

BHARAT HEAVY ELECTRICALS LIMITED TRICHY PIPING QUALITY DEPT.		STANDARD QUALITY ASSURANCE PLAN FOR BUTT WELDED FITTINGS CONFORMING TO ASME SA 234, SA 403 AND SA815						QP NO : QPG: 46 REV.NO : 03 DATE : 07-10-2024				
REF: BHEL TDC No. : TDG:102 (Latest Rev. Attached as annexure)												
SL. NO.	COMPONENT OR OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	RECORD		AGENCY		REMARKS
								Type	Req	M	B	
1	2	3	4	5	6	7	8	9	10	11	12	15
1.0	i) P91/P92 requirement - RAW MATERIAL sources for P91/P92 shall be as per QCP:19(Latest Rev.Attached as annexure); Any other source proposed by the vendor shall be subjected to BHEL approval. ii) IBR requirement- The Test Certificate for all material specifications received from RM manufacturer shall meet IBR requirements for SA 234 .											
1.1	Seamless Pipe / Forging	Chemical and Mechanical property & Hydro Test / UT	Major	Verification of MTC & Ladle Analysis Report	100%	As per Required Material (ASME) Specification	Form III-A / Form III-G - (for CS, AS) Mill TC - (for SS)	√√		P	R	Refer Note:1 Either clause 1.2 or 4.2
1.2		Radioactive contamination for SS & Duplex SS	Major	Measurement	100%	Acceptance limits: Shall be less than 0.1 milli Rontgen (MR) per hr or 1 micro Sievert per hr.	Mill TC - (for SS)	√√		P	R	
1.3		Surface defect & Dimensions Outer Dia., Thk. etc	Major	Visual & Measurement	100%	As per Spec	Raw Material Inspection Report					
1.4		Raw Material Check (chemical)	Major	PMI	100%	As per Required Material (ASME) Specification		√		P	V	
1.5		Hardness Test for P91 & P92 material	Major	Measurement	100%	As per Spec						
1.6	Plates	Co-relation & verification of Mill TCs for										
1.7		a) Chemical & Mechanical	Major	Verify	100%	BHEL Drawing , Material Spec.	Form IV - (for CS, AS) Mill TC - (for SS)	√√		P	R	\$ t > 10 mm
1.8		b) Soundness	Major	NDE - UT \$	100%	SA578 Acceptance level - B						
1.9		c) Dimension & Surface finish	Major	Measurement & Visual	100%	BHEL Drawing , Material Spec.						
LEGEND: M:- Manufacturer; B:- BHEL/ BHEL Nominated Agency; P - Perform; V - Verification; R-Review; W - Witness; H - Hold ; LEGEND: Record Requirement - "√"- Documents required for verification only; "√√"- Documents required for Review and Witness and same to be submitted to BHEL.												
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2.0 IN PROCESS INSPECTION												
2.1	Fitting Forming / Forging Procedure	Procedure qualification	Major	Review	100%	ASME SA 234 & BHEL TDG:102	BHEL Approved Procedure	√	P	V		Procedure shall be approved by BHEL.
2.2	NDE - MT, UT and RT Procedure	Procedure Review	Major	Review	100%	ASME SA 234 & BHEL TDG:102	BHEL Approved Procedure	√	P	V		Procedure shall be approved by BHEL.
2.3	Forming/ Forging of pipe fittings	Process parameters	Major	Temperature, Measurement & Visual	100%	ASME SA 234 & Appd.Procedure	Internal report	√√	P	W*		W* : For 1st off trial at random
2.4	Heat Treatment (HT)	Rate of Heating, Rate of Cooling & Soaking time	Critical	Temp & Time graph	100%	ASME SA 234 & BHEL TDG:102 Clause: 3.2, 3.3, 3.4, 3.5	HT Chart	√√	P	R / W*		W* : For 1st off trial at random
2.5	Welding	Procedure qualification	Major	Review	100%	ASME SA 234 & BHEL TDG:102 Clause 3.1.(ii) & 3.5 Refer Note : 4 & 5	WPS, PQR, WPQ	√	P	V		Welded Fittings shall be made from Two - Halves.
2.6	Post weld Heat Treatment (PWHT)	Rate of Heating, Rate of Cooling & Soaking time	Critical	Temp & Time graph	100%	ASME SA 234 & BHEL TDG:102 Refer Note : 2	PWHT Chart	√√	P	R / W*		W* : For 1st off trial at random
3.0 TESTS												
3.1	Test Piece	Selection of Test coupons	Major	Measurement & Marking	One Sample / Heat / HT Batch	As per ASTM A370 Refer Note : 4 & 6	Report	√√	P	R / W*		W* : For 1st off trial at random
3.2	Test Piece	Product Analysis	Major	Chemical Composition	One Sample / Heat	ASME SA 234 & BHEL TDG:102	Test Report	√√	P	R / W*		W* : For 1st off trial at random
3.3	Test Piece	YS, UTS, % Elongation	Major	Mechanical	One Sample / Heat / HT Batch	ASME SA 234 & BHEL TDG:102	Test Report	√√	P	R / W*		W* : For 1st off trial at random
3.4	Finished Products	Hardness	Major	Hardness test	100% / 10%	ASME SA 234 & BHEL TDG:102	Test Report	√√	P	W		100% for WP91 & 92; 10% for others
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3.5	Finished Products	Volumetric Defect for OD ≥ 219 mm or WT ≥ 6 mm.	Major	NDE - UT	100% / 10%	ASTM E213 - longitudinal notch of 5% - For Pipe Fittings ASTM A578 Level-B - For Plate		Test Report	√√	P	W	100% for WP91 & 92 ; 10% for others
3.6	Finished Products	Sub-surface Defect for all sizes	Critical	NDE - MT	100% / 10%	ASTM E709	ASME B31.1 Cl. 136.4.3	Test Report	√√	P	W	100% for WP91 & 92 ; 10% for others
	Finished Products			NDE - DPT for SS & Duplex SS	100% / 10%	ASTM E165	No linear indications	Test Report	√√	P	W	
3.7	Finished Products	Volumetric Defect - Welded Fittings	Major	NDE - RT	100%	ASME SEC-V & ASME SecVIII Div-1, UW-51		Test Report	√√	P	R*	R* - Review of RT films
3.8	Finished Products	Photomicrograph test & Microstructure for WP91 & 92 Fittings	Major	Metallographic test	One Sample / Heat / HT Batch	BHEL TDG:102 Clause 4.0.e (No micro fissures. Microstructure shall show tempered martensite. Grain growth if any has to be examined further. Delta ferrite for Gr 92 - 3% max)		Test Report (Magnification at 500x)	√√	P	W	Photomicrographs shall be provided as records for review & acceptance and future in-service reference
3.9	PMI for AS, SS & Duplex SS fittings	Chemical	Major	PMI	100%	ASME SA 234, SA 403 , SA 815 & BHEL TDG:102 Clause 5.0		Test Report	√√	P	W	
3.10	Burst Test	Performance & Design Proof	Critical	Hydro Test	One / Type (on similar Fitting ^s)	ASME B 16.9 & ASME SA 234		Test Report	√	P	V	\$ - As allowed in relevant standard
4.0 FINAL INSPECTION on Finished Products												
4.1	Dimensional Inspection	Surface check, Bend angle, Radius, End-to-end dimn, Ovality, Thickness, Wrinkles, d1 at ends, Edge preparation & other dimensions as per Drg.	Critical	Visual & Measurement	100%	ASME B16.9 / BHEL Drg BHEL TDG:102 Clause 6.0 & P.O. for D1 details		Report; [Thickness Report format as Doc No. - TDG 102 : 001 for Elbow & TDG 102 : 002 for Tee]	√√	P	W	Minimum thickness measured at any location on the finished fitting shall be not less than 0.875 of the specified nominal thickness.
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BHARAT HEAVY ELECTRICALS LIMITED
TRICHY
PIPING QUALITY DEPT.

