

Product : **STEEL CASTINGS.(VALVES & BOILERS)**Document No: **TDC:0:412**Rev No : **15**Effective Date: **27-12-08**

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Revision record: Rev 15: 27-12-08 : (1)Modified in entirety.

1.0 MATERIAL:

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

CARBON STEEL(CS) : SA / ASTM A216 WCB, WCC & 352 LCB, LCC

ALLOY STEEL(AS) : SA / ASTM A217 WC6, WC9, C12A.

STAINLESS STEEL(SS): SA / ASTM A351 CF3M,CF8,CF8C & CF8M.

Additional Requirement : As listed below(Supplementary to Specification)

Size, Qty, Grade/Class : As per Purchase order & Drawing / Pattern.

2.0 CHEMICAL COMPOSITION AND PROCESS:

Melting: As per the Specification, Fully Killed.

Carbon= 0.25% maximum : for SA / ASTM A216 WCB only.

Carbon= 0.15% maximum : for SA / ASTM A217 WC6 & WC9 (For the castings used in QCNRV,CRHNRV,TOA Valves & Conventional valves having contours for welding.)

Product Analysis on test bar for each melt including residual elements shall be carried out.

Additional requirements for API-6D materials:

CS: Carbon=0.23% max.(in ladle) and 0.25% max.(in Product analysis)

Carbon Equivalent=0.43 max.(in ladle) and 0.45 max.(in Product analysis)

Carbon Equivalent=%C+(%Mn/6)+(Cr+%Mo+%V)/5+(%Ni+%Cu)/15

SS: Carbon=0.03% max. except as below.

Carbon=0.08% max.for stabilized steels with Nb >10xC.and

for stabilized steels with Nb and Ta mass of (Nb+Ta)>8xC.

3.0 DIMENSIONS AND TOLERANCES:

Tolerances as per the Drawing.

Untoleranced Dimensions for valve components as per the Drawing:VL:STDC:023(Latest)

4.0 HEAT TREATMENT :(HT)

CS. Castings of High Pressure Valve.(Cl.1500 & above),QCNRV & CRHNRV: Shall be in Annealed Condition.

AS. Castings: Normalized and Tempered.

Normalizing Temperature: for SA/ASTM A217 WC6, WC9: 920-950 °C and for C12A: 1050-1080 °C

Tempering temperature(Minimum): SA/ASTM A217 WC6: 680°C; WC9: 720 °C; C12A: 740-780°C

Others: Heat Treated as per the Specification.

5.0 MECHANICAL TESTS:

Test bars to be cast integral with the casting or separately. If cast separately, they shall be cast at the same time as the castings and from the same ladle. A metal strip with heat number stamped shall be fused with the test bar during casting, to maintain traceability. If one(1) casting is made from more than one heat, separate test bars for each cast to be poured & all test bars shall satisfy the requirements. Following tests to be conducted per heat / Heat treatment batch, as per ASTM A370.

S. NO	TEST	Material specification		
		SA/ASTM A216,217	SA/ASTM A352	SA/ASTM A 351
1	Tension Test	As per the Specification		
2	Hardness Test	As per the Specification	225 BHN. max.	Not applicable
3	Bend Test	S3 of SA703 For SA217 WC6 Angle of Bend-120 Deg.	Not applicable	S3 of SA703
4	Charpy- U Impact for all QCNRV.CRHNRV BODIES FOR IBR.	As per IBR. at Room temperature. Acceptance: Avg /Single=36J/32J min.	Not applicable	Not applicable
5	Charpy- V Impact for CE Marking-Pressure Equipment Directive (PED) items as Specified in the Purchase Order.	At 20 Deg.C temperature. Acceptance: Avg /Single=40J/27J min.	Not applicable	Not applicable
6	Charpy- V Impact for API -6D items if design temperature below minus 29°C (-29 °C)	Test Temperature=As per specification Acceptance: Avg/Single=34J/25J	Not applicable	Not applicable

6.0 FETTLING, DRESSING & CLEANING:

Dressing of castings-Free from risers, in gates, notches, undercuts, deep marks etc.

