



**BHARAT HEAVY
ELECTRICALS LIMITED**
PIPING CENTRE, MADRAS - 17
QUALITY ASSURANCE & CONTROL DEPT.

**STANDARD QUALITY ASSURANCE PLAN FOR FORGED FITTINGS
CONFORMING TO ASME SA105 & SA182**

QP NO : QPG: 87
REV.NO: 01
DATE : 05-05-2018

REF: BHEL TDC No. : TDG:104 (latest revision)

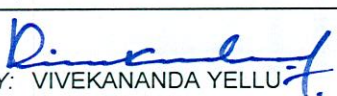
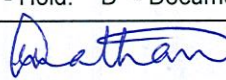
SL . NO.	COMPONENT OR OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	TYPE OF RECORD		AGENCY		REMARKS
									D*	M	B	
1	2	3	4	5	6	7	8	9	10	11	12	13
2.6	Test Piece Marking (TPM)	Selection of Test coupons	Major	Measurement & Marking	One Sample / Heat / Size/ HT Batch	As per ASTM A370		Internal report	X	P	V/ W*	Refer Note : 1
3.0	TESTS											
3.1	Finished product	YS, UTS, % Elongation (Mandatory)	Major	Tensile Strength,	One Sample / Heat / Size/ HT Batch	Material Specn. & BHEL TDG:104		Test Report	X	P	V	
3.2		Product Analysis	Major	Chemical Composition	One Sample / Heat / Size	Material Specn. & BHEL TDG:104		Test Report	X	P	V/ W*	
3.3		Hardness	Major	Hardness test	100% / 10%	Material Specn. & BHEL TDG:104		Test Report	X	P	W	100% for F91/92 ; 10% for others
3.4		Surface Defect	Critical	NDE - LPT	100%	Material Specn. & BHEL TDG:104 Only for SS & Duplex SS items		Test Report	X	P	W	
3.5		Sub-surface Defect	Critical	NDE - MPT	100%	ASTM E709	ASME B31.1 Cl. 136.4.3	Test Report	X	P	W	Wet MPT for F91/92; Dry MPT for others
3.6		Volumetric Defect##	Major	NDE - UT##	100%	ASME SA388	ASME Sev-VIII, Div.2 Cl.3.3.4	Test Report	X	P	W	##: Bars/Rounds: OD = 40mm and above; Others: OD >= 200mm or Thickness >= 6mm
3.7		Microstructure (Applicable for F91/92 Fittings)	Major	Metallo- graphic test	One Sample / Heat / Size/ HT Batch	No micro fissures. Microstructure shall show tempered martensite. Grain growth if any has to be examined further.		Test Report (Magnification at 500x)	X	P	W	F92: Delta Ferrite shall be 3% max as per VD TUV 1272 & Refer Note :8
3.8	PMI for AS fittings	Chemical	Major	PMI	100%	Material Specn. & BHEL TDG:104		Test Report	X	P	W	

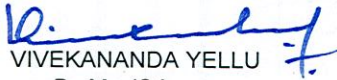
LEGEND: M:- Manufacturer; B:- BHEL/ BHEL Nominated Agency; P - Perform; V - Verification; R-Review; W - Witness; H - Hold. D* - Documents required if marked "X"