STANDARD QUALITY ASSURANCE PLAN FOR BUTT WELDED FITTINGS
CONFORMING TO ASME SA 234, SA 403 AND SA815

QP NO : QPG: 46
REV.NO : 03

DATE : 07-10-2024

REF: BHEL TDC No. : TDG:102 (Latest Rev. Attached as annexure)

SL. NO.	COMPONENT OR OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	RECORD		AGENCY		REMARKS
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4.2	Radioactive contamination for SS & Duplex SS	Radioactivity	Major	Measurement	100%	BHEL TDG:102 Clause 4.0.h		Report	√√	P	W [#]	W [#] - 10%; Either clause 1.2 or 4.2
4.3	Surface Protection	Paint TC	Major	Verification of TC	100%	BHEL TDG:102 Clause 7.1 & P.O for Additional req		Paint TC	√√	P	R	
4.4	Finished Products	Marking	Major	Visual	100%	BHEL TDG:102 Clause 7.3 & P.O for Additional req			√√	P	W [#]	W [#] - 10%
4.5	Finished Products	Color coding	Major	Visual	100%	BHEL TDG:102 Clause 7.2 & P.O for Additional req			√√	P	W [#]	W [#] - 10%
4.6	Painting	Finish and Workmanship (Chalking, Peeling, Flaking, sagging, Ugly Brushmark, Uneven/over coating and other painting flaws are not accepted) (Weld Primer to be applied on weld edge)	Major	Visual	100%	BHEL TDG:102 Clause 7.1 & P.O for Additional req		Report Format as Doc No. - TDG 102 : 003	√√	P	W	W - 100%
4.7		Paint Thickness	Major	DFT	100%	BHEL TDG:102 Clause 7.1 & P.O for Additional req			√√	P	W [#]	W [#] - 10%
4.8	Pre Dispatch Inspection	Preservation & Packing	Major	Visual	100%	BHEL TDG:102 Clause 8.0 & P.O for Additional req		Report Format as Doc No. - TDG 102 : 004	√√	P	R	
5	DOCUMENTATION & CERTIFICATION											
5.1	Documentation Clearance	Manufature Test Certificate	Critical	Verification	100%	BHEL TDG:102 Clause 9.0 & P.O for Additional req			√√	P	H	
5.2		IBR Certification	Critical	all tests as per IBR	100%	IBR		FORM III-C / FORM III-I	√√	P	H	Not applicable for SS & Duplex SS
5.3		Other Reports	Critical	Verification	100%	All reports as required in this QAP with proper correlation.		Report	√√	P	H	Note-14

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NOTES :-

1.0 (a) If the raw materials are received directly from RM Manufacturer's works, the material shall be accepted based on (i)correlation of Heat number on material with TC and (ii)verification of TCs.
 (b) If the materials are received through Dealers place, check test (Chemical and Mechanical tests on one sample per Heat/ size) shall be done in addition to the above for accepting the material

POST FORMING HEAT TREATMENT :-

For Gr91 & 92 materials :

Normalise at 1040 - 1080 deg.C & Temper at 760-780 deg.C; Soaking shall be 2Hrs minimum for thickness upto 50mm and 4Hrs minimum for thickness 51-100mm

Normalising and Tempering shall be carried out within 72 hours after completion of forming.

The items shall be kept dry and stress free.

2.0 The temperature shall be brought down to room temperature after hot forming before normalizing and also after normalizing before tempering

Normalising and tempering of Gr91 & 92 shall be done encompassing the entire component.

