



### 1.0 GENERAL

Materials: SA106GrB, Gr C; SA 335 P11, P12, P22, P91 & P92 (Code case: 2179).

This Technical Delivery Condition specifies the requirements in addition to ASME SA 106, SA 335.

### 2.0 CHEMICAL COMPOSITION

For SA106 Gr B and Gr C: - Carbon content shall be limited to 0.25% max, for pipe thickness  $\leq$  20 mm; and 0.30% max, for pipe thickness above 20 mm.

For SA335 P92: Si: 0.10-0.50%; Ni: 0.30max and Cu: 0.25max.

### 3.0 TOLERANCES

Unless otherwise specified in the PO, tolerances shall be as below:

#### 3.1 OD specified pipes:-

SA335 P91 & P92: the tolerance on OD shall be:  $\pm 1\%$  (Max: 4mm) of Nominal OD.

Other than SA335 P91 & P92: the tolerance on OD shall be:  $\pm 1\%$  upto OD 660mm and for OD > 660mm tolerance shall be  $\pm 1\%$  (Max: 4mm) of Nominal OD.

**3.2 ID specified pipes** are specified by the maximum Internal Diameter and Minimum wall thickness. The tolerance if not specified in the PO shall be: ID: +0.0mm, -3.2mm & Thickness: +3.2mm, -0.0mm

### 4.0 STRAIGHTNESS

The Pipes shall not deviate from straightness by more than 1mm in any one meter and shall not be more than 6mm over the entire length. A sharp bend at the end or kink and twist are not acceptable. These limitations are applicable for any given plane.

### 5.0 HEAT TREATMENT & MECHANICAL TESTS

#### 5.1 HEAT TREATMENT

CS: OD  $\leq$  76.1mm no heat treatment required. OD > 76.1mm shall be in Normalised conditioned.

AS: All sizes – SA335 P11, P12 & P22 – Either in Normalised and tempered or Isothermal Annealed condition.

AS: All sizes – SA335 P91 & P92:

Normalising Temp. : 1050°C - 1080°C (for wall thickness larger than 75 mm, accelerated cooling may be done to obtain a fully martensitic structure).

Tempering Temp. : 750°C - 780°C Soaking time: 2.5min/mm of thickness (1 hr min.), still air cooling.

#### 5.2 MECHANICAL TESTS:

Number of Test (as per IBR): 2 numbers up to first 100 pipes and additional 1 number per 100 or part thereof for pipes over 100 numbers.

For P91 Pipes, Ys (0.2% offset) - 450 MPa Min ; Ts – Min 630 MPa, Max 850 MPa.

For P92 pipes Ts- Min 655 Mpa, Max 850 Mpa.

For other grades, Ys and Ts shall be as per specifications.

**5.3 HARDNESS FOR SA 335 P91 & P92 PIPES** Hardness test shall be carried out on each pipe. The hardness value for P91 shall be 191-250 BHN and that for P92 shall be 196-250 BHN. The hardness test values shall be indicated in the Test certificate

### 6.0 SUPPLEMENTARY TESTS

These are applicable to SA 106 Cr C, SA335 P11, P12, P22, P91 & P92. The supplementary test results shall be indicated in the Test Certificate along with the mandatory test results.

**6.1. Product Analysis (S1):-** Product Analysis shall be carried out on 5% of pipes per heat per heat treatment batch (minimum 2 Nos) for size NB 200 mm and above.

**6.2. Transverse tension test (S2):-** Transverse tension test shall be carried out (for size NB 200 mm and above) on one end of 5% of pipes per heat per heat treatment batch (minimum 1 No).

**6.3. Photomicrograph test for P91 & P92 (S5):-** Photomicrograph test shall be carried out from a specimen of pipe in the as finished condition for each individual size (OD and wall thickness) from each heat per heat treatment batch. Acceptance norms - The Material shall be free from any micro fissures. Microstructure shall show tempered martensite and also to be examined for any grain growth. Photomicrograph with 500x (Min) magnification along with Photomicrograph report to be provided. The actual magnification shall be indicated.

