hard skinning etc., when kept in closed container and livering (excessive viscosity build up) during its rated shelf life.

The dried surface of the coating shall be smooth, uniform, homogenous appearance and shall be free from physical defects like, pinholes, wrinkles, hard particles, blisters, air bubbles etc.

7.0 CHEMICAL COMPOSITION:

The paint shall be formulated with anti-corrosive pigments like Red oxide of iron, Zinc phosphate, extenders etc., dispersed in unsaponifiable modified alkyd medium in solvent, thinner and drier in suitable proportions so as to satisfy the requirements prescribed in this

specification. The raw materials used in the formulation of the priming paint shall be of good quality and conform to following Indian standards.

a) Zinc Phosphate : IS: 10897

b) Red Oxide of Iron : IS: 44

c) Petroleum hydrocarbon solvent : IS: 1745

The supplier of the material has to certify that the paint supplied shall be free from lead or its compounds and also meets the legislative requirements of ISO 14001.

8.0 TEST SAMPLES AND TEST METHODS:

Tender samples will not be required when once the type approval is given and the supplier concerned declared that the material for which the tender is given of the same quality as the type approved sample.

500ml of thoroughly mixed sample representing lot be drawn from randomly selected drum and shall be sent to laboratory for testing. The testing shall be done in accordance with relevant part and section of IS: 101 or as specified in this specification.

9.0 PROPERTIES:

9.1. Drying Time

Surface dry : 2 hours, maximum

Hard dry : 12 hours, maximum

9.2. Consistency

Smooth and uniform and suitable for brushing without appreciable drag on the brush or spraying as required.

Efflux time by Ford cup No. 4, at 27 ± 20°C: 80 - 120 secs.

9.3. Mass per Ten Litres:

13.5 kgs. min.

9.4. Flash Point:

30°C, min

9.5. Scratch Hardness:

When tested on coated panels air dried for 48 hrs and tested at a load of 1500g on steel panels and 1000g on tinned mild steel panels, no such scratch as to show the bare metal shall be produced.

9.6. Flexibility and Adhesion:

When tested on coated panels air dried for 48 hrs, no visible damage or detachment of coating shall take place and passes the test when tested by cylindrical bend test method.

9.7. Resistance to Salt Spray:

When tested as per test method of IS 2074, the test panel prepared from the followed by air drying for 48 hrs, material shall show no sign of corrosion after continuous exposure for 96 hrs, in salt spray cabinet.

9.8. Protection against Corrosion under Conditions of Condensations:

The coated panels air dried for 48 hrs, are subjected to continuous exposure, shall show no sign of deterioration of the coating & metal surface show no sign of corrosion.

9.9. COMPOSITION:

9.9.1. Pigment Content: 50 ± 5% by mass

9.9.2. Zinc Phosphate (IS 10897): 16.0%, min. by mass on pigment

9.9.3. Red Oxide AS Fe_2O_3 (IS 44): 50.0%, min. by mass on pigment

10.0 VOLUME SOLIDS: 40.0% min. (Pigment + Binder) by weight.

11.0 COMPATIBILITY TEST WITH COATS:

The primer paint shall be fully compatible with top coats like, High quality full glossy finishing paint conforming to AA56126 /IS 2932, when tested as per method prescribed in Annexure-1.

12.0 WET OPACITY (FOR INFORMATION ONLY):

Theoretical coverage: 10 sq.m / litre @ Dft: 35 microns.

13.0 TEST CERTIFICATES:

Unless otherwise stated, three copies of test certificates shall be supplied along with each consignment.

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

The test certificates shall bear the following information:
AA56101 Rev. No. 07 - ANTI-CORROSIVE PRIMING PAINT

BHEL order:

Supplier's Name and address

Identification/Trade Mark, if any.

Batch No/Lot No.:

Date of Manufacture and Expiry.

Lot Quantity:

Test results of clause 7.0 to 12.0.

Special Instructions, if any.

14.0 KEEPING PROPERTY:

When the material stored in a covered dry place in the original sealed container at under ambient conditions, the same shall retain the properties prescribed in this specification for a period of at least 12 months after the date of manufacture, which shall not be subsequent to the date of placing the order and not earlier than one month of the scheduled delivery date mentioned in BHEL order.

CORPORATE PURCHASING SPECIFICATIONS

15.0 ENVIRONMENTAL REQUIREMENTS:

The supplier shall furnish Material Safety Data Sheet (MSDS) covering all information relating to human safety and environmental impacts of the hazardous materials particularly during their transportation, storage, handling and disposal along with each supply. Each container shall be marked with corresponding symbol and minimum worded cautionary notice for flammable / corrosive / toxic / harmful / irritant and oxidizing etc. as applicable.

16.0 PACKING & MARKING:

Unless otherwise stated, the paint shall be supplied in packing size as specified in BHEL order and shall be packed in air tight leak -proof metal container conforming to IS: 1407 and IS: 2552. Each container shall bear following information neatly written or pasted on the container.

AA56101 - ANTI-CORROSIVE PRIMING PAINT

BHEL order:

Name of supplier and address:

Identification/Trade Mark, if any.

Quantity of material:

Batch No/Lot No.:

Date of Manufacture and Expiry.

Special Instructions, if any:

17.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1) IS : 44
2) IS : 101
3) IS : 1407
4) IS : 1745
5) IS : 2074
6) IS : 2552
7) IS : 2932
8) IS : 10897
9) IS : 12744
10) IS : 13262
11) ASTM D 3359
12) AA56126
13) AA56701

ANNEXURE-I

TEST FOR COMPATIBILITY OF ANTI-CORROSION PRIMING PAINT (AA 56101) WITH TOP COATS OF FINISHING PAINT (AA56126/IS: 2932)

The compatibility of anti- corrosive priming paint conforming to AA 56101 with top coat finishing paint to AA 56126/IS: 2932, shall be checked by Cross-cut tape adhesion method prescribed in ASTM D 3359. The adhesion tape used shall conform to IS: 13262 or any other tape bearing ISI mark having sufficient adhesion strength.

A Steel plate of size 150x100mm is taken for testing compatibility. Thoroughly clean the plate with emery to make it free from rust, oil, dust etc. Apply two coats of homogenized anticorrosive priming paint after allowing coating to dry over night before, application of next coat.

Apply two coats of top coat finishing paint evenly covering plate completely. Allow the coatings, to dry for 48 hours at ambient conditions before performing the cross cut adhesion test.