SA234 WPB : As per Specn; **SA105 & SA234WPC** : Normalised; **SA234 WP11/WP12/WP22** : Normalised & Tempered.

POST WELDING HEAT TREATMENT :

For Gr91 & 92 materials : PWHT at 760 ± 10 deg.C; Soaking shall be at the rate of 2.5 minutes per mm of thickest weld - minimum 1 hr. Preheat shall be maintained till welding is completed. Interpass temperature shall be limited to 350 deg C. After post heating, joints shall be slowly cooled at room temperature and then kept at that temperature for a maximum of 72 hrs before PWHT.

3.0 Forged Fitting shall be forged to the shape with a minimum forge reduction ratio of 1:4. Forged Fitting shall not be machined from a forged block.

4.0 Seal tranfer on pieces to be cut shall be done by BHEL inspector & IBR for Gr-91 & 92 materials and IBR for other than Gr-91 & 92 materials.

5.0 Welding consumables shall be approved by BHEL.

6.0 Chemical & Mechanical tests shall be performed at NABL approved laboratories.

7.0 All NDE procedures shall be submitted to BHEL for review and approval.

8.0 NDE procedures shall have Level-III certified personnel approval incase of in-house. Incase of non-availability of inhouse facility NDE shall be performed by NABL approved laboratories.

9.0 Gas cutting & Plasma cutting are prohibited for Gr91 & 92 material.

10.0 All items shall be inspected and cleared by BHEL / BHEL authorised Inspection agency & IBR/IBR Authorized Inspecting Authorities.

11.0 Necessary IBR Requirements shall be fulfilled and IBR documents to be submitted.

12.0 Documents Marked as "√" for verification only shall be submitted to BHEL / BHEL authorised Inspection agency on demand

13.0 1st off trial Documents shall be verified by BHEL / BHEL authorised Inspection agency before review of present document

14.0 For TPIA - All applicable documents as per QAP to be attested and uploaded in BHEL CQIR portal before issue of Final IR.

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PAGE : 5 of 5



1.0 SCOPE: -

The fittings shall meet Indian Boiler Regulations (IBR) except SS and Duplex SS (UNS32205) specifications unless otherwise specified, and the following requirements in addition to the standards specified in the Purchase Order (PO).

2.0 RAW MATERIALS: -

- All fittings shall be of seamless construction unless otherwise specified in the purchase order. Pipes used for manufacturing of seamless fittings shall be seamless pipes or forgings only.
- The raw material used for fittings shall meet the respective specification. The test certificate shall be furnished with Traceability.
- Raw material Steel for IBR items to be inspected at Mill & test certificate countersigned by IBR Authorized Inspecting Authority, if the mill is not approved under IBR as well-known steel maker.
- For Gr-92 items : Si : 0.10-0.50% ; Ni : 0.30max and Cu : 0.25 max. (both Ladle & Product analysis)

3.0 MANUFACTURING & TESTING REQUIREMENTS:

3.1 MANUFACTURING PROCESS :

(i) Seamless Fittings:-

- A) Tees & Reducers :** Upto 80mm thickness : Formed Type.
Above 80mm thickness Formed or Forged type.
- B) Elbows :** Formed type for all thickness

(ii) Welded Fittings:- Supplied only if indicated in P.O and shall be of **Two-Half construction**.

3.2 Machined Fittings (Max size permitted 4”- directly from bar) – Reducers, Couplings & End Caps : Fittings machined from Castings are prohibited.

Starting material	Heat treatment	CS – Normalised ; AS – Normalised & Tempered SS & Duplex SS (UNS32205) – Solution Annealed
	NDE – UT	To be done after Heat treatment. For size above 40mm – to be done as per ASTM A 388 Acceptance to - ASME Sec.VIII Div.2 Cl.3.3.4. Actual measured notch depth to be specified in Test Certificate.
Finished fitting (after machining)	Heat treatment	Not required
	NDE (for all sizes)	• MT (100%) - Procedure - As per ASTM E709. No linear indications are acceptable (Linear Indication : Length $\geq$ 3XWidth) For WP91 & WP92 Wet MPI shall be done • LPI – SS & Duplex SS (UNS32205) : Shall be done as per ASTM E165. No linear indications are acceptable.
	Hardness	Base material Hardness for. WPB, WPC, WP11, WP12, WP22 – 197 HBW max. WP91 - 190-250 HBW – 100% to be checked WP92 - 196-250 HBW – 100% to be checked Duplex SS (UNS32205) – 300BHN max
	Dimension	ASME B16.9 or as per Engineering Drawing indicated in Purchase Order.
	Bend Test (for IBR items)	Specimen: 19mm. Thickness (t) x 25.4mm width - cold bent 180 deg. over thin section without fracture, mandrel radius: CS : $\leq$ 6.35 mm. AS, SS : $\leq$ 1.5 times specimen thick.