Fused wires, parting line fins, chills etc. shall be removed by grinding.

Gas cutting if employed shall be done before Heat treatment.

Preheat the material to 200 Deg. C. before gas cutting the Alloy steels.

Castings shall be blast cleaned both inside and outside for the removal of fused sand, scales etc.

Visual inspection of castings for surface quality as per MSS-SP-55.shall be carried out.

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7.0 NON DESTRUCTIVE TESTING (NDT) AFTER HEAT TREATMENT:

Castings shall be free from surface and internal defects like porosity, shrinkage, sand inclusion, crack, cold shut and other harmful defects.

7.1: MAGNETIC PARTICLE INSPECTION (MPI): As per ASTM E709

7.1.1: 100% on all critical areas like change of sections, riser & ingate portions at the time of Development of casting. However weld repaired areas identified in visual examination for doubtful indications to be probed by MPI.

7.1.2: All accessible surfaces including belly shall be tested for Special class valves, QCNRV, CRHNRV, Body & Wedges of TOA Valves (Class: 1500 & above):.

7.2: LIQUID PENETRANT INSPECTION (LPI): As per ASTM E165

LPI Can be substituted for MPI in all inaccessible area and for stainless steel castings.

Acceptance for MPI & LPI: ASME B16.34.

(1) Cracks are not permitted.

(2) For linear indications (with length > 3 times width) other than cracks, indications must be separated by a distance greater than the length of an acceptable indication.

Maximum allowable length of the indication shall be:

(a) For thickness (t) up to 13mm = 8mm,

(b) For thickness from 13 to 25mm = 13mm and (c) For thickness above 25mm = 18mm.

(3) For rounded indications (circular or elliptical with length < 3 times width), 4 or more indications in a line separated by 1.5 mm or less edge to edge are unacceptable.

Maximum allowable diameter of the indication shall be:

(a) For thickness up to 13mm = 8mm, and (b) For thickness above 13mm = 13mm

7.3: RADIOGRAPHIC TESTING (RT):

All castings shall be of radiographic quality. Procedure: ASME B16.34.

No cracks, hot tear or unfused chaplets, inserts permitted.

7.3.1: CONVENTIONAL AND API 6D VALVES :-

a) Pressure containing parts with pressure rating of ASME Class 600 & above:

RT on critical areas indicated in the drawing/ASME B16.34 (latest). **Acceptance:** Table-2 below. and For butt weld ends Gas hole/Porosity and sand inclusions to be within level A1 & B1 respectively.

b) During developmental stages & When called for in the PO., Casting rating less than Class.600 shall be 100% radiographed. (on critical areas indicated in the drawing/ASME B16.34 (latest)).

Acceptance: Table-1 below

c) Butt welding ends shall be free of shrinkage, crack and hot tear.

TYPE OF DISCONTINUITY	ACCEPTANCE LEVEL CATEGORY	TABLE-1 (< 600 CLASS)		TABLE-2 (= > 600 CLASS)	
		Thickness ≤ 2"	Thickness > 2"	Thickness ≤ 2"	Thickness > 2"
Gas Porosity	A	A2	A3	A1	A2
Sand/Slag inclusion	B	B3	B3	B2	B2
Shrink Type-1	C	CA2	CA3	CA1	CA2
Shrink Type-2	C	CB3	CB3	CB2	CB2
Shrink Type-3	C	CC3	CC3	CC2	CC2
Crack	D	NONE	NONE	NONE	NONE
Hot Tear	E	NONE	NONE	NONE	NONE
Inserts (Chills/Chaplets)	F	NONE	NONE	NONE	NONE

d) During developmental stage RT on sample castings of yoke, yoke clamp & wedge/disc shall meet Level-3 of ASTM E446/E186/E280

7.3.2: FOR QCNRV AND CRHNRV BODIES:

1) For Class 150 and 300:- RT on Butt weld ends only.

2) For Class 600 and above & For other classes if shown in the Purchase Order:- RT/UT on Butt weld ends, Change of sections including seat and neck portion. Acceptance: Same as conventional valves.