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### 7.0 NON DESTRUCTIVE TEST

Each pipe shall be ultrasonically tested as per ASTM E 213 in both clockwise & anticlockwise directions; calibration to be done on two axial notches of 50 mm length (inside & outside) and a depth of 5% of wall thickness (minimum 0.3 mm; maximum 1.5mm). The results shall be indicated in the Test Certificate.

### 8.0 REPAIR

Repair by welding is prohibited. The pipe shall meet the dimensional tolerance (clause 3.0 above) after any mechanical repair as permitted in the standard.

### 9.0 WORKMANSHIP

The Inside & outside surfaces of the pipes shall be free from any imperfections & defects like laps, seams, folds, cracks, pitting etc. Localised imperfections, if any, may be removed by skin machining only to a surface finish of  $\leq 6.3$  microns ensuring the wall thickness, inside and outside diameter. Local depressions or ground spots are not acceptable. Loose scales shall be removed by blast cleaning in both inside and outside surface.

### 10.0 MARKING & COLOUR CODING

The following details are to be marked on the consignment for identification

- 1) PO Number      2) Supplier's emblem/code      3) Specification & grade      4) Heat number  
5) Size              6) No. of pipes                              7) Inspector's seal

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|-------------------------------------|---|
| OD up to 31.8 mm (excluding)        | Details 1 to 7 shall be stamped on metal / plastic tag attached to bundle   |
| OD 31.8 mm to OD 76.1mm (including) | Details 1 to 5 shall be paint stencilled on each pipe.<br>Details 1 to 7 to be stamped on Metal / Plastic tag attached to bundle.                             |
| OD above 76.1 mm                    | Details 2,3,4,5 & 7 shall be hard stamped with round edged stamp at 100mm from an end of each pipe.<br>Details 1 to 5 shall be paint stencilled on each pipe. |

Longitudinal colour bands shall be made throughout the length of the pipe. The colours shall be as per BHEL procedure SIP: PP: 21(Latest).

### 11.0 PRESERVATION

- Outside: - Resin type rust preventive coating with visibility to stencilled details. Thick Black coating which camouflages the Surface of the pipes is not permitted.
- Inside: - Rust inhibitor or resin type rust preventive coating.
- Ends of the pipes shall be secured with caps.

### 12.0 INSPECTION AND CERTIFICATION (In English Only)

- 12.1. Pipes shall be inspected at the manufacturer's works by the IBR / IBR approved Inspecting Authority. Inspection certificate in IBR Form IIID for Well-known pipe maker recognised in IBR and others in IBR Form III A, along with Mill Test certificate and NDT reports certified by IBR / IBR approved Inspecting Authority shall be submitted.
- 12.2. Test Certificate shall include PO no.(BHEL) ,TDC no., Pipe size and quantity- melt wise, specification and grade with year of code, Heat no., Steel & Pipe making process, chemistry including incidental elements on Ladle and Product analysis, Heat treatment details with actual temperature and soaking time, Mechanical results.
- 12.3. Detailed NDT reports with reference norms, acceptance standards and test results shall be furnished along with Test certificates.
- 12.4. For P91 & P92 pipes the Photomicrograph test report along with photomicrograph with 500x (min) magnification shall be furnished.

### RECORDS OF REVISIONS

- i) Rev 03 – Para 4.1, 4.2.b are included; Para 6.0, 13.0 are modified  
ii) Rev 04 – Para 3.1, 3.2 modified  
iii) Rev 05 – SA335 P92 included. Para 1.0, 2.0, 4.1, 4.2, 5.0, 6.0 are modified & Para 5.3, 13.4 included.  
iv) Rev 06 – Para 4.0 added. Para 1.0, 3.1, 3.2, 4.1, 5.1, 5.2, 6.1, 6.2, 6.3, 9.0, 10.0, 11.0 & 12.1 revised and further clauses renumbered.

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