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3.3 Seamless Formed Fittings – Ells, Tees, Reducers, Dished end (End cover / Cap)

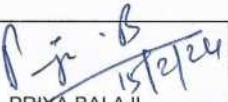
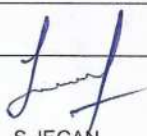
Starting material:	Heat treatment shall be as per starting material specification	CS – Normalised AS – Normalised & Tempered SS & Duplex SS (UNS32205) – Solution Annealed					
1)Tube & Pipe	NDE – UT	UT shall be done as per - ASTM E 213 with longitudinal notch of 5% wall thickness with max.1.5mm and min. 0.3mm. Actual measured notch depth to be specified in Test Certificate.					
2) Forged blank (For End covers)	NDE – UT	For size above 40mm ; UT shall be done as per - ASTM A 388 In acceptance to - ASME Sec.VIII Div.2 Cl.3.3.4. Actual measured notch depth to be specified in Test Certificate.					
3) Plate	NDE – UT	For size above 10mm SA 578, Acceptance Level – B. Actual measured notch depth to be specified in Test Certificate.					
Finished fitting (cold/hot forming)	Heat treatment after forming	Shall be done as per SA234 and follow below table for heat treatment values.					
		Material		Heat Treatment Temp.°C		Soaking time, hr/in	
				Normalising	Tempering	Normalising	Tempering
		CS- WPB & WPC		870-900	-	1/2	-
		AS-WP11 & WP12		920-960	640-670	1/2	1
		AS-WP22		920-960	680-710	1/2	1
		AS- WP91		1040-1080	760-780	1/2	1
	AS- WP92		1040-1080	760-780	1/2	1	
			Stainless Steel - All grades & Duplex SS (UNS32205): - Solution Annealed: 1050-1100 Deg C Soaking time : ½ hr per inch with minimum 15 minutes Note: Normalising shall be done for a minimum time of 30 min while tempering to be done for a minimum time of 60min for all materials except SS & Duplex SS (UNS32205).				
	NDE (for all sizes) – Except for Plate formed Dished end	• MT (100%) - Shall be as per - ASTM E709 No linear indications are acceptable. For WP91 & WP92 Wet MPI shall be done. • LPI – SS & Duplex SS (UNS32205): Shall be done as per ASTM E165. No linear indications are acceptable.					
NDE–for Plate formed Dished end	For Plate Formed Dished end – 100% MT as per - ASTM E709 on both inner and outer surfaces of Knuckle radius and weld ends. No linear indications are acceptable. UT shall be as per A578 Level-B. Actual measured notch depth to be specified in Test Certificate.						
NDE – UT For OD >= 219mm or W.T >= 6mm	If made from Pipe & Tube – Shall be done as per - ASTM E 213 with longitudinal notch of 5% wall thickness with max.1.5mm and min. 0.3mm. Actual measured notch depth to be specified in Test Certificate. If made from Forging - Shall be as per - ASTM A 388 In acceptance to - ASME Sec.VIII Div.2 Cl.3.3.4. Actual measured notch depth to be specified in Test Certificate.						
Hardness	Base material Hardness for WPB, WPC, WP11, WP12, WP22 – 197 HBW max. WP91 - 191-250 HBW – 100% to be checked WP92 - 196-250 HBW – 100% to be checked Duplex SS (UNS32205) – 300HBW max						
Dimension	ASME B16.9, As per Engineering drawing indicated in Purchase Order. The ends of reducers shall have a straight portion of Minimum 13mm.						
Bend Test for IBR items (if starting material is forged blank)	Specimen: 25.4 mm x 19 mm thick - cold bent 180 deg. over thin section without fracture, internal radius of bend: CS :<=6.35 mm. AS, SS: <=1.5 times specimen thick.						
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3.4 Forged Fittings –Tees, Reducers, Couplings, Flanges & Dished End (End cover/Cap)

Shall be forged to the shape with a minimum forge reduction ratio of 1:4. Fitting shall not be machined from a forged block.

Starting material: Rolled or Forged Bars, Blooms, Billets (Killed steel)	Heat treatment shall be as per starting material specification	CS – Normalised AS – Normalised & Tempered SS & Duplex SS (UNS32205) – Solution Annealed				
	NDE – UT	To be done for diameter or thickness above 40mm Procedure - As per ASTM A388 In acceptance to - ASME Sec.VIII Div.2 Cl.3.3.4. Actual measured notch depth to be specified in Test Certificate.				
Finished fitting	Heat treatment After forging (cold/hot forging)	Shall be done as per SA234 and follow below table for heat treatment values.				
		Material	Heat Treatment Temp, °C		Soaking time, hr/in	
			Normalizing	Tempering	Normalizing	Tempering
		CS- WPB & WPC	870-900	-	1/2	-
		AS-WP11 & WP12	920-960	640-670	1/2	1
		AS-WP22	920-960	680-710	1/2	1
		AS- WP91	1040-1080	760-780	1/2	1
	AS- WP92	1040-1080	760-780	1/2	1	
		Stainless Steel - All grades & Duplex SS (UNS32205): - Solution Annealed: 1050-1100 Deg C Soaking time : ½ hr per inch with minimum 15 minutes Note: Normalising shall be done for a minimum time of 30 min while tempering to be done for a minimum time of 60min for all materials except SS & Duplex SS (UNS32205).				
	NDE – UT For OD >= 219mm or W.T >= 6mm	UT shall be done as per - ASTM A388 In Acceptance to - ASME Sec.VIII Div.2 Cl.3.3.4. Actual measured notch depth to be specified in Test Certificate.				
NDE (for all sizes)	MT- (100%) Shall be done as per ASTM E709. No linear indications are acceptable. For WP91 & WP92 Wet MPI shall be done. LPI – SS & Duplex SS (UNS32205): Shall be done as per ASTM E165. No linear indications are acceptable.					
Hardness	WPB, WPC, WP11, WP12, WP22 – 197 BHN max. WP91 - 191-250 BHN – 100% to be checked WP92 - 196-250 HBW – 100% to be checked Duplex SS (UNS32205) – 300BHN max					
Dimension	ASME B16.9 or ASME B16.5 or as per Engineering drawing indicated in Purchase order.					
Bend Test (for IBR items)	Specimen: 19mm. Thickness (t) x 25.4mm width - cold bent 180 deg. over thin section without fracture, mandrel radius: CS : <=6.35 mm. AS, SS : <=1.5 times specimen thick.					

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3.5 Welded Fittings– Ells, Tees, Reducers (Two-Half construction):

Pipe made from plate and long seam welded shall not be used as a starting material.