Test method B shall be followed and the acceptance criteria shall be 4 B, i.e., small flakes of the coating material are detached at intersections and less than 5% of the area is affected

	CORPORATE STANDARD	AA7126938
		Rev. No. 05
		PAGE 1 of 3

SCREWS, HAMMER DRIVE, STEEL

1 DESIGNATION

A Hammer Drive screw of screw No.4, length 8 mm and made of steel shall be designated as

1.1 On drawings

i) Material specification column : AA7126938

ii) Description column : SCRU HAMMER No.4X8-ST

1.2 On indents

Screw, Hammer Drive, No. 4 × 8-ST: AA7126938

1.3 For issuing enquiries and on purchase orders

While issuing enquiries and purchase orders, delete BHEL standard number from the above description and add the information given under clause 2.

2 COMPLIANCE WITH STANDARDS

2.1 Dimensions, Tolerances & General Requirements

As per IS 7519-1974, Table-1 & 2

2.2 Material

As specified in IS 7519

2.3 Finish

As specified in BHEL order.

9/11/16

ES-0041

DRC-R5050

Revisions: As per clause 34.2.A) of MOM of MRC-F			APPROVED: INTERPLANT MATERIAL RATIONALISATION COMMITTEE – MRC (F)		
Rev. No. 05	Amd. No.	Reaffirmed	Prepared HEP, Bhopal	Issued Corp. R&D	Dt. of 1st Issue 01-01-1977
Dt: 25-10-2016	Dt:	Year:			

CORPORATE STANDARD

BHEL

3 NOTE

3.1 Length & Screw No. Combination (refer Table-1 at page 3 of 3) between the bold lines should only be used.

3.2 Hammer drive screws shall have fully formed threads, extending from the base of the pilot to the head, except that threads at the starting end and under the head may be complete for a length equal to one-half of the maximum screw diameter due to the natural flow of material in the thread forming operation.

3.3 The material shall be thick enough to provide adequate thread engagement and the thickness should not normally be less than the screw diameter.

3.4 Screws to this standard would be un-plated, divisions wishing to have plated screws would have to get them plated.

3.5 Weights given in this standard are for general reference only and are not meant for commercial transactions.

3.6 When fasteners are to be tested with in BHEL, sampling and acceptance plan shall be as per IS 1367, Part 17

4 REFERRED STANDARDS (Latest publications including amendment)

1) IS 1367, Part-17

EXPLANATORY NOTE

The following changes have been made in this revision

- Clause 1.2 modified.
- Clause 2.1, Re-affirmation year of IS: 7519 modified as 2006

9/11/16 14-00-52

CS-0041 9/11/16

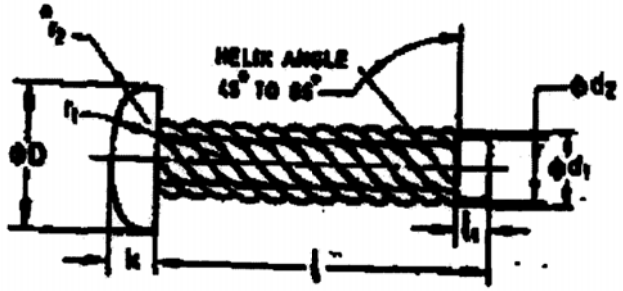


FIG . 1

Note:
1. Corporate Sub-code Numbers only are shown in the Table1.
2. Weights have been shown in kg. per 1000 Nos.

Table-1

All dimensions are in mm

Screw No.	Outside diameter d_1 Max.	HEAD		Pilot diameter d_2 Max.	Number of Thread Starts	Mating hole diameter H11		l_1 Min.	BASIC LENGTH (l)										
		Diameter D Max.	Height k Max.			Thin sheet metal , nonferrous castings, phenol	Cast Iron, thick sheet metal		Tol.	2.4	3.2	4.0	4.8	6.4	8.0	9.5	12.5	16.0	19.0
										± 0.4							± 0.8		
00	1.52	2.51	0.86	1.25	6	1.30	1.40	0.50	Sub- code										
									Weight										
0	1.90	3.23	1.24	1.60	6	1.65	1.75	0.90	Sub-code					012					
									Weight					0.16					
2	2.54	4.12	1.75	2.11	8	2.20	2.30	1.20	Sub-code					055					
									Weight					0.31					
4	2.95	5.36	2.18	2.44	7	2.55	2.70		Sub-code					020	063		101		
									Weight					0.49	0.58				
6	3.56	6.60	2.62	2.95	7	3.10	3.30		Sub-code					039	071	098			
									Weight					0.81					
8	4.24	7.85	3.05	3.45	8	3.70	3.90	1.60	Sub-code							080			
									Weight							1.30			
10	4.62	9.12	3.48	3.84	8	4.10	4.30		Sub-code								047		
									Weight								2.37		
12	5.38	10.36	3.89	4.50	8	4.80	5.00	2.00	Sub-code										
									Weight										
14	6.15	11.62	4.32	5.13	9	5.50	5.80		Sub-code								110		
									Weight										

CORPORATE STANDARD

AA7126938 | Rev. No. 05 | PAGE 3 of 3

LIST OF APPLICABLE STANDARDS ON LIMITS, FITS AND TOLERANCES

1.0 SCOPE:

The standard covers the list of applicable standards on Limits, Fits and Tolerances. These standards are applicable unless or otherwise specified.

2.0 LIST OF APPLICABLE STANDARDS:

SL. NO.	STANDARD NO.		TITLE
1.	AA0230201	-	Limits and Fits (Tolerance grade, Position and Class).
2.	AA0230202	-	Limits and sizes for commercial bolts and nuts.
3.	AA0230204	-	Guide for selection of Fits.
4.	AA0230206	-	Standard limits for Shafts (upto 500 mm).
5.	AA0230207	-	Standard limits for Shafts (above 500 mm and upto 3150 mm).
6.	AA0230208	-	Allowable deviations for dimensions without specified tolerances (linear and angular).
7.	AA0230402	-	Permissible deviations for untoleranced dimensions of castings.
8.	AA0230403	-	Tolerancing system ISO Metric Screw Threads
9.	AA0621101	-	Tolerances and Machining allowances for Flame cutting.
10.	AA0621104	-	General tolerances for welding constructions for length and angles.
11.	AA0621105	-	General tolerances for welded structures – form and position.

NOTE:

1) AA 023 02 08

Medium class of deviation is applicable, if the same is not mentioned on the drgs./specs.

2) AA 023 04 02

Tolerance class 5 is applicable, if the same is not mentioned on the drgs./specs.

3) AA 062 11 04

Accuracy class A is applicable if the same is not mentioned on the drgs.

4) AA 062 11 05

Accuracy class E is applicable, if the same is not applicable on drgs.