7.3.3: FOR SAFETY VALVE (SV) AND SAFETY RELIEF VALVE (SRV):

1) For Safety Valve and Safety Relief Valve Base and Bonnet Castings:

The Zones for RT: Areas shown in the sketch (PAGE-4). The areas where RT cannot be carried out MPI Shall be done as per ASME B 16.34. Acceptance: Class-4 of ASTM E446/E186.

7.3.3: Contd....

2) All SV& SRV (Flanged End & BW end) base Castings:

- One(1) Number for Every 10 Nos (10%) of casting covering 100% area.(**Sampling**)
- Additionally on Butt Weld Ends: All Castings 100% RT and shall be free of shrinkage,crack & hot tear. Gashole/Porosity and sand inclusions to be within level A1 & B1 respectively.

3) For SRV Nozzles: 100% RT –All areas.

Acceptance:Class 2 of ASTM E446/E186.Hot tear,Crack unacceptable.

4) Radiography not required after satisfactory development of casting & production based on established method for following parts: SRV Bonnet,Disc holder,Upper and Lower adjusting rings,Packed cap,Cover plate,Yoke and SRV guide flanges.

5)The defective castings to be repaired.In such cases the method followed by the foundry to be reviewed and corrected. The first casting poured after corrective action to be radiographed and accepted before bulk production.

6) Sampling shall be done as follows: (Wherever specified)

The vendor shall inform to BHEL the readiness of the lot (along with melt number / Sl.nos of the castings covered in the lot) for Radiography. On intimation of the lot quantity details from the vendor,BHEL / QC will indicate the specific castings by melt number /Sl.no punched on the casting,on which radiography checks are to be done.The vendor shall radiograph these specified castings and incorporate the lot size and melt no/Sl.no in the RT reports along with the other sl.nos of the other castings covered in the lot.If the identified casting is defective then 2 more castings shall be radiographed.If these 2 castings are defect free then the lot is acceptable.If any one of these castings is defective then all the remaining castings shall be radiographed and all defective areas shall be repaired.

8.0 REPAIR:

8.1:Castings with unacceptable cracks, hot tears, shrinkage, etc. to be rectified by grinding & if required by welding. Welding to be done by qualified welder and qualified procedure as per ASME Section IX .For IBR items welder shall be qualified as per IBR.

8.2:CS & AS to be Post weld heat treated (PWHT) after weld repair if repair depth > 20% of wall thickness or 25mm whichever is less or the extent of repair exceeds 65 sq.cm.

8.3:Weld repair in C12A material to be done only after approval by BHEL. All repaired C12A castings to be Post weld heat treated irrespective of depth or size of repair.

8.4:The repaired area shall be re-examined by the NDE method which originally disclosed the defect. MT/PT shall be performed after PWHT if performed as above. Weld repairs made as a result of RT shall be RT tested after welding. The acceptance standards for porosity and slag inclusion shall be as per UW-51 of ASME Section VIII Division 1.

9.0 SURFACE TREATMENT:

SS castings to be pickled & passivated (after repair & HT if any) as per ASTM A380. Satisfactory passivity of the surface to be checked using SS passivity test kit (Free iron test). After passivation, rinsing & test, the rinsed demineralised water to be checked for chloride with 1% Silver nitride, which shall not exceed 0.5 PPM.

10.0 SAMPLE CASTINGS:

Foundry to ensure, first sample pieces meet dimensional & Quality requirements in this TDC, before starting bulk production. 3 Castings with nominal bore (NB) ≤ 100mm. & 1 casting with NB > 100mm., for each type of casting to be inspected (proof machined wherever necessary). at BHEL for dimensions & RT. Supplier to be appraised of acceptability or modifications to castings required. In case of deviations, Supplier to submit further samples if required. Accepted sample castings may be considered for fixing the nominal weight of the castings.

11.0 DIMENSIONAL CHECK:

For all QCNRV & CRHNRV Body Castings: Thickness of the body shall be checked throughout the surface on a grid of 50mm x 50mm and recorded & submitted to BHEL.

