

BHEL, Tiruchirappalli – 620014.	Quality Assurance	Technical Delivery Conditions
Product: <b>Carbon, Alloy &amp; Stainless Steel Forgings (Boilers And Valves)</b>		
Document No.: <b>TDC:0:404</b>	Rev. No.: <b>09</b>	Effective date: <b>23/02/2010</b> Page <b>1 of 2</b>

Revision Record: Rev:07:AISI 410 forgings added consequent to material rationalization by Engg.Valves.Rev:08:Cl.2.0 modified for clarity. Cl.5.0 modified to include impact test for CS QCNRV & CRHNRV Valves.Cl.6.0 modified for clarity in UT.Rev:09;New materials F23,F92 added in Cl:1.0,Cl:2.0,Cl:4.0 to Cl:6.0.CE marking certification clarity included in Cl:10.0 .

## 1.0 MATERIAL:

Specification: ASME{Latest on date of Purchase Order (PO)}:

(ASTM also applicable for non pressure parts / Valves)

CARBON STEEL:(CS) : SA 105, SA 350 LF 2

ALLOY STEEL: (AS) : SA 182 F6a Class 3, F12 Class 2, F22 Class 3,  
SA 182 F23 (Code Case:2179),SA 182 F91 & F92 (Code Case:2199)

STAINLESS STEEL: (SS) : SA 182 Gr. F 304, 304L, 316, 316L, 316H, 321, 321H, 347 & 347H  
AISI 410 for TOA Gland and bushings.

Additional Requirement: As listed below (supplementary to Specification)

Size and Qty.: As per Purchase order & Drawing.

## 2.0 CHEMICAL COMPOSITION & PROCESS:

- Melting: fully killed. Product analysis per heat:  
CS: C<=0.25%. AS: SA182 P23: Si:0.25-0.50% & Cu:0.25 max .  
SA182 P92: Si:0.10-0.50%; Ni:0.30max & Cu:0.25max
- Steel for forging for IBR items to be inspected at Mill & test certificate countersigned by IBR approved Authority, if the mill is not approved under IBR as well known steel maker.
- Steel for IBR items of SA 182 F12, F22 from indigenous mills to be from following manufacturers approved under IBR for creep resistant steels: (i) Alloy Steel Plant, Durgapur,(ii) Tata Iron & Steel Company, Jamshedpur & (iii) Mahindra Ugine Steel Company, Bombay.(iv) M/S Mukund Limited Karnataka, (v) M/S Kalyani Steels Karnataka.(vi) Remi Metals Gujarat Limited. Gujarat (vii) ISMT Pune.Steel for IBR items of SS and AS other than above shall be imported.
- Forging: to ensure uniformity of structure & strength with reduction ratio in area:1:4min.from ingot to final forging, close to final size & shape. Flow lines to be parallel to axis of openings.
- Blooms / Billets used for forgings (Dia>= 50mm) shall be UT tested. For Acceptance Norm refer Cl.6.0. For finished bars this can be done at final stage.

## 3.0 DIMENSIONS AND TOLERANCES:

Tolerances as per Drawing. Untoleranced dimensions for valve components: VL:STDC:023(latest).

## 4.0 HEAT TREATMENT(HT):

CS: SA 105: Normalised, SA 350 LF 2: Normalised at 880-900 °C & Tempered at 620-640 °C

AS: Normalised and Tempered. For SA182 F91, F92, F23 :Normalizing Temperature: 1050-1080°C

Tempering Temperature: 750°C-780°C. Soaking:1 Hour minimum. Still Air Cooling

AISI 410:Supply in Quenched &Tempered condition as below. Quenching at 955-1010°C in air or water or oil or Polymer.Soaking 30 mts/inch maximum thickness. Tempering at 663°C.min.Soaking :60 mts/inch maximum thickness and Air cool.