Starting material: Plate	NDE – UT	For thickness above 10mm SA 578, Acceptance Level – B.				
Finished fitting	Heat Treatment	Shall be done as per SA234 and follow below table for heat treatment values.				
	After forming	Material	Heat Treatment Temp, °C		Soaking time, hr/in	
			Normalizing	Tempering	Normalizing	Tempering
		CS- WPBW & WPCW	870-900	-	1/2	-
		AS-WP11W & WP12W	920-960	640-670	1/2	1
		AS-WP22W	920-960	680-710	1/2	1
		AS- WP91W	1040-1080	760-780	1/2	1
		AS- WP92W	1040-1080	760-780	1/2	1
		Stainless Steel - All grades & Duplex SS (UNS32205): - Solution Annealed: 1050-1100 Deg C Soaking time : ½ hr per inch with minimum 15 minutes				
	Post Weld Heat Treatment (PWHT)	PWHT shall be done as indicated below.				
	Material	Heat Treatment Temp, °C		Soaking time		
	CS- WPB-W & WPC-W If weld thk>19mm	595-635		2.5min per mm of weld thk; Minimum 30minutes.		
	AS-WP11-W&WP12-W	650-680				
	AS-WP22-W	690-710		2.5min per mm of weld thk; Minimum 60minutes.		
	AS- WP91-W	760-780				
	AS- WP92-W	760-780				
	NDE (for all sizes)	• MT (100%)- Procedure - As per ASTM E709. No linear indications are acceptable For WP91 & WP92 Wet MPI shall be done • LPI – SS & Duplex SS (UNS32205) : Shall be done as per ASTM E165. No linear indications are acceptable.				
	NDE – for Weld	• RT (100%)- Acceptance norm shall be UW 51 of ASME Sec VIII DIV-1.				
	Hardness	Base material Hardness for WPB, WPC, WP11, WP12, WP22 – 197 BHN max. WP91 - 191-250 BHN – 100% to be checked WP92 - 196-250 HBW – 100% to be checked Duplex SS (UNS32205) – 300BHN max Weld Hardness WP91 - 300 BHN max. – 100% to be checked WP92 - 300 BHN max. – 100% to be checked				
	Dimension	ASME B16.9 or as per Engineering drawing indicated in Purchase order.				
	Bend Test (for IBR items)	Specimen: 19mm. Thickness (t) x 25.4mm width - cold bent 180 deg. over thin section without fracture, mandrel radius: CS : <=6.35 mm. AS, SS : <=1.5 times specimen thick.				

4.0 GENERAL REQUIREMENTS:

- Carbon < or = 0.25% for WPB (all thickness) and WPC (thickness < or = 20mm)
- Carbon < or = 0.30% for WPC (thickness > 20mm)
- If UT not done on the starting material, the same shall be done by the fitting manufactures before forming / fabrication.

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- d) **Chemical and Mechanical Testing** – Test samples shall be tested in the Heat treatment of fitting delivered condition.
- i) Product analysis – one / heat / size.
 - ii) Tension test – one / heat / heat treatment lot / size
 - iii) Hardness test – 100% for Gr91 and Gr92. 10% for others.
- e) **Photomicrograph test for WP91 & WP92** :- Photomicrograph test shall be carried out on one per heat, per size. 3 replicas in one fitting. 1 replica for the size Nb 80 & below. 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 and delta ferrite (to be maintained within 3% for Gr92 when measured as per VD TUV 1272). Photomicrograph with 500x (Min) magnification along with Photomicrograph report to be provided. The actual magnification shall be indicated.
- f) In case of welded fittings, WPS, PQR & welder qualification shall be approved by BHEL, prior to start of welding.
- g) Unless otherwise specified in the P.O SA 234 WP 11/12/22 fittings shall be supplied as per class1.
- h) **Stainless Steel (SS) & Duplex SS (UNS32205)** : Finished fittings shall be checked for radioactive contamination and reported. Survey meter shall be used to measure at 5cm near the surface. Acceptance limits: Shall be less than 0.1 milli Rontgen (MR) per hr or 1 micro Sievert per hr.

5.0 POSITIVE MATERIAL IDENTIFICATION (PMI) FOR ALLOY STEEL (AS), STAINLESS STEEL (SS) AND DUPLEX SS (UNS32205) FITTINGS.

Each AS, SS and Duplex SS (UNS32205) fitting shall be checked for the correctness of the material during manufacturing and final inspection using X-ray fluorescence principle or spark emission spectrography.

6.0 WORKMANSHIP, FINISH AND REPAIR

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

Flatness on curved surfaces of fittings shall be limited to 6% of nominal OD.

Thickness: Outer Diameter & Transition: Variation shall be merged smooth to min 1:4 taper.

7.0 PAINTING, COLOUR CODING & MARKING

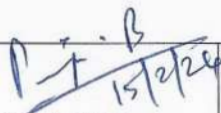
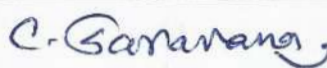
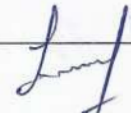
7.1 **PAINTING:** All fittings (except stainless steel and galvanized) shall be **painted** on the external surface as given below (unless otherwise specified): -

- a) **Surface preparation:** Blast cleaning to SSPC SP-10 (SA 2½) with surface profile 35-50 microns.
- b) **Primer coat:** One coat of 60 microns of In-Organic Ethyl Zinc Silicate primer.
- c) **Finish coat:** Two coats of 20 microns each of Heat Resistance Aluminium paint to IS13183 Gr-1.
- d) **Total DFT:** 100 microns minimum.
- e) **Shade:** Aluminium -- for all fittings.

