

Revision Record

Rev 01: text re-written, Tolerance document no, added. High temperature tensile deleted.

Rev 02: F1 grade removed due to standardization, Q&T temp. Added for F22.

Rev 03: High temperature tensile test requirement removed.

Rev 04: Cl 4, 5 and 9 modified incorporating requirement for F91 material.

Rev 05: New materials F23, F92 and its requirement added in Cl: 1, 2, 4 to 6. Cl 2 Additional sources added; UT for bloom/billets added.

Cl 4: Tempering range and soaking time added for SA182. Cl 5 Additional mechanical requirements added for SA182. Cl 6 MPI & Clarity in UT testing added. Cl 9 Punching details modified. Cl 5, 10 Photomicrograph details added.

Rev 06: Cl 2 – Steel makers names removed and requirement for creep testing added as per IBR Reg 4, Cl 4 – tempering temperature and soaking time modified for SA182 F91, F92, and F23. Cl 4 – Photomicrograph added. Cl 5 – Photomicrograph removed.

Rev 07: Cl 2 Pt 4, 5 modified. Cl 6 – Wet MPI for CS, AS added, Cl 10 – IBR Forms indicated

Rev 08: Cl 2, Cl 4, Cl 6, Cl 10 modified

1. MATERIAL

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

Carbon Steel (CS) : SA 105

Alloy Steel (AS) : SA 182 F12 Cl.2 ; SA 182 F22 Cl.3, SA 182 F23 (Code Case:2199) ;
SA 182 F91 and SA 182 F92 (Code Case:2179)

Additional Requirement : As listed below (supplementary to Specification)

Size, grade and Qty. : As per Purchase Order & Drawing.

2. CHEMICAL COMPOSITION & PROCESS

1) Melting: fully killed.

2) Product analysis per heat. CS: C≤0.25%, AS: SA 182 F23: Si:0.25-0.50% & Cu:0.25 max,
SA 182 F92: Si: 0.10-0.50%; Ni: 0.30max & Cu: 0.25 max

3) Raw material 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.

4) Forging: to ensure uniformity of structure & strength with reduction ratio in area: 4:1 min. from ingot to final forging, close to final size & shape. Flow lines to be parallel to axis of openings. Forged Items ordered to this TDC shall be forged to the nearest shape before machining to final dimensions as per respective drawing

5) Blooms / Billets used for forgings (side length, dia ≥ 50mm) shall be UT tested. For Acceptance Norm refer Cl 6.0. For finished bars, this can be done at final stage.

3. DIMENSIONS AND TOLERANCES

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

4. HEAT TREATMENT(HT)

1) CS:Normalised. SA 182 F12 Cl.2: Normalised and Tempered.

SA 182 F22 Cl.3 : Quenched & Tempered. (Liquid quenching at 900°C min. and tempering at 675°C min.)

SA 182 for F91, F92 & F23 : Normalised and Tempered. (normalising : 1050-1080°C and tempering : 750-780°C

2) Photomicrograph test for F91 & F92 forgings - one per heat treatment lot per size and reported in test certificate.

Acceptance – The material shall be free from any micro fissures. Microstructure shall show lathe tempered martensite and also to be examined for grain growth. Photomicrograph with 500x (Min) magnification along with Photomicrograph report to be provided. The actual magnification and result of actual microstructure shall be indicated/certified.

5. MECHANICAL TESTS

1) Extent of test: for each size/heat/HT batch from sample product or identical test coupon. Mechanical tests shall be done on heat treated material only.

2) Additional requirements of SA 182 F23, F91 & F92 :

F91: Yield Strength(0.2% offset): Min 450 MPa. Tensile Strength(MPa): Min 630, Max 850, Hardness(HB): Min: 205, Max: 261

F92 : Tensile Strength(MPa): Min: 630, Max: 850. Hardness(HB): Min: 200, Max: 265

F23 : Tensile Strength(MPa): Min: 510, Max: 730. Hardness(HB): Min: 158, Max: 230

3) Additional requirements of tests:

4) Bend test: CS: 1 Sample 19mm. Thick(t) x 25.4mm width to be bent 180 deg. Around mandrel of radius 6.35 mm.

AS: Sample 25.4mm width to be bent 180 deg. Around mandrel of radius = 1.5 x t.

5) Charpy V-notch Impact test at 20°C shall be done either in Transverse or Longitudinal direction: SA 370: Acceptance: Average of 3 specimens.

Material	Impact in KgM/Sq.cm	
	Transverse (T)	Longitudinal (L)
SA 105	4.0	6.0
SA 182 F12 Cl. 2	4.3	6.3
SA 182 F22 Cl. 3	6.3	7.5
SA 182 F23	6.3	7.5
SA 182 F91	6.3	7.5
SA 182 F92	6.3	7.5

6. NON DESTRUCTIVE TEST

- 1) Extent of test: for each product. Stage of test : After heat treatment.
- 2) UT : 100% : As per ASTM A388. Acceptance: ASME Sec.VIII Div. 2. CI 3.3.4.
 - a) SA105, SA 182 F12 Cl. 2, F22 Cl. 3 : side length/Bars of dia = / > 50mm
 - b) SA182 F23, F91, F92 : for all sizes
- 3) MPI : 100% : As per ASTM E 709. Linear Indications like cracks, folds & other injurious defects are unacceptable.
 - a) Dry MPI/ Wet MPI : SA105, SA 182 F12 Cl. 2, F22 Cl. 3, F23 : for all sizes
 - b) Wet MPI : SA182 F91, F92 : for all sizes.

7. WORKMANSHIP AND FINISH

Items to be proof machined as per drawing or shot blasted & free from scales & defects like laps, seams, folds, cracks, etc. Machined items to be coated with a layer of transparent rust preventive before despatch.

8. 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. MARKING AND PACKING

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

10. INSPECTION AND 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):
Certification in IBR Form IIIF for Well Known forger and for others IBR Form IIIG.

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. Supplier of the steel used in making the finished product– Well known steel maker IBR Form IV & others Form IVA
5. Heat treatment details of the material and test bars.
6. Photomicrograph at 500 x resolution for F91 & F92.
7. Mechanical test results, NDE test results with reference & acceptance standard.
8. Repair details if any.

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. Items found defective during check or subsequent processing at BHEL are liable for rejection.

12. END USE

Valve bodies, nozzles, covers etc. meeting IBR and ASME Section I. and ASME B 16.34.

Haritha.C QA	Kalyanaraman.V QA	Selvarajan.S QA	Rajasekar.N Engg	Revisankaran.U QA
Prepared	Reviewed			Approved