



Product: Forgings/Forged Fittings of UNS N06617 (SB564) for Fire Side Corrosion Test Rig (FSCTR) for AUSC

Record of Revision:

Rev 00: 07/08/17: Fresh Issue

Rev 01: 11/08/17: Scope of TDC modified to include forgings based on feedback from MM, AUSC group and WRI.
Clauses 2, 4, 8, 9 & 12 modified to include forgings

1. Material:

Specification : ASME SB564 (Latest on the date of Purchase Order)
Material : UNS N06617
Additional Requirement : As listed below (Supplementary to Specification)
Size and Qty. : As per Purchase order

2. Chemical Composition and Process:

Material shall be produced by using vacuum induction melting (VIM) followed by vacuum arc re-melting (VAR) or electro slag refining (ESR). Any other suitable melting and re-melting process shall be used only after approval from the purchaser.
Forged bar shall be ensured for uniform structure & strength with reduction ratio in area: 3:1 min. from ingot to finished forging.
Forgings/Forged Fittings shall be manufactured as close to the final shape as possible.
Product Analysis: As per specification
Heat Analysis in weight %: As per specification
Raw materials used in making of forged bars including incoming scrap shall be checked by supplier to ensure freedom from radioactivity.

3. Dimensions and Tolerances:

Dimensions and tolerances: As per BHEL purchase order and relevant drawings.

4. Heat Treatment on Forgings/Forged Fittings:

UNS N06617 – solution annealed in the range 1150°C to 1175°C.

5. Mechanical Tests:

Extent of test: one sample/for each size/heat/HT batch; on final heat treated condition samples:
UNS N06617: Tensile Strength: Min 655 MPa, Yield Strength (0.2% off set): Min 241 MPa, Elongation ($L=5.65\sqrt{A}$), min 35%
Macrostructure: Grain size ASTM No 2 to 5.

6. Non-destructive testing:

UT: 100% for all diameters. Notch depth 3% of max thickness. Testing method and acceptance shall be as per supplementary requirement in ASME SB-564.

Reference hole as per table: UT testing reference hole for inspection in radial direction		
Dia of forging, mm	Dia of ref flat bottom hole, mm	Remarks
$D \leq 150$	3.2	
$150 < D \leq 400$	6.4	
$400 < D \leq 600$	6.4	
$600 < D \leq 1200$	6.4	1. Sensitivity of 6.4mm hole shall be ensured at 600mm depth and the scan should be carried out from throughout the circumference to cover the complete diameter. 2. Dual element transducer shall be used to inspect the near surface areas within the dead zone of the single element transducer used for inspection as described in point 1.

LPI: 100% - test method & acceptance as per supplementary requirements in ASME SB-564.

All the chemicals used for LPI shall meet the requirement that total halogen and sulphur of each material shall not exceed 1% by weight of residue. Recommended for NP grade (nuclear purpose) LPI consumables.

7. Workmanship and Finish:

The Inside & outside surfaces shall be free from any imperfections. The material shall be plain, uniform in quality and condition, smooth, straight or flat and free of wrinkles, overlaps, tears, cracks, seams, folds, pitting etc. Localised imperfections, if any, may be removed by mechanical means ensuring the wall thickness. Local depressions or ground spots are not acceptable. Loose scales shall be removed by blast cleaning in surfaces after heat treatment. No weld repairs permitted.

8. Marking & Packing:

Details of stamping on front face of each item with low stress stamps and border by oil paint: (1) Heat number, (2) Specification & grade, (3) Size, (4) Maker's emblem/code, (5) Identification details as per drawing. Work inspectors stamp next to heat number. The *Forgings/Fittings* are to be properly packed and despatched to avoid damage during transit.



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9. Inspection & Certification:

IBR Form IIIG (in case of forgings) or Form IIIC (in case of forged fittings), as applicable, countersigned by applicable IBR approved inspection agency and Test certificate with following details, shall accompany the product. Also Manufacturer Test Certificate shall be provided with the following details: -

1. Purchase Order No. (BHEL), TDC No. & Test certificate number.
2. Specification, Grade with applicable year of code, Heat Number, Drawing No., Quantity & Size
3. Supplier TC of the steel used in making the finished product in IBR Form IV.
4. Details of steel ingot, Melting & forging process, Chemistry including incidental elements - Heat wise.
5. Heat treatment details of the material and test bars, Mechanical test results with reference & acceptance standard.
6. NDE examination test results with reference & acceptance standard.
7. Results of dimensional inspection.

Survey meter shall be used to measure radioactive contamination at 5cm near the surface. Acceptance limits: Shall be less than 0.1 milli Rontgen (MR) per hr or 1 micro Sievert per hr. The Measured Radioactivity levels shall be reported in the Mill Test Certificate. (Not to be recorded in IBR Form).

All the tests specified here shall be carried out at works and the test results shall be furnished in the test certificates (4 copies) in English. The *forgings/fittings* shall be inspected and certified by the inspecting agency authorised by BHEL, wherever specified in the purchase order.

10. Quality Plan:

Before start of production the manufacturer shall submit a Manufacturing and Inspection plan (MIP) to **BHEL product QA** for approval. The MIP shall constitute of:

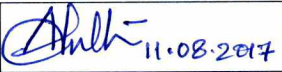
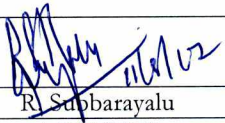
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| i) melting & refining, | v) heat treatment along with | viii) marking preservation and dispatch, |
| ii) forging ratio, | parameters, | ix) test instructions for NDE along with |
| iii) preliminary heat treatment, | vi) test and inspections after heat | sketches, |
| iv) internal tests and inspection | treatment, | x) examination after machining. |
| before final heat treatment, | vii) test certificate requirements, | |

11. Audit Checks at BHEL:

BHEL reserves the right to carry out audit checks for chemistry, HT condition, mechanical test and NDT on representative test bars or job. Supplies found defective during check or subsequent processing at BHEL are liable for rejection.

12. End Use

These *Forgings/fittings* are intended for Advanced Ultra-Super Critical (AUSC) boiler applications *in the FSCTR*.

 11.08.2017	 11/08/17	 11/08/17	 11/08/17
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