BHEL	TD-215 Rev.00	**AMENDMENT-NOTIFICATION**	HY 064 07 63 REV.NO.03 PAGE 1 OF 1

PROCESS SPECIFICATION FOR POST WELD HEAT TREATMENT OF CARBON STEEL AND LOW ALLOY STEEL PRESSURE VESSELS PARTS & OTHER COMPONENTS

The following clause shall be added in page no. 3 of 11, after clause 3.4.

Clause 3.4.1 Threaded portion of the weldments / components shall be protected or preserved by applying "ERPEDOL" compound

(Material Code no. is HY5510062002).

REF: HY:Tech:001	AMD.NO.	APPROVED	ISSUED	DATE	CUM. Sl.No.
	01	MANAGER, STDS. ENGG.	STDS. ENGG.	29.9.2001	A 0351

PROCESS SPECIFICATION FOR POST WELD HEAT TREATMENT OF CARBON STEEL AND LOW ALLOY STEEL PRESSURE VESSELS PARTS & OTHER COMPONENTS

1.0 GENERAL:

1.1 This procedure outlines precautions/general guide lines to Technologists/Heat treatment personnel to ensure code requirements are fully met with during Post Weld Heat Treatment (PWHT) and is written in line with clauses UW-40, UCS-56 and UCS - 85.

1.2 For complete code requirements, relevant clauses/Tables shall be referred to.

1.3 Code requirements /' code cases shall over rule this procedure in case of any discrepancy.

1.4 This procedure is applicable for coded vessels constructed with carbon steel and low alloy steels singularly stress relieved (whole or local) clubbed with other coded/non-coded vessels/weldments.

1.5 This standard stipulates guidelines for applications as per ASME Section VIII div.1. Specific jobs shall be postweld heat treated in consultation with welding engg dept.

1.6 The components/products for which the material specification is in accordance with National/ International codes such as IBR/BS/DIN/ASTM/ANSI/API, the post weld heat treatment requirements stipulated in the relevant codes shall be applicable.

2.0 COMPLIANCE WITH STANDARD:

This standard is based on ASME SECTION VIII, Division 1, Clauses UCS-56, UCS-85 and UW-40.

3.0 EQUIPMENT AND ITS CALIBRATION:

3.1 Heat treatment furnaces operating on electric power or gas or oil are suitable.

3.1.1 In case of thermocouple not placed on component, uniformity of temperature in the working zone shall be maintained within ±14°C during the operation.

3.2 Furnace shall be provided with suitable controller/recorder for temperature measurement. All controlling furnace instruments shall be calibrated as per QMI 001.

PLANT STANDARD
HYDERABAD

3.3 Location of the thermocouple shall be as per the guide lines given below (applicable for ASME coded vessels/ parts) and as per the details given in the technology process sheet of relevant part.

3.3.1 Placement of thermocouples must represent realistic temperature spread expected in the furnace both vertically and axially.

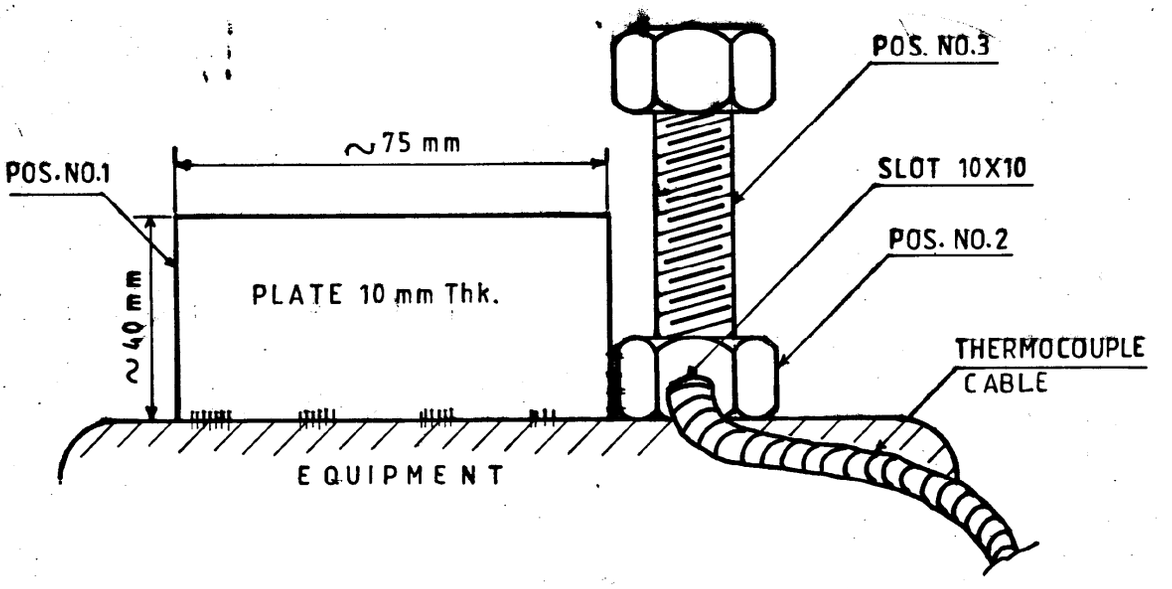
3.3.2 Two thermocouples are required on every single charge upto 5 meters long (zone). An additional thermocouple is required for every additional 5 meter or fraction there of. No two thermocouples may be placed more than 5 meters apart.

3.3.3 When more than one pressure vessel or pressure vessel parts are postweld heat treated in one furnace charge, each such vessel part shall be represented by atleast one thermocouple. Pressure vessels shall be so located such that it satisfies the requirement of clause 3.3.2.

3.3.4 Closure seams of pressure vessels locally or wholly heat treated will have two thermocouples placed 180° apart around the out side of the seam, on top and bottom or on the sides. In case of tube sheet to Hemihead joint (C1 joint) one thermocouple will be placed in tube hole near to center of the tube plate. However, for carbon steel tubed Heat exchanger, thermocouple at the centre is not required.

3.3.5 Fixing of themocouple prior to PWHT on the job shall conform to the procedure for fixing thermocouples as given below:

a) Thermocouple shall be fixed on the equipment with the help of fixing arrangement shown in figure below.



b) Material for Pos. No.1 shall be cut from pressure vessel quality carbon steel plates.

c) Plate Pos.No.1 shall be tackwelded to the nut Pos.No.2 which is provided with a slot of 10x10 mm to facilitate insertion of thermocouple cable. Ensure the nut (Pos.No.2) bottom surface is flush with the plate (Pos.No.1) before tackwelding.

d) Pos. No.1 shall be tackwelded to the equipment by qualified welder with approved WPS. The nut shall not be tackwelded to the equipment.

e) Thermocouple cable shall be secured to the equipment by tightening bolt Pos.No.3 as shown in the fig. above.

f) After PWHT, plate Pos.No.1 shall be removed from the equipment by grinding the tacks.