PREPARED & REVIEWED BY: VIVEKANANDA YELLU
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 BHARAT HEAVY ELECTRICALS LIMITED PIPING CENTRE, MADRAS - 17 QUALITY ASSURANCE & CONTROL DEPT.		STANDARD QUALITY ASSURANCE PLAN FOR FORGED FITTINGS CONFORMING TO ASME SA105 & SA182							QP NO : QPG: 87 REV.NO: 01 DATE : 05-05-2018			
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1.0	Raw material sources for F-91&92 shall be as per QCP:18(Latest Revision); Any other source proposed by the vendor shall be subjected to BHEL approval.. The Test Certificate for all material specifications received from RM manufacturer shall meet IBR requirements.											
1.1	Raw Materials	Chemical Composition, Mechanical Properties & NDT	Major	Verification of MTC & Ladle Analysis Report	100%	As per Required Material (ASME) Specification	MTC	X	P	V/R	F92 : Si: 0.10-0.50%; Ni: 0.30 max and Cu: 0.25 max. MTC - Mill Test Certificate	
1.2		Surface defect	Major	Visual	100%	As per Required Material (ASME) Specification	Report	X	P	V		
1.3		Dimensions Outer Dia.,Thk.etc	Major	Measurement	100%	As per Spec	Report	X	P	V		
1.4		Chemical Check for Semi-Finished Components	Major	PMI	100%	As per Required Material (ASME) Specification	Report	X	P	R/W*	W*For F91/92 material	
1.5		Hardness Test for Semi-Finished Components	Major	Measurement	100%	As per Specification	Report	X	P	R/W*		
		Forging ratio shall be 1:4 minimum & shall be reported in Mill test certificate incase of semi-finished forging otherwise manufacturer test certificate.										
2.0	IN PROCESS INSPECTION											
2.1	Fitting Forming Procedure	Procedure qualification	Major	Review	100%	Material Specn. & BHEL TDG:104	Appd. Procedure	X	P	V	Forming Procedure shall be approved by BHEL.	
2.2	LPT Procedure	Procedure Review	Major	Review	100%	Material Specn. & BHEL TDG:104 Only for SS & Duplex SS items	Appd. Procedure	X	P	V	LPT - Liquid Penetrant Test	
2.3	MPT Procedure	Procedure Review	Major	Review	100%	Material Specn. & BHEL TDG:104	Appd. Procedure	X	P	V	MPT - Magnetic Particle Test	
2.4	UT Procedure	Procedure Review	Major	Review	100%	Material Specn. & BHEL TDG:104	Appd. Procedure	X	P	V	UT - Ultrasonic Test	
2.5	Heat Treatment	Rate of Heating, Rate of Cooling & Soaking time	Critical	Temp & Time graph	100%	Material Specn. & BHEL TDG:104 Refer Note : 2	HT Chart	X	P	V/ W\$	W\$: For 1st off trial / at random	
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4.0	FINAL INSPECTION												
4.1		Surface check, Bend angle, Radius, End-to-end dimn, Ovality, Thickness, Wrinkles, d1 at ends, Edge preparation & other dimensions as per Drg.	Major	Visual & Measurement	100%	ASME B16.9/B16.11 / BHEL Drg. & P.O.	Report	X	P	W			
4.2		IBR Certification	Major	all tests as per IBR	100%	IBR	FORM-IIIG	X	P	IBR	Refer Note : 11		
4.3		Marking / Color coding	Critical	Visual	100%	BHEL TDG:104 & P.O.	Report	X	P	V	Refer Note : 13		
4.4		Surface Protection, Preservation & Packing	Critical	Visual	100%	BHEL TDG:104 & P.O.	Report	X	P	V	Refer Note : 9 & 12		
5.0	Inspection clearance	Documentation	Critical	Verification	100%	All reports as required in this QAP	Report	X	P	H			
NOTES :-													
1.0	Seal tranfer on pieces to be cut shall be done by BHEL inspector & IBR for F91/92 materials and only IBR for other than F91/92 materials.												
2.0	POST FORMING HEAT TREATMENT (AFTER FORGING & BEFORE MACHINING):-												
	For F91/92 materials : Normalise at 1050 - 1080 deg.C & Temper at 750-780 deg.C; Soaking shall be 30 minutes minimum for thickness upto 50mm and 1Hr 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. 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.												
	SA105 : Normalised; SA182 F11/F12/F22 : Normalised & Tempered.; SS & Duplex SS : Solution Annealead.												
3.0	Finished SS & Duplex SS fittings shall be checked for radioactive contamination and reported in raw material(Ingot/Blooms/Billets) manufacturer TC / Mill TC. 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.												
4.0	Chemical & Mechanical tests shall be performed at NABL approved laboratories(in-house/outside).												
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5.0	All NDE procedures with Level-III authorised shall be submitted to BHEL for review. NDE shall be performed by qualified personnel. All NDE shall be done before proof machining.												
6.0	Items shall be visually checked. No hard scales shall be present on inside & outside surfaces.												
7.0	Gas cutting & Plasma cutting are prohibited for F91/92 material.												
8.0	1 replica for the size Nb 80 & below per Heat Treatment batch. 3 replicas in one fitting per Heat Treatment batch. Actual magnification shall be indicated in the photomicrograph. Photomicrographs shall be provided as records for review & acceptance and future in-service reference.												
9.0	All fittings shall be Painted as below when not specified in the P.O./Drawing:- a) Fittings supplied to BHEL's Stores: All items except SS & Duplex SS to be applied with resin type rust preventive coating with visibility to punched and stenciled details on outside. b) Fittings supplied directly to BHEL's Sites(DTS): Surface preparation by Blast cleaning (SSPC-SP10); Primer : 1 coat of 60 microns of In-Organic Ethyl Zinc Silicate primer; Finish : 2 coats of 20 microns each of Heat Resistance Aluminium paint to IS13183 Gr-1; Total DFT : 100microns minimum; Shade: Aluminium The internal surface shall be protected with rust preventive coating or rust inhibitor. Stainless steel and Duplex SS (UNS32205) fittings need not be painted. Pickled & Passivated as per ASTM A380.												
10.0	All items shall be inspected and cleared by BHEL / BHEL authorised Inspection agency & IBR authorities.												
11.0	Necessary IBR Requirements shall be fulfilled and IBR documents to be submitted. a) Well-Known Forger: - (i) Finished Fittings: No further fabrication like Machining/Cutting at shop: Form IIIC. (ii) Semi-Finished Fittings: Form IIIG signed by Forger. b) Not Well-Known Forger: - (i) Finished Fittings: No further fabrication like Machining/Cutting at shop: Form IIIC. (ii) Semi-Finished Fittings: Form IIIG – counter signed by IBR authorities.												
12.0	Machined ends shall be well protected using end caps and suitably packed to avoid transit & other damages. Tack welding is prohibited on F91/92 material.												
13.0	Marking :- a) Items dispatched to Stores : The finished components shall be punched & paint stencilled with Material code, Heat number, material specification, maker's emblem, Inspectors seal and Statutory authorities seal (as applicable) b) DTS (Direct to Project Site) Items :- DTS shall be hard punched and paint stencilled with DU code (14 digit work order du detail) as given by purchase in addition to marking done as per 13 (a). Colour coding : SA105 - Blue ; SA182 F11 - Green & White; F12 - Black & Red; F22 - Blue & Red; F91 - Brown & Red; F92 - Brown & Blue; F316 - Black & Blue; F316L - Blue, Brown & Yellow; Duplex SS - Red, White & Green												

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