1.0 CODES

The fittings shall meet Indian Boiler Regulations, (IBR) in addition to the standards specified in the Purchase Order (PO).

2.0 RAW MATERIALS

(a) The raw material used shall meet the respective specification and the test certificate shall be furnished.

(b) Steel for SA 182 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, Bombay.

(c) The raw materials shall be ultrasonically tested (UT) as per SA 388 and the acceptance norms shall be as per 3.3.4 of ASME Sec . VIII Div.2.

(d) Carbon content of Carbon steel fittings (SA 105) shall be restricted to 0.25% max.

3.0 PROCESS

(a) Process of manufacture shall conform to applicable standards.

(b) Dimensions shall be as per ASME B 16.11

(c) Unless otherwise specified in the P.O, SA182 F11/12 fittings shall be supplied as per class 2 and SA182 F22 shall be of Class 3 only.

4.0 HEAT TREATMENT

4.1 All fittings shall be heat treated as below:

SA 105	- Normalised
SA182 F11/ F12/ F22	- Normalised & Tempered

4.2 Fittings confirming to 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 $\pm$ 10 deg C

5.0 TESTING

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

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

(c) Hardness test shall be carried out on each fittings of F91; for other fittings on

10% of the fittings.

(d) SUPPLEMENTARY TEST : The following supplementary tests shall be carried out for specifications namely SA105, SA 182 F11 / F12 / F22 / F91
a) Product analysis – one / heat / size.
b) Tension test – one / heat / heat treatment lot / size.

(e) 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 WORK MAN SHIP, FINISH AND REPAIR

All fittings shall have smooth, workman like finish, and to be free from scale & defects like laps, seams folds, cracks, etc. Repairs by fusion welding are prohibited. Surface defects can be removed by mechanical means and defective areas smoothly dressed up with the adjacent surface. Minimum dimension after repair to meet drawing / Specification.

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

8.1 **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.

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

SA105	=	Blue
SA182 F11	=	Green & White
SA182 F12	=	Black & Red

SA182 F22	=	Blue & Red
SA182 F91	=	Brown & Red
SA 182 F 304	=	Blue &Yellow
316	=	Black &Green
321	=	Blue & Brown
347	=	Yellow&Black

8.3 **MARKING :**

8.3.1 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.

8.3.2 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 8.3.1.

8.4 **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.

9.0 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 IIIC (for fittings under IBR purview) shall be submitted along with the Work Test Certificate countersigned by any of 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. Steel making / forming process
9. Laddle Analysis of Raw Material and product analysis of fittings wherever applicable.

*10. Supplementary Test S2/S3/S4 as applicable.
*11. Heat Treatment Chart.
*12. NDE report. (VISUAL,MPI, LPI,UT)

*13. Tensile Test Report
*14. Hardness Test Report
15. Metallography Report along with photomicrograph with 500x (min) magnification
*16. Dimensional conformance.
*17. Starting material details.

*18. Guarantee of HTP shall be given as follows:- "Fittings are capable of with standing without failure, breakage 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.

10.0 RECORDS OF REVISION : -

01	Fully revised for better clarity. Cl 2.0 a) added
02	a) Para 4.0, 6.0 included. b) Para 2(c) ,5.0(b), 5.0(e), 5.0(f), 8.0 and 9.0 (15) are revised.