Do not hammer to break the tacks. Flush grind the tacks after removing the plate.

3.4 Components/pressure vessels shall be protected from the direct impingement of flame.

3.5 Quality control shall ensure conformity of the requirement stipulated in clause 3.1 to 3.4.

4.0 Simulated test coupons shall be proved wherever necessary for all materials used in the ASME code vessels except as permitted in UCS-85(d), (e), (f) and (g). The total time at temperature during simulation shall be atleast 80% of the total time at temperature during actual heat treatment of the product and may be performed in a single cycle. Material of P.No.1, Gr.No.1 & 2 and all carbon steels and low alloy steels used in annealed condition are exempted from this requirement.

5.0 POST WELD HEAT TREATMENT (PWHT) CYCLE:

5.1 All materials in the PWHT charge shall be categorised as per 'P' number and group no. according to ASME Section IX - Clause QW-422. For weldments involving non ASME materials, P numbers and group no. shall be assigned based on nearest equivalent ASME material specification.

5.2 Outline special requirements/instructions if any from drgs/Route cards/material specifications. Necessary information shall be filled in Furnace loading sheet No. PD-316 enclosed.

5.3 Clubbing of non ASME material with coded vessels shall be considered only when such requirements are acceptable to code specified PWHT Cycle.

5.3.1 For assembly of materials of different P nmumbers, the postweld heat treatment shall be the lowest range of the material requiring the higher postweld heat treatment temperature after giving due consideration to the mass of the material involved.

5.4 The temperature of the furnace shall not exceed 425°C at the time of loading.

5.5 Rate of heating:

5.5.1 Rate of heating above 425°C shall not be more than 222°C/hr divided by the maximum metal thickness of the shell or head plate in inches, but in no case more than 222°C/hr. Maximum metal thickness in coded vessel or other weldments in the charges, whichever is maximum shall be used in the calculation. During the heating period there shall not be greater variation in temperature throughout the portion of the vessel being heated than 138°C within any 4.6 M interval of length.

5.5.1.1 The rate of heating and cooling need not be less than 55°C/hr. However, the reduced rates of heating and cooling for closed chambers and complex structures may be considered to avoid distortion due to excessive thermal gradient.

5.6 Soaking Temperature and Time:

5.6.1 Minimum holding time and temperature shall be as per table UCS-56 as given in annexure-1.

A temperature range of 50°C shall be specified starting from code specified minimum normal holding temperature which may be relaxed to 60°C range to facilitate clubbing with vessels constructed to codes other than ASME Sec.viii Div.1.

5.6.2 Wherever impracticable, PWHT at minimum normal holding temperature can be considered as permitted by table UCS 56.1 as given in the annexure-2.

5.6.3 For assessing min. holding time, the nominal thickness shall be the thickness of weld joint as defined in UW-40 (f).

5.6.4 For combined charge the min. holding temperature is the max. of the min. normal holding temperatures of the applicable materials in the charge as per 5.6.1 above. Holding temperatures lower than the min. normal holding temperatures (clause 5.6.2) can be considered only when such temperature is acceptable for all materials in the charge.

5.6.5 For combined charge, the min. holding time is the max. of the min. holding times for various weldments as calculated in applicable clauses 5.6.1, 5.6.2 and 5.6.3 above.

5.6.6 For vessels requiring notch toughness properties (low temp. application, customer requirement etc.) which are post weld heat treated singularly or clubbed with other components/vessels; Soaking time shall be specified in consultation with welding engineering.

5.7 Rate of Cooling:

5.7.1 Above 425°C, cooling shall be done in a closed furnace or cooling chamber at a rate (vide clause 5.5.1.1 also) not greater than 278°C/hr divided by the maximum metal thickness of the shell or head plate in inches, but in no case more than 278°/hr. From 425°C the vessel may be cooled in still air.

6.0 LOCAL POSTWELD HEAT TREATMENT:

6.1 Wherever not practicable, circumferential joints may be locally post weld heat treated by gas fired split furnace or by electrical heating which shall ensure required uniformity.

6.2 The width of the heated band on each side of the greatest width of finished weld shall be not less than two times the shell thickness.

6.3 The portion outside the heating device shall be protected so that the temperature gradient is not harmful.

7.0 POWER/GAS FAILURE DURING PWHT CYCLE:

7.1 Safety precautions on power / gas failure.

7.1.1 Ensure isolation of gas line by closing gate valve on gas inlet line.

7.1.2 Fully open all dampers.

7.1.3 Close all burners.

7.2 Safety precautions before recharging.

7.2.1 Open main door.

7.2.2 Purge residual gases in furnace, by operating air blower.

7.3 Record time and date of gas / power failure and restart of the furnace on the chart.

7.4 Repeat PWHT cycle as per loading chart. Starting temperature for the cycle shall be the existing job temperature.

8.0 INSPECTION AND CERTIFICATION:

8.1 Heat treatment chart shall be certified by Shop QC/third party inspection as per Route card/Quality plan requirements.

9.0 **REFFERED STANDARDS:**

ASME Sec.VIII Div.I

PLANT STANDARD
HYDERABAD

ANNEXURE - 1

TABLE UCS - 56.1

ALTERNATIVE PWHT REQUIREMENTS FOR CARBON AND LOW ALLOY STEELS
(Applicable only when permitted in table UCS-56)

Decrease in temperature below the min. specified temperature °C	Minimum holding time [Note (1)] at decreased temperature (hrs)	Note
28°C	2	--
56°C	4	--
84°C	10	(2)
112°C	20	(2)

Note: (1) Minimum holding time for 25mm thickness or less, Add 15 minutes per 25mm for thickness greater than 25 mm.

(2) The above lower PWHT temperatures permitted only for P No.1 Gr. No.1 and 2 materials.

