1.0 CODES:-

The fittings shall meet Indian Boiler Regulations (IBR) and the following requirements in addition to the standards specified in the Purchase Order (PO)

2.0 RAW MATERIALS:-

a) All pipes used for fittings shall meet the respective specification. The test certificate shall be furnished.
b) All mother pipes used for fittings shall be subjected to a hydraulic test as per SA 530 or UT as per ASTM E 213 at the mill
c) All plates used for fittings shall be UT tested as per S1 of SA578 and acceptance norms shall be as per Level B of SA578
d) The raw material forging shall be ultrasonically tested as per SA 388 and the acceptance norm shall be as per 3.3.4 of ASME Sec VIII Div 2.
e) Steel for SA182 F11,F12 &F22 if indigenously procured, to be from following manufacturers approved under IBR for creep resistant steels: i) Alloy Steel Plant Durgapur, ii)Tata Iron & Steel company, Jamshedpur & iii) Mahindra Ugine Steel Company , Mumbai.
f) Carbon content of SA 234 WPB, WPC, SA 105 fittings shall be restricted to 0.25% max

3.0 PROCESS:-

a) Process of manufacture shall conform to applicable standards.
b) All fittings shall be of seamless unless otherwise specified in the purchase order.
c) In case of welded fittings, WPS,PQR & welder qualification shall be approved by BHEL - PC, prior to start of welding.
d) All fittings shall have smooth surfaces, workman like finish and free from loose scales and defects like laps, seams, folds, cracks, pitting etc.. Repair by welding is NOT permitted.
e) Dimensions shall be as per ASME B16.9 or B16.28,Butt Weld edges shall be as given in Purchase Order. The ends of reducers shall have a straight portion of Minimum 13mm.
f) Unless otherwise specified in the P.O SA 234 WP 11/12/22 fittings shall be supplied as per class1, SA 182 F11/12 shall be supplied as class 2, SA 182 F22 shall be of class 3 only .

4.0 HEAT TREATMENT:-

4.1 All fittings shall be heat treated as below.

SA 234 WP B	- As per specification
SA 105,SA234 WP C	- Normalised
SA234 WP11/ WP12/ WP22	- Normalised & Tempered
SA182 F11/ F12/ F22	- Normalised & Tempered
Stainless Steel :-	
SA 182 F304/ 316/ 321/ 347	- Solution annealed
SA 403 WP304/ 316/ 321/ 347	- Solution annealed

4.2 Fittings confirming to SA 234 WP91 and SA182 F91shall be normalised at1040 to1070deg C (for wall thickness larger than 75 mm, accelerated cooling may be done to obtain a fully martensitic structure) and tempered at 760 ± 10 deg C

5.0 TESTING : -

(a) All ferrous fittings shall be tested by MPI as per ASTM E-709 and SS fittings shall be LPI tested as per ASTM E 165.

Approved by

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P. Elangovan, QA — K. Ganeshan, MPL

(b) One fitting of each specification, heat, heat treatment lot and size shall be subjected to Tension Test as per applicable standard.

(c) All fittings of wall thickness above 6mm or NB 200mm and above shall be Ultrasonically Tested as per SA 388; acceptance norms shall be 3.3.4 of ASME section VIII Div.2.

(d) Hardness test shall be carried out on each fittings of WP91 / F91. For other fittings hardness shall be checked on 10% of the fittings.

(e) In case of welded fittings; all the welds shall be 100% RT tested and acceptance norms shall be UW 51 of ASME Sec VIII DIV-1

(f) The following supplementary tests shall be carried out for specifications namely SA105, SA 182 F11 / F12 / F22 / F91, SA 234 WPC / WP11 / WP12 / WP22 / WP91
(No supplementary test applicable for SA 234 WPB)
a) Product analysis – one / heat / size.
b) Tension test – one / heat / heat treatment lot / size.

(g) Metallography:- Metallography shall be carried out on one per heat, per size, per heat treatment lot of WP91 / F91 fittings. Acceptance norms - The Material shall be free from any micro fissures. Microstructure shall show tempered martensite and also to be examined for any grain growth. Photomicrograph with 500x (Min) magnification along with Metallography report to be provided. The actual magnification shall be indicated.

