

Record of Revision:

Rev 00: 09/05/2017: Fresh Issue

Scope

This Technical Delivery Conditions pertains to procurement of raw materials manufacturing & quality requirements of fabricated Y-Pieces for Advanced Ultra Super Critical Power Station Piping conforming to Indian Boiler Regulations. Material shall be procured only from manufacturers (not be procured from traders/ stockists).

1. General:

Specification : ASTM B564/ASME SB564 (Latest revision on the date of Purchase Order)
Material : Alloy 617M – UNS N06617
Additional Requirement : As listed below (Supplementary to Specification)
Size and Qty. : As per Purchase order

2. Components:

❖ **Material:** Shall be produced by using vacuum induction melting (VIM) followed by vacuum arc re-melting (VAR) or Electro slag refining (ESR).

- In case of Inconel 617M Forgings shall be ensured for uniform structure & strength with reduction ratio in area: 3:1 min. from ingot to finished forging. Forgings shall be manufactured as close to the final shape as possible. Shall be procured as per TDC 436/latest. Vendor details shall be furnished in the bid and sources shall be approved by BHEL.
- In case of Inconel 617M Pipes shall be procured as per TDC 125/latest or TDC 437/latest. Pipe vendor details shall be furnished in the bid and sources shall be approved by BHEL.
- In case of Inconel 617M Plates shall be procured as per TDG 117/latest. Plate vendor details shall be furnished in the bid and sources shall be approved by BHEL.

If any other form of raw material is used, the same shall be informed in the bid along with its source of procurement.

Product Analysis: As per spec B880

Heat Analysis in weight %: Test method as per ASTM E1473

Table 1

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	0.05 max	0.002-0.005	0.3 max	0.008 max	0.05 max	0.3-0.5	Bal.

Raw materials shall be checked by supplier to ensure freedom from radioactivity.

- ❖ **Dimensions and tolerances:** As per purchase order and relevant drawings.
- ❖ **Heat Treatment:** solution annealed condition - 1150°C to 1175°C.
- ❖ **Mechanical Test:** Extent of test: one sample/for each size/heat/HT batch; on final heat treated condition samples:
Tensile Strength: Min 655 Mpa, Yield Strength (2% off set): Min 241 Mpa, Elongation: min 35%
Micro: Grain size ASTM 2-5.
- ❖ **NDT: UT:** 100% for all thickness/diameters. Testing method and acceptance shall be as per supplementary requirement in ASME SB-564.
For hollow forgings - notch depth 3% of material thickness (minimum depth shall be 0.3mm).
Longitudinal wave:

Reference hole as per table: UT testing reference hole for inspection in radial direction	
Thickness of forging, mm	Dia of ref flat bottom hole, mm
t ≤ 150	3.2
150 < t ≤ 400	6.4

NDT: 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 to use NP grade (nuclear purpose) LPI consumables.

3. Fabrication of Y-pieces:

Fit up, fabrication, dimension and tolerance shall be as per BHEL drawing.

- **Welding:** Process shall be TIG process, a stress free Edge preparation method shall be adopted.
The 617 filler welding consumable chemistry shall be as per **Table 1**. Consumable TC shall be submitted for approval before taking up of actual job for welding. Sources of Welding consumable shall be informed to BHEL. Batch test (consumable and test piece) shall be conducted and submitted to BHEL for approval before taking up of actual job for welding.
- WPS and PQR shall be approved by BHEL and shall address the following also: Inter pass temperature shall be less than 150°C.

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BHEL Piping Centre	Quality Assurance	Technical Delivery Conditions
Product: Welded Y-piece of Alloy 617M for Advanced Ultra Super Critical (AUSC) Boiler		
Document No. TDG: 116	Rev.No. 00	Effective Date: 09/05/2017
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A Distortion control methodology has to be adopted during welding. The same shall be proposed, validated and submitted to BHEL before taking up of actual job for welding.

PWHT for Inconel material shall be 980 deg C ($\pm 10^{\circ}\text{C}$). Rate of heating: $50^{\circ}\text{C} / \text{hr}$ (max). Holding time shall be minimum 2 hours, for thickness up to 25mm. Additional: 1 hr per inch. Followed by furnace cooling.

4. Non-destructive testing: (for welds)

All NDE shall be done after PWHT only – and witnessed by Inspection authorities.

NDE procedures (LPI, RT, UT and Hardness) shall be approved by BHEL. All welds shall be subjected to UT, RT and LPI as per ASME Sec V and evaluation and acceptance norms shall be as per ASME Sec VIII- Div.2.

Hardness: max 260 HV (after PWHT)

Qualified Level II personnel shall perform the examination as well as evaluation, and a test report shall be issued.

5. 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 parent material/weld repairs are permitted. Welded Y piece to be clean & shot blasted to remove scales after HT.

6. Marking & Packing

All items shall be punched with a low stress stamp indicating:- 1) Specification, 2) Grade, 3) Heat No, 4) Maker's emblem and 5) the Inspection Authorities Seal.

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

7. Inspection & Certification: (in English only)

All items are to be Inspected at the manufacturer's works by IBR approved authorities. Inspection certificate in IBR Form IIIC shall be submitted along with the Work Test Certificate (EN 10204 Type 3.2) countersigned by authorities as per IBR (if not well-known) and shall include the following. (Three ink signed originals required)

1. Purchase Order No. (BHEL), TDG No. & Test certificate number.
2. Specification, Grade with applicable year of code, Heat Number, Drawing No., Quantity & Size
3. Details of ingot, Melting & forging process, Chemistry including incidental elements - Heat wise.
4. Heat treatment details of the material, Mechanical test results with reference & acceptance standard.
5. Individual NDE reports (LPI, UT) with reference & acceptance standard on forgings and (LPI, UT, RT) on finished Y pieces (weld joints).

The following shall also be furnished:

6. Heat treatment chart
7. Hardness test report
8. Dimensional report (as built drawings with dimensions)
9. TC for steel shall be provided.
10. TC for the raw forgings/pipes/plates shall be provided.
11. Applicable IBR forms for Sub-components.
12. WPS and PQR shall be provided along with welder qualification.
13. Batch test report for welding consumables and test piece shall be provided.

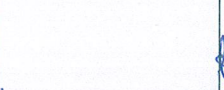
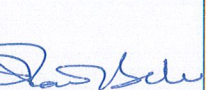
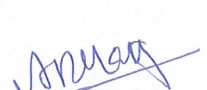
8. Quality Plan

Before start of production the manufacturer shall submit a Manufacturing and Inspection plan (MIP) to BHEL approval.

The MIP shall constitute of: i) melting & refining, ii) ingot weight and type, iii) forging process, press rating iv) fitup and welding procedures, v) NDE and PWHT parameters vi) sketch of the equipment and welding details, vii) type of machining and examinations, viii) internal tests and inspection before final heat treatment, ix) heat treatment, x) test and inspections after heat treatment, xi) marking preservation and dispatch, xii) test certificate requirements

9. Audit Checks at BHEL

BHEL reserves the right to carry out audit checks at any stage of manufacture on representative test bars or job. Supplies found defective during check or subsequent processing at BHEL are liable for rejection.

					
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