ANNEXURE - II

POSTWELD HEAT TREATMENT REQUIREMENTS FOR CARBON AND LOW ALLOY STEELS

Sl. No.	P No.	BHEL Specification (Base Standard)	ASME Equivalent	Product Form	Nominal Holding Temp °C Minimum	Minimum Holding Time at Normal Temperature For Thickness(mm) (See UW-40(f))			Remarks
						≤ 50	> 50 ≤ 125	> 125	
1.	P1 or equivalent (Low Carbon Steels	AA 10108 (IS 2062,Gr.A)	--	Sheet	600	1hr/25mm 15minutes minimum	2 hr + 15minutes for each additional 25 mm over 50 mm	2 hr + 15 minutes for each additional 25 mm over 50 mm	Refer Notes 1, 2, 3 of table UCS-56 also
2.		AA 10112 (IS 9550,Gr.20)	--	Bars section	600	"	"	"	"
3.		AA 10119 (IS 2062,Gr.B)	--	Pl, Sh, section bars	600	"	"	"	"
4.	-	AA 10122 (IS 961 Gr. Fe 540 W.Hr)	--	Plates	600	"	"	"	"
5.	-	AA 10152 (IS 1239 pt.1 ERW)	--	Tubes	600	"	"	"	"
6.	-	AA 10156 (ASTM A 179)	SA 179	Tubes	600	"	"	"	"
7.	-	AA 10157 (ASTM A 179)	SA 179	Tubes	600	"	"	"	"

Sl. No.	P No.	BHEL Specification (Base Standard)	ASME Equivalent	Product Form	Nominal Holding Temp °C Minimum	Minimum Holding Time at Normal Temperature For Thickness(mm) (See UW-40(f))				Remarks
8.	-	HY10192 (DIN:2391) Gr.St35-NBK		Tubes		"	"	"	"	
9.	-	HY 10193 (DIN:2391) St52-NBK		Tubes		"	"	"	"	
10.	-	HY 10194 (IS 3601 CDS-430)		Tubes		"	"	"	"	
11.	-	HY 10198 (ASTM A 36)	SA 36	Section		"	"	"	"	
12.	-	HY 10199 (IS1570 pt.II Gr.15C8)		Bars		"	"	"	"	
13.	-	HY 10408 (ASME SA 516 Gr.70)	ASME SA516 Gr.70	Plates	600	"	"	"	"	
14.	-	AA 10455	SA106 Gr.B	Pipes	600	"	"	"	"	
15.	-	HY 10470	SA516 Gr.70	Pipes	600	"	"	"	"	

Sl. No.	P No.	BHEL Specification (Base Standard)	ASME Equivalent	Product Form	Nominal Holding Temp °C Minimum	Minimum Holding Time at Normal Temperature For Thickness(mm) (See UW-40(f))				Remarks
16.	P1 Gr.1	AA 19931 IS 2004 Cl.2	-	Forging	600	"	"	"	"	
17.	-	AA 19341 (IS4367 20C15)	SA105	Forging	600	"	"	"	"	
18.	-	HY 19361	SA105	Forging	600	"	"	"	"	
19.	-	HY 19364	SA350 LF2	Forging	600	"	"	"	"	
20.	Gr.2	HY 19366	SA266 Cl.2	Forging	600	"	"	"	"	
21.	-	AA 19511 (ASTM A 216 WCC	SA216 Gr.WCC	Casting	600	"	"	"	"	
22.	-	AA 19521 (IS 2708 Gr.1)	--	Casting	600	"	"	"	"	
23.	-	HY 19561 (ASTM A 352 LCB	(SA352 LCB	Casting	600	"	"	"	"	
24.	-	HY 19562 (ASTM A 216 WCA	SA216 Gr.WCA	Casting	600	"	"	"	"	
25.	-	HY 19569 (DIN17245 GS-C25)	SA216 Gr.WCA	Casting	580	"	"	"	"	

BHEL
TD-218-Rev.00

PLANT STANDARD
HYDERABAD

HY 064 07 63
REV.No. 03
PAGE 9 OF 11

Sl. No.	P No.	BHEL Specification (Base Standard)	ASME Equivalent	Product Form	Nominal Holding Temp °C Minimum	Minimum Holding Time at Normal Temperature For Thickness(mm) (See UW-40(f))			Remarks
26.	-	HY 19570 (DIN17245 GS-C25)	SA216 Gr.WCA	Casting	580	"	"	"	"
27.	P3 (C-Mo Steel)	HY 19571 (DIN 17245) GS-22Mo4		Casting	660	1h/25mm 15 min. minimum	2h + 15 minutes for each additional 25mm over 50 mm	2h + 15 min for each additional 25mm over 50mm	Refer 1, 2, 3, 4 of table Ucs-56
28.	P4 (1Cr 1/2Mo)	AA 10632	SA335 P11	Plates	600	1hr/25mm 15 min. minimum	1hr/25mm	5hr + 15 min. for each additional 25mm over 125mm	Refer 1, 2 of table UCS-56
29.	P4(1Cr 1/2Mo)	HY 19387	SA182 F11	Forging	600	"	"	"	"
30.	P5 (2¼Cr 1 Mo Gr.1	AA 10630	SA335 P22	Pipes	680	"	"	"	Refer notes 1, 2, 3 of table UCS-56
31.	-	ASME SA387 Gr.5	SA 387 Gr.5	Plates	680	"	"	"	"

Sl. No.	P No.	BHEL Specification (Base Standard)	ASME Equivalent	Product Form	Nominal Holding Temp °C Minimum	Minimum Holding Time at Normal Temperature For Thickness(mm) (See UW-40(f))				Remarks
32.	P6 (13%Cr Stain-less steel)	BS1504 Gr.425 C11	--	Casting	540-560	"	"	"	"	

Note: Maximum holding temperature shall be 30°C below the actual tempering temperature of the parts/components.

FURNACE LOADING SHEET

1. HEAT TREATMENT DETAILS:

CYCLE NO:

DATED:-

1.1 TYPE OF TREATMENT : STRESS RELIEVING (FURNACE/LOCAL)

1.2 RATE OF HEATING ABOVE 425°C:

1.2.1 AS PER CODE : (MAXIMUM) :

1.2.2 RESTRICT TO : (MAXIMUM) :

1.3 SOAKING TEMPERATURE :

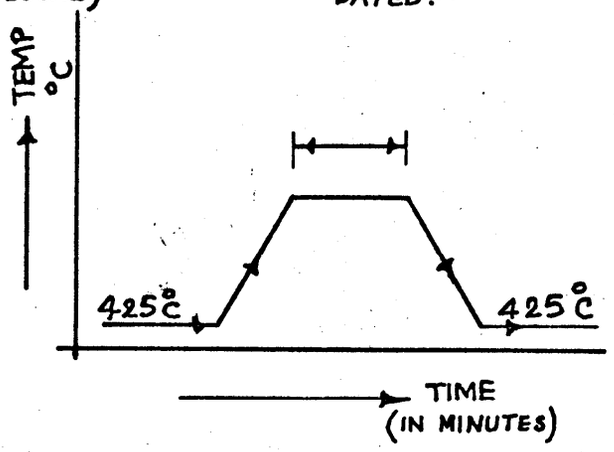
1.4 SOAKING TIME (MINIMUM) : ; MAXIMUM :