The internal surface shall be protected with rust preventive coating or rust inhibitor. Edge preparations for Site ends shall be protected with weldable primer.

Stainless steel and Duplex SS (UNS32205) fittings need not be painted. Stainless steel and Duplex SS (UNS32205) fittings to be surface treated (Pickling & Passivation) as per ASTM A380.

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

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Material Specification		Colour Code
SA 234	WPB	Red
	WPC	Blue
	WP11	Green & White
	WP12	Black & Red
	WP22	Blue & Red
	WP91	Brown & Red
	WP92	Brown & Blue
SA 403	WP304	Blue & Yellow
	WP304L	Blue, Red & Yellow
	WP304H	Black, Blue & Yellow
	WP316	Black & Green
	WP316L	Blue, Brown & Yellow
	WP321	Blue & Brown
	WP347	Yellow & Black
SA815 (Duplex Stainless Steel)		Red, White & Green

7.3 MARKING (In English only):

7.3.1 For fittings of size above 2” (50mm) :

All the fittings shall be necessarily hard punched / etched and paint stencilled with the details: Material code, Heat number, material specification, size, maker's emblem, Inspectors seal, Running Serial number for the P.O. quantity and Statutory authorities seal as applicable, if fittings are sent to BHEL Stores. (Letter size shall be 6mm minimum and bordered with white paint for easy identification)

7.3.2 For fittings of size 2” (50mm) & below :

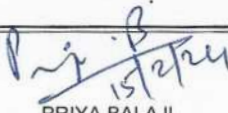
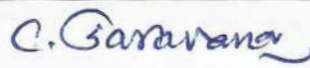
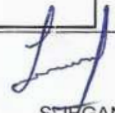
- Engraving on each fitting with minimum details like melt, branch no and Paint stencilling of all above details. Where paint stencil is not possible, permanent metal marker shall be used. (Normal white board permanent marker shall not be used).
- Fittings of size up to 2” (50mm) shall be tied together of appropriate numbers and the above details as indicated in Para 7.3.1 shall be engraved in a separate metal/plastic tag and securely tied to it.

7.3.3 For fittings of thickness less than 6mm :

If the thickness of the fitting is less than 6 mm, punching is not permitted. The above details as indicated in Para 7.3.1 shall be engraved and paint stencilled on each fitting. Where paint stencil is not possible, permanent metal marker shall be used. (Normal white board permanent marker shall not be used).

7.3.4 In case of fittings dispatched directly to project site as **DTS**, material code shall be replaced with DU code (14-digit work order DU detail) as given by Purchase during DTS advice. All other details shall be hard punched and paint stencilled as indicated in Para 7.3.1.

Sample format for Punching & Stencilling is given below.

Vendor code & Name : _____		Makers Emblem Insp. Authority Stamp	
Material code / DU details : _____			
Melt No. : _____			
Material Specification : _____			
Qty. : _____			
Serial No : _____ (Example : 1,2,3,..... & 25)			
Weight. : _____			
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8.0 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 as per the Packaging procedure PC: PKG: 01 to avoid transit & other damages.

9.0 INSPECTION & CERTIFICATION (In English only):

9.1 All items 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 & Form III-I for Dished Ends shall be submitted along with the Work Test Certificate countersigned by the above authorities and shall include the following (Three ink signed originals required).

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 (MTC shall contain size and spec details strictly as per PO)
6. Specification, Grade & Year of code.
7. Heat/Melt Number
8. Starting material details with traceability.
9. Steel making process
10. Ladle Analysis of Raw Material and product analysis of fitting.
11. *Supplementary Test (Product analysis, Tension test) results.
12. Tensile Test Report.
13. Painting Report as per format Doc no TDG102:003.
14. Photocopy of Marking details of one sample for one PO Serial No vetted by TPIA.
15. *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.

9.2 The following reports shall be **furnished separately** along with the IBR Forms & MTC indicated in para 9.1 above.

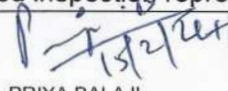
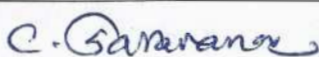
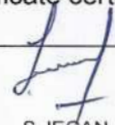
- i. NDE reports for MT, RT, UT (UT Reports in soft copy + hard copy). Actual measured UT-notch depth to be specified in Test Certificate.
- ii. Positive Material identification (PMI) report
- iii. Heat Treatment Chart.
- iv. Hardness Test report.
- v. Photomicrograph test report along with photomicrograph with minimum 500x magnifications.
- vi. Dimensional report (as built drawing with dimensions)
- vii. Thickness Measurement Report for Elbows & Tees as per Doc No : TDG102:001 & TDG102:002.

The above report numbers shall be indicated in the MTC for ready correlation. Vendor shall ensure correlation and traceability wrt documentation.

9.3 For CE marking items if indicated in P.O. the TCs with details specified above shall be submitted as per EN-10204 (Latest).

- i. For pressure parts test certificates of type 3.1 or 3.2 is acceptable.

Type 3.1 – Suppliers shall have ISO 9001-2008/2015 (with validity as applicable) certification certified by Notified Body recognized by European Community and test certificate certified by suppliers authorized inspection representative.

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Type 3.2 – Components inspected and test certificates certified by both the supplier's authorized inspection representative and Notified Body recognized by European Community.

ii. For non-pressure parts test certificates of type 2.2 is acceptable.

Type 2.2 – Suppliers test certificates certified by the supplier's authorized inspection representative with test results as required by this TDG.

10.0 AUDIT CHECKS AT BHEL :

BHEL reserves the right to carry out audit checks for Chemistry, HT condition, Mechanical test and NDT on fittings.

Supplies found defective during check at BHEL are liable for rejection.