## 5.0 MECHANICAL TESTS:

- Extent of test: for each size/heat/HT batch from sample product or identical test coupon.
- Additional requirements for SA182 F91,F92 and F23:  
F91: Yield Strength:(0.2% offset):450MPa min. Tensile Strength: Min:630 MPa,Max:850MPa  
Hardness(HB):Min:191.Max:250  
F92- Tensile Strength:Min:655 MPa, Max:850 MPa. Hardness(HB):Min:196.Max:250  
F23- Tensile Strength: Min:510 MPa, Max:730 MPa. Hardness(HB):Min:150.Max:220
- AISI 410:Hardness 197-235 BHN. No other mechanical test required.
- Additional requirements of tests: (Other than AISI 410 Only.)
- Bend test: Carbon Steel:1 Sample 19mm.Thick(t) x 25.4mm width to be bent 180 deg. around mandrel of radius 6.35 mm. Alloy Steel: Sample 25.4mm width to be bent 180 deg. Around mandrel of radius =1.5 x t.
- Impact test for QCNR Valves & CRHNR Valves: CS and AS: 1 / HT batch.as per ASTM A 370, 2mm. Charpy-U notch,at Room temperature.Acceptance: Avg of 3specimens:36J,Single Min: 24J.
- CE-marking items: Charpy- V impact test at 20 deg.C as per ASTM A 370 for, Acceptance : Avg : 40joules, Min. single value: 27 joules.

## 6.0 NON DESTRUCTIVE TEST:

- Extent of test: for each product. Stage of test : After heat treatment.
- UT: As per SA 388 Bars of dia. = / > 50mm, Body & yoke of special class valves, all forgings & bars of SA 182 F91, F92, F23. Acceptance: ASME Sec.VIII Div. 2. Cl:3.3.4
- MPI : CS, AS: 100%, As per ASTM E 709, Linear indications like cracks, folds & other injurious defects are unacceptable.
- LPI: for SS: 100%: ASTM E165, No linear indications acceptable.

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**7.0 WORKMANSHIP AND FINISH:**

Items to be proof machined as per drawing or shot blasted for CS/AS, Pickled & passivated as per ASTM A 380 for SS, & be free from scales & defects like laps, seams, folds, cracks, etc. Machined items (except SS) to be coated with a layer of transparent rust preventive before despatch.

**8.0 REPAIR:**

Repairs by fusion welding are prohibited. Surface defects can be removed by mechanical means and defective areas smoothly dressed up with the adjacent surface. Minimum thickness after repair to meet drawing / Specification.

**9.0 MARKING AND PACKING:**

Details of stamping on each item with low stress stamps: Heat number, Specification & grade, Maker's emblem/code & Inspection Authority's seal. Forgings to be properly packed and despatched to avoid damage during transit.

**10.0 INSPECTION AND CERTIFICATION:**

(A) 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. Test certificate countersigned by applicable inspection agency for each product with following details shall accompany the product (in format approved by Boiler inspectorate for IBR items).

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. Melting & forging process, Chemistry including incidental elements - Heat wise.
4. Heat treatment details of the material and test bars.
5. Mechanical test results, NDE test results with reference & acceptance standard.
6. Repair details if any, Certified copy of TC for starting material.

(B) For CE-marking items the TCs with details specified above shall be submitted as per EN-10204 (latest)

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

Type 3.1:Suppliers shall have ISO 9001 certification certified by Notified Body recognized by European community and test certificate certified by suppliers authorized inspection representative.

Type 3.2 – Components inspected and test certificates certified by Notified Body recognized by European community.

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

Type 2.2 – suppliers test certificates signed by suppliers authorized inspection representative with test results as required by TDC.

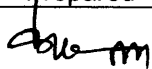
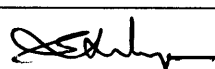
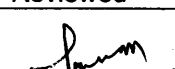
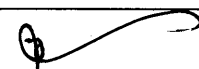
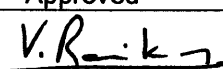
**11.0 AUDIT CHECKS AT BHEL**

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.

**12.0 END USE**

Valve bodies, bonnets, discs, socket ends, body guides etc., Pressure part fittings in boilers & low temperature service like discs, socket weld tees, ells, weld neck flanges & stubs (except drum nozzles) meeting IBR, ASME Section I, ASME B16.34 and API.

Non pressure part items in boilers: For these, requirements on starting material, bend test, and inspection by IBR are not required.

Prepared	Reviewed			Approved
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