6.0 POSITIVE MATERIAL IDENTIFICATION (PMI) FOR ALLOY STEEL FITTINGS.

Each alloy steel fitting shall be checked for the correctness of the material during manufacturing and final inspection using X-ray fluorescence principle or spark emission spectrography.

7.0 PAINTING , COLOUR CODING, MARKING, PACKING & END PROTECTION

7.1 **PAINTING :** All fittings (except stainless steel and galvanised) shall be **painted** on the external surface as given below

a) surface preparation : Blast cleaning
b) Primer coat : 50 microns of Red oxide zinc phosphate confirming to IS 12744
c) Final coat : 70 microns of Synthetic enamel paint confirming to IS2934 .
d) Shade : (i) smoke grey -- shade no 692 of IS5 for all carbon steel fittings
(ii) Sea green -- shade no 217 of IS5 for all Alloy steel fittings
The internal surface shall be protected with rust preventive coating or rust inhibitor.
Stainless steel and Galvanised fittings need not be painted.

7.2 **COLOUR CODING :** All fittings shall be colour coded circumferentially at ends as given below

SA 234 WPB / WPBW	=	Red
WPC / SA105	=	Blue

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WP11 / SA182 F11	=	Green & White
WP12 / SA182 F12	=	Black & Red
WP22 / SA182 F22	=	Blue & Red
WP91 / SA182 F91	=	Brown & Red
SA182 / SA 403 F / WP 304	=	Blue & Yellow
316	=	Black & Green
321	=	Blue & Brown
347	=	Yellow & Black

7.3 **MARKING :**

7.3.1 The fittings dispatched to **BHEL Stores** shall be punched / etched with Material code, Heat number, material specification, maker`s emblem, Inspectors seal and Statutory authorities seal (as applicable) .
In addition, the above details along with size shall be paint stenciled on the fittings.
If the thickness of the fitting is less than 6 mm, punching is not permitted and the above details shall be paint stenciled only . Fittings of size up to 2" (50mm) shall be tied together and the above details shall be punched / etched in a separate tag and tied to it.

7.3.2 The fittings dispatched directly to project site as **DTS** shall be punched and paint stenciled with DU code (14 digit work order du detail) as given by purchase in addition to marking done as per para 7.3.1.

7.4 **PACKING AND END PROTECTION :** Machined ends of the fittings shall be well protected using end caps and fittings shall be suitably packed in box / crate to avoid transit & other damages.

8.0 INSPECTION & CERTIFICATION : -

All fittings are to be Inspected at the manufacturer's works by the Inspection agencies / authorities as per IBR and as indicated in the P.O. Inspection certificate in IBR Form III C shall be submitted along with the Work Test Certificate countersigned by the above authorities and shall include the following.

1. Test Certificate Number & date.
2. BHEL P.O Number & Amendment Number
3. BHEL P.O. Serial Number
4. BHEL TDC Number
5. Size-wise Quantity
6. Specification, Grade & Year of code.
7. Heat/Melt Number
8. Starting material details.
9. Steel making process
10. Laddle Analysis of Raw Material and product analysis of fitting.

*11. Positive Material Identification (PMI) report for Alloy steel fittings.
*12. Supplementary Test(Product analysis, Tension test..) results.
*13. Heat Treatment Chart.
*14. NDE report. (VISUAL.MPI, LPI,UT)
*15. Tensile Test Report
*16. Hardness Test Report

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17. Metallography Report along with photomicrograph with 500x (min) magnification.
*18. Dimensional conformance.
*19. RT test report / Results (for welded fittings)
*20. Guarantee of HTP shall be given as follows:- "Fittings are capable of withstanding without failure, leakage or impairment of their serviceability a hydrostatic test pressure equal to that prescribed for the specified matching pipe of equivalent material".

*Details furnished in the Tests certificate in lieu of chart/report is acceptable.

9.0 RECORDS OF REVISION :-

Rev 01 : a) Fully revised for better clarity.
: b) Para 2.0 e added.

Rev 02 : a) Para 2.0 (c): UT acceptyance norms revised from level A to B.

