



**Bharat Heavy Electricals Limited,
Piping Centre, Chennai**

TDG : 40	Technical Delivery Conditions for Seamless Pipes Conforming to ASME SA106, SA335, SA312.	Date : 11.01.2022
Rev. 01	Project : Turbine Integral Piping.	Page : 1 of 6

1.0 SCOPE :-

1.1 The seamless steel pipes shall meet the requirements of ASME SA 106 Gr B, Gr C, SA 335 Gr P11, P22, P91, P92 and SA 312 TP 321 as applicable.

2.0 DIMENSIONS:-

The pipe dimension: Unless otherwise specified in the PO, tolerances for OD pipes shall be as below

- a) SA335 P91 / 92: the tolerance on OD shall be: $\pm 1\%$ (Max: 4mm) of Nominal OD.
- b) Other than SA335 P91: the tolerance on OD shall be: $\pm 1\%$ (Max: 6mm) of Nominal OD.
- c) Tolerance on Thickness : $\pm 12.5\%$ of the specified thickness

3.0 CHEMICAL COMPOSITION :-

3.1 Product analysis (in addition to ladle Analysis) shall be carried out on one pipe per melt for all steels.

Chemistry shall be controlled as given below for specific grades. For all other grades as per the applicable material specification

- SA 106 Gr B : Carbon : 0.25 Max,
- SA 106 Gr C : Thickness ≤ 20 mm, Carbon : 0.25 Max
- SA 106 Gr C : Thickness > 20 mm, Carbon : 0.30 Max
- SA335 Gr P92 : Si:0.10-0.50, Ni : 0.30 max, Cu : 0.25 max

3.2 The billet and bloom shall be fully killed and vacuum degassed. The billet/ bloom shall be sourced from well known steel makers. Mill test certificates shall be submitted to BHEL.


4.0 STRAIGHTNESS & POLYGONIZATION :-

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 for Pipes of OD > 76.1 mm. A sharp bend at the end or kink and twist are not acceptable. These limitations are applicable for any given plane.

Also, for Pipes with OD ≤ 76.1 mm, shall be made by processes specified below:

- 1. All pipes shall be cold formed in case of "t/D" ratios > 0.15 , where "t" is the specified nominal wall thickness and "D" is the specified nominal OD of the pipe.

	 13/1/22		
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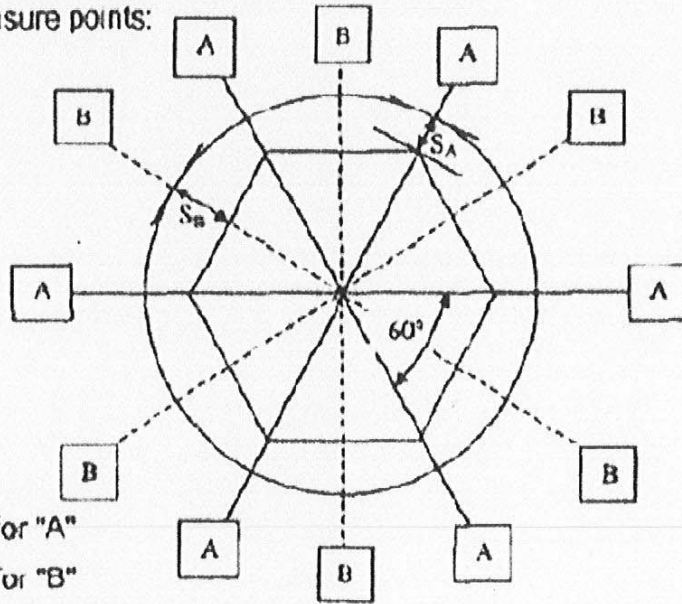
- Pipes may be cold formed or hot formed in case of "t/D" ratios upto and including 0.15.
- The degree of polygonization (P), measured as indicated in Fig.1 & calculated using the below formula, shall not exceed 15% in both the above cases:

$$P = \{[\sum SB - \sum SA] / [0.135*(3D - \sum SA)]\} * 100$$

where, P is the degree of Polygonization in %
 D is the specified nominal OD of the pipe
 $\sum SB$ is the sum of maximum pipe wall thicknesses measured at 6 locations 60 degrees apart and
 $\sum SA$ is the sum of minimum pipe wall thicknesses measured at 6 locations 60 degrees apart.

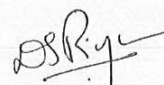
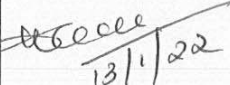
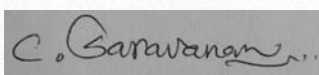

Wall thickness shall be measured using profile projector/shadowgraph/digital scanner/any other suitable instrument meant for this purpose.