11.0 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 acceptance 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.

Rev 05 : a) New material specification SA 815 Duplex Stainless Steel included.

b) Para 4.1, 4.2, 5.0 (d), 7.1 & 7.2 are revised.

c) 5.0 (a), (b), (c), (e), (f), (g), 7.3.1 & 7.3.2 are modified for better clarity.

Rev 06 : a) Para 8.2 added.

b) Para 5.0(d), 5.0(g), 7.1, & 8.1 are revised.

c) Para 1.0 & 7.2 are modified.

Rev 07 : Para 8.2 - vii added.

Rev 08 : a) Title revised for better clarity

b) Para 1.0, 2.0(a), 5.0(c), 8.4, 9.1(8) & 9.2(vi) are revised.

c) From Para 3.0(f), 4.2, 5.0(d), (f), (g), 7.2 forging spec removed

d) Para 2.0(c), (f), 3.0(a), 7.0 & 10.0 added

e) Para 3.0(e) deleted

f) Document no. TDG102:002 Rev.00 added.

Rev 09 : Fully revised for better clarity

Rev 10 : (a) Title and Para 1.0 revised.

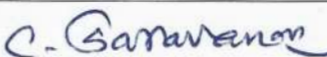
(b) Requirement of Gr92 fittings included, hence TDG 120 will become obsolete.

(b) CI 1.0 - Creep test requirement removed.

(c) CI 7.0 - Painting, Color coding & Marking modified for better clarity.

(d) CI 9.0 - Revised for improved documentation.

(e) Document no. TDG102:003 and TDG102:004 Rev.00 added.

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THICKNESS MEASUREMENT REPORT FOR ELBOW

Doc No: TDG102:001 Rev.00

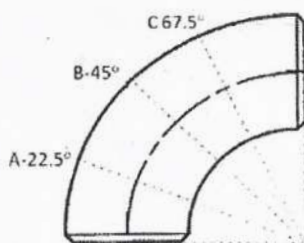
Date: 03.02.2014

PO Number:

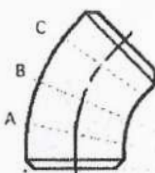
Work order/Du:

Heat no:

Size:



90° Elbow



Less than 90°

Measurement (Extrodus) points

Angle	A	B	C
90	22.50°	45.00°	67.50°
60	15.00°	30.00°	45.00°
45	11.25°	22.50°	33.75°
30	NA	15.00°	NA

Description of item :
Material Spec :
Material Code :

No	Wall thickness at ends		Wall Thickness at angle			Remarks
	End 1	End 2	A	B	C	
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						

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Prepared by	Reviewed by		Approved by



THICKNESS MEASUREMENT REPORT FOR TEE's

Doc No: TDG102:002 Rev.00

Date: 20.06.2015

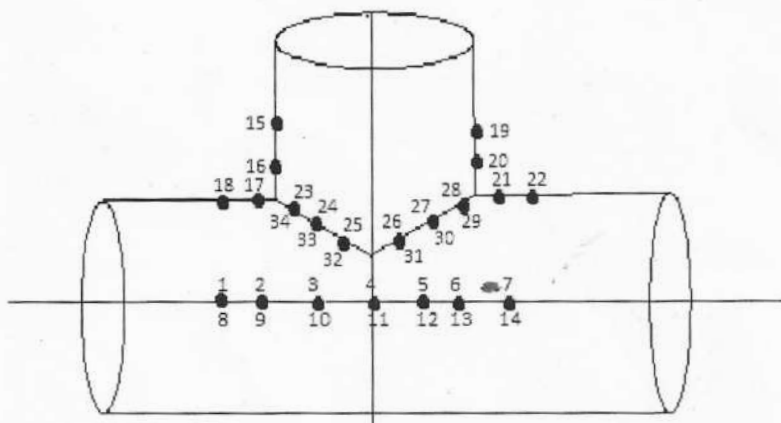
PO Number:

Description of Material:

Size:

Material Spec.

Work order/Du:



Location	Thickness (mm)	Location	Thickness (mm)	Location	Thickness (mm)
1		13		24	
2		14		25	
3		15		26	
4		16		27	
5		17		28	
6		18		29	
7		19		30	
8		20		31	
9		21		32	
10		22		33	
11		23		34	
12		24			

<i>J. N. S. E.</i> J. NANTHINI MGR/ QA	<i>P. Priya Balaji</i> PRIYA BALAJI SDGM / MM	<i>C. Saravanan</i> C. SARAVANAN AGM / ENGINEERING	<i>S. Jegan</i> S.JEGAN SR.MGR / QUALITY
Prepared by	Reviewed by		Approved by



PAINTING & MARKING REPORT

Doc No: TDG102:003 Rev.00

Date: 15.02.2024

Report No:

Date:

BHEL PO. NO & Date :
TDG No :
Applicable Painting Scheme :
Surface Preparation :
Primer Coat :
Primer paint Batch no & Expiry date :
Finish Coat & Shade :
Finish paint Batch no & Expiry date :
Internal surface coating (if applicable) :

PO. Sl.No	Description	Quantity	Total DFT Required	Total DFT Measured	Remarks

(Add Annexure, if no of PO Sl.no is more)

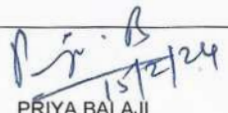
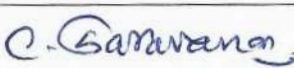
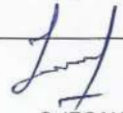
Color Code (marked Circumferentially at all ends) :

Marking : As per TDG & PO requirements.

It is hereby confirmed that the above mentioned components/items/equipment was/were painted as per the TDG & PO requirements as referred above and found acceptable.