Rev 03 : a) Fully revised for better clarity.
: b) Para 4.2,6.0, 8.0 (11) added.
c) Para 2 (d) ,4.1, 5 (d) are revised.

Rev 04 : a) Para 5.0 (g), 7.0 and 8.0 (17) are revised.

*****

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P. Elangovan, QA		K. Ganeshan, MPL	

FIRST ANGLE PROJECTION(ALL DIMENSIONS IN MILLIMETRES)

DRAWING No. 3-80-300-19825

NOTES: –

01. APPLICABLE FOR P91 MATERIAL
02. FOR OD MISMATCHING REF. FIGURE–Xa.
03. α = 6° FOR WALL THICKNESS ≤ 30 mm
04. α = 10° FOR WALL THICKNESS > 30 mm

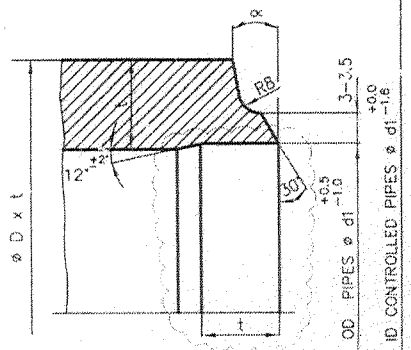


FIGURE – X

MATCHING EDGE PREPARATION FOR MISMATCH OD DIAMETRICALLY GREATER THAN 8 mm (ie OD1 – OD2 > 8mm) APPLICABLE FOR BENDS/FITTINGS OF P91 MATERIALS

NOTES: –

01. OD OF STRAIGHT TO BE PHYSICALLY MEASURED/VERIFIED.
02. α = 6° FOR WALL THICKNESS ≤ 30 mm
03. α = 10° FOR WALL THICKNESS > 30 mm

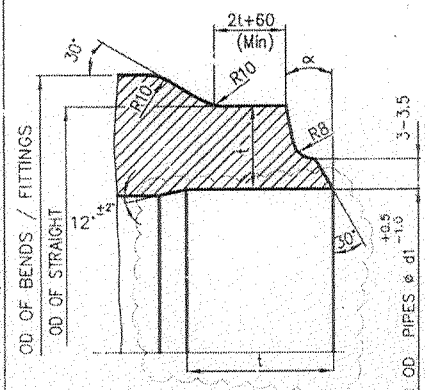
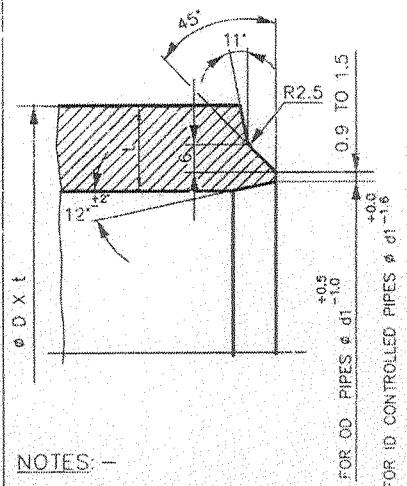


FIGURE – Xa



NOTES: –

01. USE WHEN t ≥ 14.2 mm.
02. FOR OD MISMATCHING REF. FIGURE–Pa

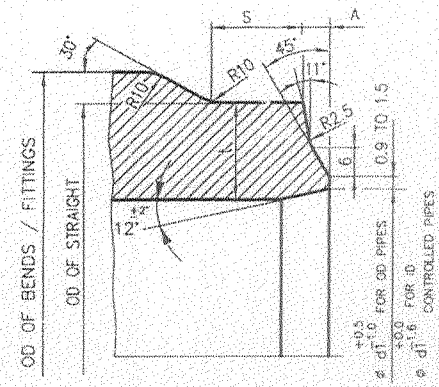
STYLE – P

MATCHING EDGE PREPARATION FOR MISMATCH OD DIAMETRICALLY GREATER THAN 8 mm (ie OD1 – OD2 > 8mm) APPLICABLE FOR BENDS/FITTINGS OTHER THAN P91 MATERIALS

NOTES: –

01. OD OF STRAIGHT TO BE PHYSICALLY MEASURED/VERIFIED.
02. WHEN t<65, S+A = 65 Min. & t>65,S=65 Min.

WHERE t=THK OF CONN.PIPE(STRAIGHT).