1.5 RATE OF COOLING UPTO 425°C

1.5.1 AS PER CODE (MAXIMUM) :

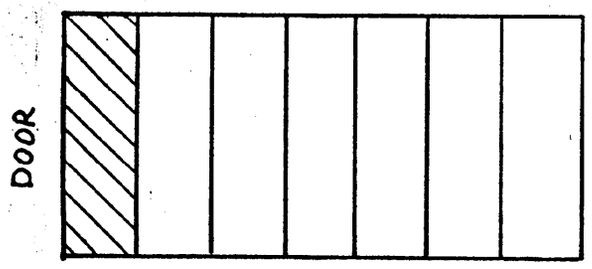
1.5.2 RESTRICT TO (MAXIMUM) :

1.6 TYPE OF COOLING : FURNACE COOLING



SL. NO.	WORK ORDER	PART NO:	DESCRIPTION	QTY.	TOTAL WEIGHT	P.NO TO P.NO	WPS NO.	GOVERNING THK FOR	
								HEATING/ COOLING RATES	SOAKING

THERMO COUPLE POSITION



REMARKS

APPROVED

(FABRICATION TECHNOLOGY)

CLEARANCE BEFORE STARTING THE CYCLE

(QUALITY CONTROL)

DATE OF LOADING;

DATE OF CHARGING;

DT. & SHIFT	OPERATION INCHARGE	ACTUAL TIME		REMARKS
		STARTING	COMPLETION	
				HEATING SOAKING COOLING

THERMOCOUPLE INDICATION:

SNO.	CALIBRATION DUE DATE	COLOUR	SNO.	CALIBRATION DUE DATE	COLOUR
1.			4.		
2.			5.		
3.			6.		

RECORDER NO. DUE DATE OF CALIBRATION.

(PRODUCTION INCHARGE)

H.T. CHART REF. NO.

REVIEWED AND ACCEPTED. RELEASED FOR FURTHER OPERATIONS.

(QUALITY CONTROL)

CARBON STEEL BARS
(Gr. 15 C8)

1.0 GENERAL:

This specification governs the quality of hot rolled/forged Carbon Steel bars of grade 15 C8.

2.0 APPLICATION :

For the manufacture of machined parts for general engineering purposes. Bars of dia 100 mm and above may be used for the manufacture of forged components also.

3.0 CONDITION OF DELIVERY :

3.1 Bars upto dia / size 100 mm (inclusive) shall be supplied in hot rolled condition.

3.2 Bars above 100 mm dia / size can be supplied in hot rolled or forged condition.

3.3 Bars upto 40 mm dia / size can be supplied in as rolled condition if the mechanical properties specified in this specification are achieved.

3.4 All the bars above 40 mm dia / size shall be supplied in Normalised condition.

3.5 The bars shall be supplied with ends square and true. The bars shall be supplied in straight lengths.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

This specification complies with

(1) IS: 1570 (Part II) – 1979] Schedules for Wrought Steels
Gr: 15 C 8] Part II Carbon Steels (unalloyed Steels)

(2) IS: 1875 – 1992 – Carbon steel bars for forgings.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes: The bars shall be supplied to the dimensions specified on the order. Unless otherwise specified, Hot rolled bars / rounds shall be supplied in random lengths of 3 to 5 metres. However, the minimum length for Square bars shall be 4 metres.

Forged bars shall be supplied in the length of 1.5 to 3.0 meters.

5.2 Tolerances:

5.2.1 Hot rolled bars / flats: The dimensional tolerances shall be in accordance with Grade I of IS:3739.

5.2.2 Forged Bars: + 8 mm on diameter/side width.
- 0

5.2.3 Straightness: Unless otherwise agreed to, the permissible deviation in straightness shall not exceed 5 mm in any 1000 mm length.

5.2.4 The tolerance as per any other international standard are also acceptable with prior written approval of BHEL.

6.0 MANUFACTURE:

The steel shall be manufactured by the electric furnace, basic oxygen, duplex process or by a combination of these processes. The bars shall be manufactured from Killed steel.

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

7.0 FREEDOM FROM DEFECTS:

The bars shall be sound and free from internal and surface defects like cracks, surface flaws and laminations.

8.0 HEAT TREATMENT :

The bars shall be normalised at a temperature of 880-910°C. The normalizing operation is optional for bars upto dia / size of 40 mm (inclusive).

9.0 CHEMICAL COMPOSITION:

9.1 The melt analysis of the material shall be as follows:

Element		C	Mn	Si	S	P
Ladle Analysis	% Min.	0.10	0.60	0.15	-	-
	% Max.	0.20	0.90	0.35	0.030	0.040
Permissible variation in product analysis		± 0.02	± 0.05	± 0.03	+0.005	+0.005

Note: 1. When the steel is aluminium killed or killed with both aluminium and silicon, the requirement of minimum silicon content is not applicable.

9.2 The following elements shall be tested and reported in the test certificate. The limits are specified below.

Ni = 0.30% max. ; Cr = 0.30% max. ; Cu = 0.25% max.
Mo = 0.15% max. ; B = 0.0003% max. ; V = 0.05% max.
Sn = 0.05%

Note: (1) (Cr + Ni + Mo ≤ 0.50%)
(2) (Cu% + 10 x Sn% ≤ 0.5%)
(3) Carbon Equivalent = 0.42% max.

10.0 SELECTION OF TEST SAMPLES:

10.1 One sample of each heat shall be analysed for chemical composition.

10.2 One sample from each melt / heat treatment batch / size shall be taken for mechanical testing. Location of the test sample shall be in line with IS 1875.

11.0 MECHANICAL PROPERTIES:

11.1 Tensile : When tested in according with IS : 1608, the test pieces shall show the following properties :

Tensile Strength : 410 N/mm², minimum
Yield strength : 220 N/mm², minimum
Elongation on
5.65 √So guage length : 25 percent min.

11.2 Hardness: 10% of the bars or minimum 10 bars (whichever is more) shall be tested for hardness in accordance with IS 1500 or any other reputed national standard. The hardness shall not be less than 110 BHN.

12.0 ULTRASONIC TEST :

Each bar above 100 mm dia / side width shall be ultrasonically tested in accordance with AA 085 01 18 to ensure freedom from internal defects. The norms of acceptance shall be as per category 2 of the same.

13.0 TEST CERTIFICATES:

Three copies of the test certificate bearing the following information shall be furnished.