Verified
(Vendor QC Sign & Seal)

Reviewed
(BHEL QC Sign & Seal)

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PRE DISPATCH INSPECTION REPORT

Doc No: TDG102:004 Rev.00

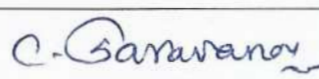
Date: 15.12.2024

S NO	PO NO & PO SI NO	MATERIAL CODE / WORK ORDER NO	ITEM DESCRIPTION	QUANTITY	WEIGHT (MT)

OBSERVATIONS : (Photos also to be enclosed)

PDI DONE BY

(BHEL/BHEL AIA Sign & Seal)

 J. NANTHINI MGR/ QA	 PRIYA BALAJI SDGM / MM	 C. SARAVANAN AGM / ENGINEERING	 S. JEGAN SR.MGR / QUALITY
Prepared by	Reviewed by		Approved by



BHARAT HEAVY ELECTRICALS LIMITED, PIPING CENTRE, CHENNAI

List of Raw material sources for Seamless Pipes conforming to ASME SA 335/ASTM A335
P91 & P92

QCP : 19
Rev : 03
Date : 06.01.2020

Sl.No.	Vendor Name	Country	Grade		Size
1	PRODUCTOS TUBULARES S.A.U	Spain	P91	P92 \$	MIN.ODXWT: 219.1X6.35MM MAX ODXWT: 610.0X101MM
2	SUMITOMO METALS (NSSMC)	Japan	P91	P92	MIN.ODXWT:15.9X1.90MM MAX ODXWT:949.3 X170.00MM
3	VALLOUREC TUBES	France & Germany	P91	P92	MIN.ODXWT:21.3X2.00MM MAX ODXWT:1540.0 X270.00MM
4	VALLOUREC(Changzhou) Co Ltd RM P91: Xingcheng Special Steel Co Ltd, China, Stahlwerk Bous GmbH, Germany RM P92: Stahlwerk Bous GmbH, Germany P91 & P92: ID > 540mm and T > 120mm hollows shall be sourced from Vallourec France/Germany	China	P91	P92	MIN.ODXWT:21.3X2.00MM MAX ODXWT:1540.0 X270.00MM
5	BENTELER STEEL / TUBE GmbH	Germany	P91	P92	MIN ODXWT:21.3X2.0 MM MAX ODXWT:157.3X20.0 MM
6	IBF S.P.A.	Italy	P91	P92	MIN.ODXWT:168 X 20 MM MAX ODXWT: 2500 X 250 MM
7	TUBOS REUNIDOS INDUSTRIAL S.L.U.	Spain	P91	P92	MIN.ODXWT:4.0 X0.50MM MAX ODXWT:177.8 X40.0MM
8	WYMAN-GORDON FORGINGS INC.	USA	P91	P92	MIN.ODXWT:219.0X12.50MM MAX ODXWT:1200.0X177MM
9	TENARIS GLOBAL (NKK TUBES)	Japan	P91	P92 \$	MIN.ODXWT:21.3X2.40MM MAX ODXWT: 622.0X48.00MM
10	TENARIS GLOBAL (DALMINE)	Italy	P91	P92 \$	MIN.ODXWT:21.3X2.40MM MAX ODXWT: 622.0X48.00MM
11	TENARIS GLOBAL (SILCO TUBES)	Romania	P91	P92 \$	UPTO 159 MM OD
12	JFE (Kawasaki)	Japan	P91	P92	MIN ODXWT:88.9X4.0 MM MAX ODXWT:406.4X55.0 MM
13	RINGMILL SPA	Italy	P91 \$	P92 \$	MIN ODXWT:350.0X50.0 MM MAX ODXWT:3000.0X300.0 MM
14	HENGYANG STEEL TUBE GROUP INT'L	China	P91 \$	P92 \$	MIN.ODXWT:88.9X4.50MM MAX ODXWT:722.0X120MM
15	YANGZHOU CHENGDE STEEL PIPE CO. LTD RM P91 & P92: BaoSteel Special Metals, Shanghai RM P91: Xingcheng Special Steel Co Ltd, Jiangsu	China	P91	P92	ABOVE 219.1 MM OD
16	JIANGSU CHENGDE STEEL TUBE SHARE CO RM P91 & P92: BaoSteel Special Metals, Shanghai RM P91: Xingcheng Special Steel Co Ltd, Jiangsu	China	P91	P92	UPTO 219.1 MM OD
17	ZHEJIANG GROSS SEAMLESS STEEL	China	P91 \$	P92 \$	MIN.ODXWT:355.6 X 8.00 MM MAX ODXWT:1200.0 X 200MM
18	YANGZHOU LONTRIN STEEL	China	P91	P92	MAX OD / WT : 1016 X 150 MM
19	TECTUBI RACCORDI S.P.A.	Italy	P91 \$	P92 \$	P91:UPTO OD 1150 (WT 150); P92:UPTO OD 813(WT 120)& OD 813 TO 1100(WT 48)
20	HUBEI XINYEGANG STEEL CO LTD	China	P91 \$	-	MAX OD / WT : 1016 X 150 MM

Supplementary Tests: S1,S2,S3,S4,S5 to be done for P92.

\$: Shall NOT be used for NTPC projects.

Rev 01: P92 sources added, Sichuan removed and other entries verified wrt PCP91.

Rev 02: SI No 4, 15, 16 revised inline with NTPC approval letters. RM - Raw Material for NTPC projects

Rev 03: SI No 7,8,18 revised inline with NTPC approval letters. SI No 18,19 added. SKT International removed.

J. N. L. E.
06/01/2020.

K. V. Ramani

PREPARED BY:
J. NANTHINI

APPROVED BY:
K.V.RAMANI

6/1/2020