Definition of the measure points:



6 measured values for "A"
 6 measured values for "B"
 respectively turned around 60°

Fig. 1

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5.0 HEAT TREATMENT :-

Heat Treatment shall be done as mentioned in the ASME standard, for the material specification as detailed in BHEL drawing.

5.1 SA 312 - Solution treated as per SA 312 std.

6.0 MECHANICAL TEST :- (Including Flattening / Bend Test as applicable)

6.1 The pipes shall be subjected to mechanical tests as per SA 106, SA 335 & SA 312 as Applicable.

6.2 Quantum of test : As per specification.

6.3 HARDNESS TEST

Hardness test shall be carried out on each pipe.
The hardness value for P91 shall be 195-250 BHN, P92 shall be 190-250 BHN
The hardness test values shall be indicated in the Test certificate

7.0 HYDROSTATIC TEST :-

7.1 All Pipes with working / operating pressure lesser than 70 bar must be Hydro tested at pressure mentioned in BHEL drawing.

8.0 NON-DESTRUCTIVE TEST :-

8.1 All Pipes with working / operating temperature greater than 400°C and/or design pressure greater than 70 bar must be 100% UT tested.

9.0 REPAIR :-

9.1 Repair by welding is prohibited.

9.2 After mechanical repairing all tolerances to be met.

10.0 WORKMANSHIP

10.1 All pipes shall have smooth surfaces, free of any defect/scale and all SA106, SA335 pipes shall be protected with translucent rust preventive on the outside and rust inhibitor inside.

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All SA 312 pipes shall be supplied in pickled & passivated condition only. No rust inhibitor is required to protect the pipe inside.

10.2 Ends shall be capped tight.

11. MARKING

Description	For Pipes of OD (in mm)		
	OD > 73.0	OD 33.4 - 73.0	OD < 33.4
1) P.O.No	A	A & C	C
2) Size	A&B	A & C	C
3) Quantity (Nos)	--	A & C	C
4) Specification	A&B	A & C	C
5) Grade	A&B	A & C	C
6) Marker's Mark	A&B	A & C	C
7) Melt Number	A&B	A & C	C
8) Inspector's seal	B	C	C

A- Paint Stencil on Pipe.

B- Hard Punch on Pipe 100mm away from both ends & etch on SS pipes.

C- Hard Punch on Metal Tag (Aluminium or Stainless Steel) and secure by metal wire to Pipe/Bundle.

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12.0 **COLOUR CODE:-** Each pipe shall be colour coded longitudinally.

12.1

SA 106 Gr. B / C	Red
SA 335 Gr. P11	Yellow
SA 335 Gr. P22	Green
SA 335 Gr. P91	Blue
SA 335 Gr. P92	Purple
SA 312 TP 321	Pink

13.0 **PACKING:-**

OD in mm	t in mm	TYPE OF PACKING
All Pipes	: UP TO 3.2mm	: BOXES
LESS THAN 88.9	: ALL	: BUNDLES
88.9 TO 168.3	: UP TO 7.11	: BUNDLES
	: ABOVE 7.11	: LOOSE
ABOVE 168.3	: ALL	: LOOSE


13.1 **BUNDLES:-**

A bundle shall weigh less than 2 tonnes & shall be strapped with galvanised steel strap/wire at both ends at every one meter interval.

13.2 **BOXES:-**

Boxes shall be made of wood with arrests at proper location so as to avoid any dent and other damages during transit.

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14.0 INSPECTION & CERTIFICATES:-

14.1 All pipes shall be inspected at works by Inspection agencies/authorities as indicated in the P.O. Mill Test Certificates shall be countersigned by above authority and shall include the following.

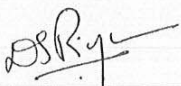
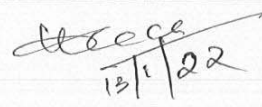
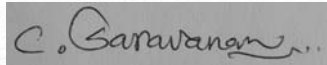

1. Purchase Order No.(BHEL).TDC No. & Test Certificate number, Size & Quantity – meltwise.
2. Specification and Grade with year of code, Heat Number, steel & Pipe making process.
3. Chemistry including incidental elements – Laddle and product analysis.
4. Heat treatment details, Mechanical test results, NDE results with reference ,acceptance standard.
5. Hydrostatic test Pressure & Result.
6. Surface treatment details.

15.0 Details not covered in this TDG, shall be complied with as per the applicable ASME standards.

16.0 RECORDS OF REVISIONS

Rev 00 – Prepared for Turbine Integral piping

Rev 01 – Inclusion of Pipe Grade P91 and P92 and general revision to comply to BHEL HEEP Specification ST 34001 Rev 08.

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