STYLE – Pa

MATCHING EDGE PREPARATION FOR MISMATCH OD DIAMETRICALLY GREATER THAN 8 mm (ie OD1 – OD2 > 8mm) APPLICABLE FOR ELBOWS OTHER THAN P91 MATERIALS

NOTES: –

01. OD = OUTSIDE DIA OF CONNECTING PIPE (STRAIGHT) TO BE PHYSICALLY MEASURED/VERIFIED.
02. t = THK OF CONN.PIPE (STRAIGHT)

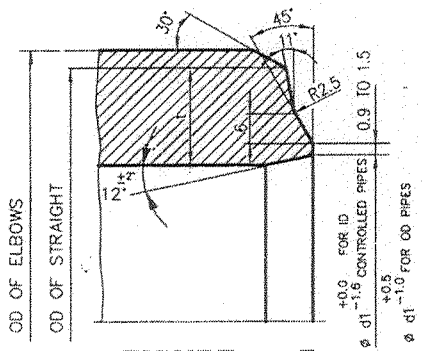
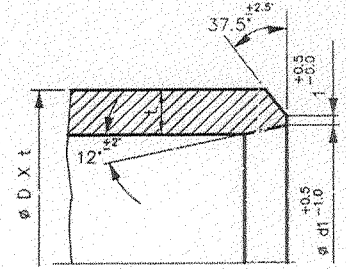


FIGURE – Z



STYLE – D

NOTES: –

01. USE WHEN t < 14.2 mm.

GENERAL NOTES :

01. THE MINIMUM THICKNESS AT WELD END SHALL NOT BE LESS THAN
  a) 0.875 TIMES t NOM. FOR OD PIPES.
  b) t MIN. FOR ID CONTROLLED PIPES.
02. t NOM & t MIN SHALL BE AS PER SPECIFIED PIPE SIZE.

NOTES FOR WELDING:

01. WELD REINFORCEMENT TO BE FLUSH GROUND AND MERGED WITH PARENT METAL WITHOUT ANY UNEVENNESS.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STANDARD (61)

BHARAT HEAVY ELECTRICALS LTD., PIPING CENTRE, CHENNAI

	NAME	SIGN	DATE	NO OF ITEMS
DRN	K.B.RAGUNATH		11.10.01	
CHD	M.C.SEKARAN		11.10.01	
APPD	A.VELAYUTHAM		11.10.01	

REV	DATE	ALTERED	APPROVED
01	11-05-04	R. Senthil	

ZONE: PROJECT NAME REMOVED AND 'STANDARD' INCORPORATED IN TITLE BLOCK.

DEPT. / CODE: C/M/F | GRADE OF UN TOL. DIM | SCALE | WEIGHT (Kg.) | NAME OF ORIGINAL ORGANISATION | ITEM No.