12.0 MARKING AND PACKING:

Details to be marked on each casting, on a raised pad using low stress stamps:

1. Foundry code, 2.Specification, grade & Melt number, 3.Other details as per drawing.

Castings shall be suitably packed to avoid damage during transit.

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13.0 INSPECTION AND CERTIFICATION:

13.1: For IBR items, inspection and tests to be witnessed by an Inspecting Authority approved by IBR.

Test certificate countersigned by the Inspecting Authority for each product with following details shall accompany the product (in format approved by Boiler inspectorate for IBR items).

If the Foundry is recognised as "Well known Foundry" under IBR, suppliers TC is sufficient.

1. Purchase Order No.(BHEL), TDC No. & Test certificate number
2. Specification and Grade with applicable year of code, Heat Number, Quantity & Size
3. Steel making 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 including HT, if any, Cleaning & Surface treatment details.
7. Any other information like clearance of sample casting.
8. Dimensional Inspection Report where applicable.

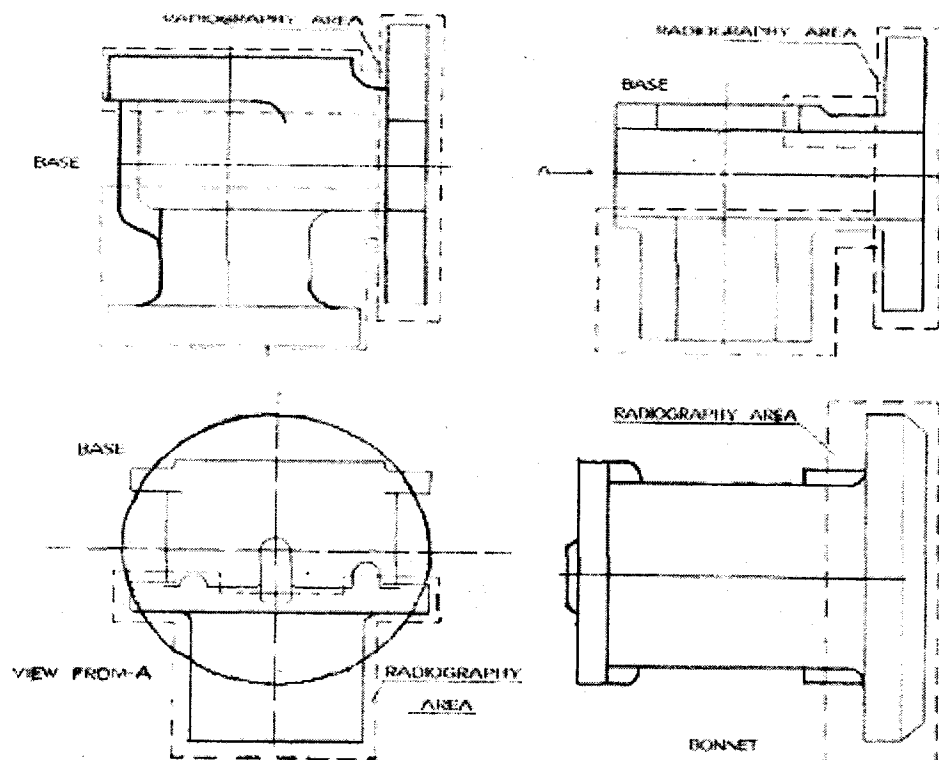
13.2: For CE-marking items the materials shall be inspected by M/s. LLoyd's/ TUV/ BVQI or any other agency approved for PED of CEmarking, if the foundry is not certified to ISO 9000 by any of the above organisation.

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

15.0 END USE:

For use in valves and other components like flanges, fittings etc. for high temperature & high pressure applications meeting IBR, ASME Section I, ASME B 16.34 and API.

SV and SRV Base castings: Sketch of zones for RT

V. KALYANARAMAN QUALITY ASSURANCE	M. RAJAKUMAR ENGG/VALVES	K. GANESAN PURCHASE/VALVES	S. SELVARAJUN QUALITY ASSURANCE	K. RENGACHARI QUALITY CONTROL	C. R. RAJU QUALITY ASSURANCE
PREPARED BY	REVIEWED BY				APPROVED BY

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