

Record of Revision:

Rev 00: 15/07/14: Fresh Issue

Rev 01: 08/08/14: Material designation in Heading & Cl 1 modified, Cl 9 – IBR inspection requirements added.

Rev 02: 20/05/15: Cl 1 steel making process clarified, Cl 2 Cu composition corrected, Cl 4 HT temp modified, Cl 5 9 Creep removed, macro corrected to micro Cl 12 modified.

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). Forged bar shall be ensured for uniform structure & strength with reduction ratio in area: 3:1 min. from ingot to finished forging.

Product Analysis: As per spec

Heat Analysis in weight %: Test method as per ASTM E350

Element	Cr	Fe	Mn	Mo	Co	Al	C	Cu	B	Si	S	N	Ti	Ni
Wt %	21-23	1.5 max	0.3 max	8-10	11-13	0.8-1.3	0.05-0.08	0.5 max	0.002-0.005	0.3 max	0.008 max	0.05 max	0.3-0.5	Bal.

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:

As per purchase order and relevant drawings.

4. Heat Treatment on Forging:

UNS N06617 – solution annealed condition – 1150°C – 1180 °C (suggested temperature)

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 700 Mpa, Yield Strength (2% off set): Min 300 Mpa, Elongation ($L=5.65\sqrt{A}$), min 35%

Micro: Grain size ASTM 2-5.

6. Non-destructive testing:

UT: 100% for all diameters. For hollow forgings - 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 ≤ 150	3.2	
150 < D ≤ 400	6.4	
400 < D ≤ 600	12.7	
600 < D ≤ 1200	12.7	1. Sensitivity of 12.7mm 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 material shall be plain, uniform in quality and condition, smooth, straight or flat and free of wrinkles, overlaps, tears, cracks and injurious imperfections. No repairs/weld repairs permitted. Forgings to be clean & shot blasted to remove scales after HT.

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 are to be properly packed and despatched to avoid damage during transit.

9. Inspection & Certification:

The inspection and tests to be witnessed by an IBR approved inspecting agency, in case the Forge shop is not recognised as a "Well known Forger" under IBR.

IBR Form IIIG countersigned by applicable inspection agency and Test certificate with following details, shall accompany the product (including proof machined). Well known Forger shall provide IBR Form IIIF and Test certificate with following details, shall accompany the product (including proof machined). 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 – Well known steel maker IBR Form IV & others Form IVA.
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 data sheet

All the tests specified here shall be carried out at works and the test results shall be furnished in the test certificates (4 copies). The bars 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, | vii) preliminary heat treatment, | xii) marking preservation and |
| ii) ingot weight and type, | viii) internal tests and inspection | dispatch, |
| iii) forging process, press rating, | before final heat treatment, | xiii) test instructions for NDE |
| iv) top bottom end discard | ix) quality heat treatment along with | examinations along with sketches |
| percentages, | parameters, | xiv) type of machining and |
| v) position of the part in ingot, | x) test and inspections after heat | examinations. |
| vi) sketch of the forging process and | treatment, | |
| its forging ratios, | xi) 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

To be used in forgings of valves for Advanced Ultra-Super Critical (AUSC) boiler applications.

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