TITLE: EDGE PREPARATION DETAILS

CARD CODE: U 01

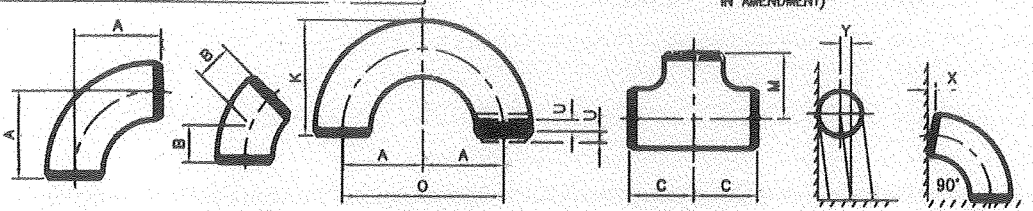
DRAWING No.: 3-80-300-19825 REV: 01

SIZE A3

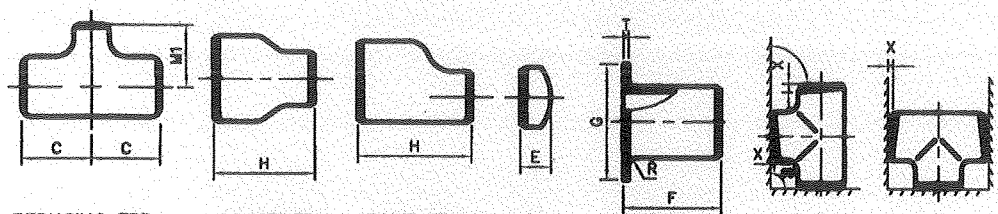
EP1

REV	DATE	ALTERED
01	05.02.05	APPROVED APMK
TITLE BLOCK AND DRAWING ALTERED		

(REFERENCE : IBR ,REG.NO 361(A) INCLUDED IN AMENDMENT)



90° BEND | 45° BEND | 180° RETURN | EQUAL TEE



REDUCING TEE | CONCENTRIC REDUCER | ECCENTRIC REDUCER | CAP | LAP JOINT STUB-END

ALL FITTINGS				90°&45° ELBOWS AND TEES	REDUCER	180° RETURNS			CAPS	LAP-JOINT		STUB END	
DN.	O.D AT BEVEL	I.D AT END	WALL THICKNESS	CENTER TO END A,B,C,M,M1	OVERALL LENGTH H	CENTER TO CENTER O	BACK TO FACE K	ALIGNMENT OF END U	OVER ALL LENGTH E	END TO END F	RADIUS R	DIA OF LAP G	THICKNESS OF LAP
15 TO 65	+1.6 −0.8	±0.8	NOT LESS THAN 87 1/2% OF NOMINAL THICKNESS	±1.6	±1.6	±6.4	±6.4	±0.8	±3.2	±1.6	+ 0 −0.8	+ 0 −0.8	+1.6 − 0
80 TO 90	±1.6	±1.6		±1.6	±1.6	±6.4	±6.4	±0.8	±3.2	±1.6	+ 0 −0.8	+ 0 −0.8	+1.6 − 0
100	±1.6	±1.6		±1.6	±1.6	±6.4	±6.4	±0.8	±3.2	±1.6	+ 0 −0.8	+ 0 −0.8	+1.6 − 0
125 TO 200	+2.4 −1.6	±1.6		±1.6	±1.6	±6.4	±6.4	±0.8	±6.4	±1.6	+ 0 −0.8	+ 0 −0.8	+1.6 − 0
250 TO 400	+4.0 −3.2	±3.2		±2.4	±2.4	±9.5	±6.4	±1.6	±6.4	±2.4	+ 0 −1.6	+ 0 −1.6	+1.6 − 0
500 & ABOVE	+6.4 −4.8	±4.8		±2.4	±2.4	±9.5	±6.4	±1.6	±6.4	±2.4	+ 0 −1.6	+ 0 −1.6	+1.6 − 0

OFF-SQUARE TOLERANCES		
NOMINAL SIZE OF FITTING	OFF SQUARE TOLERANCE, X	OFF SQUARE TOLERANCE, Y
UP TO AND INCLUDING 100	0.8	1.6
125 TO 150	1.2	2.4
200 TO 550	1.6	3.2
600 & ABOVE	3.2	6.4

NOTES : 1. ALL DIMENSIONS ARE IN MILLIMETRES

STANDARD

BHARAT HEAVY ELECTRICALS LIMITED
PIPING CENTRE
CHENNAI 600 017

	NAME	SIGN	DATE	NO.OF VAR
DRN	ENGG.ENTERPRISES	Sd	15.10.1986	
CHD	R.ANANTH	Sd	15.10.1986	
APPD	J.JUDE	Sd	15.10.1986	

DEPT / CODE	GRADE OF UNTOL.DIM	SCALE	WEIGHT (KG).	REF. TO ASSY./OLD DRG.	ITEM NO.	NO. OF ITEMS
	C / M / F	N.T.S	–	–	–	–

TITLE	CARD CODE	DRAWING NO.	REV
TOLERANCES ON FITTINGS	U 01	4-80-301-26192	01

Size A4

V1A4