BHEL Order No :

BHEL Specification No : HY 10199 Rev. 03

Supplier's Name:

Cast No :

Results of Chemical analysis and Mechanical tests.

Results of ultrasonic test (if applicable)

14.0 PACKING AND MARKING:

Bars shall be supplied in securely packed bundles and shall be suitably protected from corrosion and damage during transit. Bars over 50 mm diameter shall be stamped at one end with cast number, HY10199, and BHEL P.O. for easy identification.

Bars of 50 mm diameter and below shall be bundled and a metal lable shall be securely attached to each bundle bearing the following details:

HY 10199 Rev. 03 : Hot rolled Carbon Steel bars, Gr:15 C8

BHEL Order No:

Consignment or Indentification No:

Cast No:

Size and Weight:

Supplier's name:

BHEL HERP VARANASI
QUALITY PLAN

QUALITY PLAN FOR FABRICATED & MACHINED COMPONENT (MILD STEEL)

SL.NO.	COMPONENT	CHARACTERISTIC CHECKED	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS & ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
							P	W	V	
1.0	Raw Material									
	i.Plate material, Rounds, Pipes (Specns. as applicable)	Verification of supplier's certificates for chem. & mech. Properties	Certificate review	100%	IS2062 FOR MS PL. IS226 FOR MS ROD SA106 GR.B FOR seamless stl. PIPE, En8 /En19 FOR RODs	T.C.	3	-	2	Matl. TC can be waived off if the same is specified in Purchase Order
		Soundness of MS Plates > 40 mm thk.	UST	100%	ASTM A-435	T.C.	3	-	2	Plates < 40 mm shall be UST tested if specifically called in PO.
	ii. Standard Fasteners (Bolts, Nuts, screws)	Verification of make and class	review of sub supplier's documents	100%	Drawing / purchase order	Inspection Report	3	-	2	All Fasteners of class 8.8 and above should be of reputed make like TVS/LPS/DFL/Boltmaster/CAPAR0/Sri Pavitra make
2.0	Fabrication	i.Visual inspection of welds	Visual	100%	Free from defects	Inspection Report	3/2	-	2	Welding shall be done as per WPS mentioned in the drawing. DP test o be witnessed by BHEL if asked in the PO
		ii.Soundness of welded joints	DP Test of welded joints (If required as given in the Drg./PO)	as mentioned in Drg. / Po	AA0850131 & AA0850129	Inspection Report	3	2	-	
		iii. Verification of Dimensions and visual inspection	visual & Measurement	100% by Vendor	Drawing.	Dimension Report	3	-	2	
		iv. Stress relieving after welding (when called in Drg. or PO)	Review of H.T.Chart	100%	HY0640763	H.T.Chart	3	-	2	
3.0	Final Inspection	i. Overall dimensions after final machining	Measurement	100% for machined dimensions and random 10% for other dimensions	Drawing.	Dimension Report	3/2	2	-	Tol. For untol. Dimensions will be governed by IS2102 med. Grade for machined dimensions and Course grade for Fabricated dimensions
		ii. surface finish	Visual	100%	Drawing	Inspection Report	3/2	2	-	
		iii. Painting/preservation	Visual, Paint shade and DFT	Random Sample basis	Drawing / PO		3/2	-	2	Surface preparation shall be done by sand/grit/shot blasting/local grinding (case to case basis) prior to painting. Machined surfaces shall be protected during surface preparation. All unmachined surfaces shall be protected by applying two coats of Zinc phosphate primer (specn. AA56101). All machined surfaces shall be protected by applying Apply 1 Coat of Rust Preventive Hard Film yellow (AA55155) and 1 Coat of Rust Preventive Hard Film Black (AA55154). Very small machined components can be wrapped in polythene sheets after applying liberal amount of grease.Threaded holes shall be protected by applying grease. External threads shall be protected by PV sleeve.
		iv.Identification & Marking	Punching of P.O.No. & Inspector Seal	100% by BHEL		Inspection Report	3/2	2	-	
QP. NO.	RV/FAB & MCD/12 REV-03		APPROVED BY		SR.MANAGER P&D					
DATE	26.08.2017		SIGNATURE & DATE							
PG. NO.	1 OF 1									

P = PERFORM T.C. = TEST CERTIFICATE
W = WITNESS
V = VERIFY
3 = VENDOR
2 = BHEL

वीरेन्द्र कुमार / Virendra Kumar
उप महाप्रबंधक (पी.एण्ड डी.) /Dy. General Manager
भारत हेवी इलेक्ट्रिकल्स लिमिटेड
Bharat Heavy Electricals Limited
वाराणसी

REV-03 Painting Witness changed to verification

BHARAT HEAVY ELECTRICALS LIMITED

Ramachandrapuram, Hyderabad – 502 032, INDIA

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)

Welding Procedure Specification No.: WE006 **Date: 02.08.86** **Supporting PQR No.:** 516, **Dt** : 11.05.10

Revision No.: 07 **Date:** 24.04.2016

Welding Process (es) : *SMAW* **Type (s) :** *MANUAL*

JOINTS (QW 402)

Joint Design: *As per manufacturing drawing (groove/fillet)*

Root Spacing : *As per manufacturing drawing*

Backing (Yes) : *for double side butt welds and backing strip joints*

(No) : *for single side welds*

Backing Material (Type) : *Base metal / Weld metal*

Metal: *Yes* **Non-Fusing Metal**: *No*

Retainer: *No*

BASE METALS (QW – 403)

P. No. *: 1* **Group No. :** *1 & 2* **TO** **P. No.:** *1* **Group No.:** *1 & 2*

OR

Specification type & grade: -------- **to** Specification type & grade : -------

OR

Chemical Analysis & Mechanical Properties: --- to Chemical Analysis & Mechanical Properties: ----

Thickness Range :

Base Metal : **Groove:** *5.0 mm to 38 mm* ** **Fillet :** *all sizes*

Deposited pass thickness > 13mm – Not Permitted

Other : None

Filler Metals (QW – 404)

	SMAW
Spec. No. (SFA)	*5.1*
AWS NO (CLASS)	A5.1 (*E 7018*)
F. No.	4
A. No.	*1*
Size of Filler Metals	*Dia 2.5, 3.15, 4.0, 5.0mm*
Filler Metal Product Form	N.A
Supplemental Filler Metal	N.A
Deposited Weld Metal Thickness Range : Groove: Fillet:	38 *mm Max.* *38 mm Max Throat*
Electrode Flux (Class)	*Basic*
Consumable Insert	*No*
Max. Bead Thickness	5 *mm*

** Note : For Unequal thicknesses base material thickness qualified upto 50mm and weld metal thickness limited to 38mm max.

Rev : 07 – Note added regarding base material thickness

N.A – Not Applicable

POSITIONS (QW-405)

Position(s) Groove : *ALL POSITIONS*
Welding Progression: *UP for Vertical*
Down –Not permitted
Position (s) Fillet: *ALL*
Other : None

POSTWELD HEAT TREATMENT (QW-407)

Not Permitted
Temperature Range: *NA*

Time Range: *NA*
Other : *None*

PREHEAT (QW-406)

Preheat Temp Min: *10 º C min for < 31mm*
100 º C min for 31mm and above
Interpass Temp Max: *300 º C*
Preheat Maintenance: *Minimum specified temperature for every restart*
Other : None

GAS (QW - 408)

	Gas(es)	Percentage Composition Mixture	Flow Rate
Shielding :	N.A	-	-
Trailing :	N.A	-	-
Backing :	N.A	-	-

Other : None

ELECTRICAL CHARACTERISTICS (QW-409)

Weld Pass (es)	Process	Filler Metal		Current type & Polarity	Amps (Range)	Wire feed speed	Energy or Power (Range)	Volts (Range)	Travel speed	Other
		Classification	Diameter							
Root& Subsequent as required	*SMAW*	*E 7018*	*2.5mm*	*DCEP*	*60 – 90A*	N.A	N.A	*22-34V*	N.A	*String for horizontal; Others Weave (Max 3 times Electrode Core Dia)*
	-do-	*-do-*	*3.15mm*	*-do-*	*100-150A*	*-do-*	*-do-*	*-do-*	*-do-*	
	-do-	*-do-*	*4.0mm*	*-do-*	*150-200A*	*-do-*	*-do-*	*-do-*	*-do-*	
		-do-	*5.0mm*	*-do-*	*200-260A*	*-do-*	*-do-*	*-do-*	*-do-*	

Pulsing Current : *N.A*

Heat Input *: N.A*

Tungsten Electrode Size and Type : *N.A*

Mode of Metal Transfer for GMAW (FCAW): *N.A*

Others **:** None

TECHNIQUE (QW-410)

String or Weave Bead: *string and/or weave*

Orifice or Gas Cup Size : *N.A*

Initial / Interpass Cleaning : *chipping / brushing / grinding*

Method of Back Gouging: *grinding/gouging if required*

Oscillation *: N.A*

Contact tube to work distance : N.A

Multiple or Single Pass : *Multiple pass*

Multiple or Single Electrodes : *Single electrode*

Closed to out chamber : *N.A*

Peening : *Not allowed*

Use of thermal processes : *N.A*

Other : *Clean weld area to remove oil, rust, grease, etc. prior to welding.*

Prepared by

Welding Engineer

Approved by

HEAD / Welding Engg

N.A – Not Applicable

BHARAT HEAVY ELECTRICALS LIMITED

RAMACHANDRAPURAM, HYDERABAD-500 032.

PD - 268

QW-482 WELDING PROCEDURE SPECIFICATION (WPS)

Welding Procedure Specification No WE..QO1.. Date 2.4.94 ..... Supporting PQR No. 185 + 21

Revision No .....2..... Date.....15.09.1993.....

Welding Process (es).....SMAW..... Type (s)..... .....Manual.....

JOINTS (QW 402) Details

Joint Design As per manufacturer's Drawing

Backing (Yes) For double sided & back strip (No) For single side joints

Backing Material (Type) Joints Weld metal for double side welding and P1 for backing strip joints.

Metal Yes Non fusing metal

BASE METALS (QW-403)

P. No.....1..... Group No.....1 & 2 to P. No.....1..... Group No.....1 & 2.....

OR

Specification type and grade.....--.....

to Specification type and grade.....--.....

OR

Chem. Analysis and Mech. Prop.....--.....

to Chem. Analysis and Mech. Prop.....--.....

Thickness Range :

Base Metal : Groove 4.75 - 200mm Fillet All

Pipe Dia. Range : Groove All dia Fillet All

Other Root spacing for backing strip joints : 8-10mm
For others : 2 ± 1mm

FILLER METALS (QW-404)

Spec No. (SFA) 5.1

AWS No. (Class) E 7018

F. No. 4

A. No 1

Size of Filler Metals Ø 2.5 to 6.3mm

Deposited Weld Metal

Thickness Range : Groove 200mm Max

Fillet All

Electrode Flux (Class) Basic

Flux Trade Name NA

Consumable Insert No : Retainers : no

Bead thickness : 5mm Max.

POSITIONS (QW-405)

Position [s] Groove All

Welding Progression : Up For V Down

Position [s] Fillet All

PREHEAT [QW 406] Upto 30mm 10°C

Preheat Temp Min From 31-100mm 100°C
Above 100mm 150°C

Interpass Temp. Max 350°C

Preheat Maintenance Nil

POSTWELD HEAT TREATMENT QW-407

Temperature Range 600°C - 650°C

Time Range As per UCS - 56

GAS [QW-408]

Percent Composition NA

Gas [es] [Mixture] Flow Rate

Shielding --

Trailing --

Backing

ELECTRICAL CHARACTERISTICS [QW-409]

Current AC or DC DC Polarity Reverse (+Ve)

Amps [Range] 60-300 Volts Range 22-26

Tungsten Electrode size and type NA

Mode of Metal Transfer for GMAW NA

Electrode wire feed speed range NA

TECHNIQUE [QW-410]

String or Weave Bead String & Weave Orifice or Gas Cup Size NA

Initial and Interpass Cleaning Chipping, Brushing, Grinding

Method of Back Gouging By Grinding oscillation NA

Contact Tube to Work Distance NA Multiple or Single Pass Multi

Multiple or single Electrodes Single Travel Speed [Range] NA

Peening Not Allowed Electrode Spacing NA

Other Clean 20mm width on either side of the weld area prior to weld to remove paint, Oil, Grease etc.

Weld Layer [s]	Process	Filler Metal Class	Filler Metal Dia. mm	Current Type Polar	Current Amp. Range	Volt Range	Travel Speed Range mm/min	Other
	SMAW	E7018	2.5	DC +	60-90	--	--	String & Weave Max - 3D
	SMAW	E7018	3.15	DC +	90-140	--	--	
	SMAW	E7018	4.0	DC +	140-180	--	--	
	SMAW	E7018	5.0	DC +	180-240	--	--	
	SMAW	E7018	6.3	DC +	240-300	--	--	

PREPARED BY

SR. MANAGER
WELDING ENGG.

Krm.