Annexure-A

Supply conditions,Delivery, acceptable length

Sl.No	Material code	Size Description	Qty.(M)	TDC	Acceptable lengths	Remarks	Delivery Reqd
1	151820410000	PIPE 73.00 X 9.53 - SA106GRB	110.000	101/21	5000 to 8000 mm	CDS only	3 Months from PO
2	154870142151	TUBE OD 47.63 X 5 - SA210GRC	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
3	154870160000	TUBE OD 51 X 5 - SA210GRC	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
4	154870263101	TUBE OD 57 X 7.1 X 13100 - SA210GRC	90.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
5	154870360000	TUBE OD 76.1 X 7.1 - SA210GRC	500.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
6	154871292151	TUBE OD 76.1 X 7.6 - SA210GRC	80.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
7	151880970000	TUBE OD 51.00 X 7.10 - SA213T11	90.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
8	151880990000	TUBE D51.00 X 8.00 SA213T11	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
9	151881000000	TUBE OD 51.00 X 6.00 - SA213T11	440.000	102/21	5000 to 10000 mm	CDS only	3 Months from PO
10	154880711501	TUBE OD 44.5 X 5 - SA213T11	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
11	154880870000	TUBE OD 47.63 X 6.6 - SA213T11	460.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
12	154880900000	TUBE OD 44.5 X 5.9 - SA213T11	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
13	154881011501	TUBE OD 54 X 3.6 - SA213T11	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
14	154881140000	TUBE OD 63.5 X 6.3 - SA213T11	110.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
15	154881370000	TUBE OD 57 X 6 - SA213T11	110.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
16	154881410000	TUBE OD 44.5 X 5.3 - SA213T11	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
17	154881640000	TUBE OD 47.63 X 6 - SA213T11	410.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
18	151890190000	TUBE OD 38.10 X 6.00 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
19	151890250000	TUBE OD 32 X 5 - SA213T22	510.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
20	154890151501	TUBE OD 47.63 X 6.3 -SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
21	154890350001	TUBE OD 44.5 X 5 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
22	154890430000	TUBE OD 44.5 X 7.1 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
23	154890470000	TUBE 44.50 X 8.00 - SA213T22	110.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
24	154890480000	TUBE OD 44.5 X 5.6 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
25	154890541501	TUBE OD 44.5 X 11 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
26	154890740000	TUBE OD 47.63 X 7.6 -SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
27	154890761501	TUBE OD 47.63 X 8 -SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
28	154890892151	TUBE OD 51 X 6.3 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
29	154890910000	TUBE OD 51 X 7.1 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
30	154890921001	TUBE OD 51 X 7.6 - SA213T22	110.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
31	154891010001	TUBE OD 54 X 3.6 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
32	154891291501	TUBE OD 51 X 9 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
33	154891481501	TUBE OD 63.5 X 6.3 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
34	154891550000	TUBE OD 63.5 X 7.1 - SA213T22	170.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
35	154892210001	TUBE OD 42.4 X 8.6 - SA213T22	170.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
36	154892230000	TUBE 41.30 X 8.20 - SA213T22	550.000	102/21	5000 to 10000 mm	CDS only	3 Months from PO

Annexure-A

Supply conditions,Delivery, acceptable length

Sl.No	Material code	Size Description	Qty.(M)	TDC	Acceptable lengths	Remarks	Delivery Reqd
37	154892260000	TUBE OD 38.1 X 8.0 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
38	154892500000	TUBE 44.50 X 8.30 - SA213T22	220.000	102/21	5000 to 10000 mm	CDS only	3 Months from PO
39	154893090001	TUBE OD 50.8 x 4.19 - SA213T22	230.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
40	154893100001	TUBE OD 63.5 x 4.19 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
41	154893120001	TUBE OD 44.45 x 5.59 - SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
42	154893250000	TUBE 41.3 X7.4 - SA213T22	210.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
43	154893300001	TUBE-38.1 X 6.6 -SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
44	154893322501	TUBE-48.3 X 7.62 -SA213T22	100.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
45	154893352501	TUBE-42.4 X 8.3 -SA213T22	170.000	102/21	5000 to 10000 mm	As per TDC	3 Months from PO
46	154893940000	TUBE 76.20 X 5.59 - SA213T22	110.000	102/21	5000 to 10000 mm	CDS only	3 Months from PO
			7,460.000				

Technical: Seamless Carbon & alloy Steel Tubes
Supplier facility report

S.No	Description	Supplier comments
1	Name of the company	
2	Address of the registered office (Telephone, Email, contact person)	
3	Factory Location and address (Telephone, Email)	
4	**Installed Manufacturing capacity** • for Carbon tubes manufacturing • for Alloy steel tube manufacturing	
5	**Raw material source**	
6	**Tube/Pipe Manufacturing details** Method of Manufacturing Provide the process flow chart • Type & make of Hot Mill along with the details of the individual equipments • Type & make of Cold Mill along with the details of the individual equipments	
7	**Heat treatment Furnace details** a) Capacity of Furnace/Hr b) Number of Furnaces c) Type of Heat treatment carried out (batch or continuous)	
8	**Inhouse testing equipment details** a) Online UT facilities b) Online Eddy current (EC) facility c) Hydro Test facilities (indicate the maximum pressure) Chemical & Mechanical Testing Facilities	
9	Detail of Accreditation for Quality systems (like ISO, API, etc.)	
10	Are your firm approved by CBB for IBR well Known Tube/Pipe maker?	

Technical: Seamless Carbon & alloy Steel Tubes
Supplier facility report

S.No	Description	Supplier comments
11	Are your approved by any Third party/statutory agency? If so, specify the agency	
12	Please Confirm the manufacturing range of the following sizes OD:21.3 to 76.2mm WT: 3.2 to 14.1mm Length: 6m to 13m Supply details of the tendered specification to BHEL or any other well-known boiler manufacturer for Boiler application. Please provide the details to whom, when and how much supplied.	
13	Please go through the attached TDC:0:102:rev21 and give point by point confirmation	

Place:

Date: Signature with seal

Note: Enclose additional sheets/Annexures whenever required referring the Sl. No of this format.

Revision record:

Rev 08: 21.09.04: UT as per BS EN 10246-7, in lieu of ASTM E 213

Rev 09: 31/12/05: Cl 5.0 - mention of shape and size of tensile test specimen on TC introduces

Rev 10: 29/12/07: Cl 1.0, 3.0, 6.0, 7.0, 11.0 and 12.0 modified.

Rev 11: 19/05/09: Cl 8.0 – Modified. Cl 9.0 – Marking details included in line with material specification.

Rev 12: 08/06/11: Cl 1.0- SA 213 T12, T92 and T23 removed from this TDC. Cl 2.0 Process of Manufacture – Clarified. Cl 9.0- Stenciling and colour coding modified. Cl 12.0- Modified.

Rev 13: 04/07/11: Cl 6.0: Modified, Cl 9.0 – Marking: Correction made in the "Details to be identified"

Rev 14: 26/10/12: Cl 2.0, 6.0 and 12.0 modified

Rev 15: 19/02/2016: TDC: 0:124 requirements merged in this TDC. And Cl 1 modified; Cl 2 modified to include polygonization requirements; Cl 4– heat treatment temperature added for Gr 91; Cl 5– lot size for mechanical tests defined & additional requirements of Gr 23, 91 & 92 added; Cl 6, 7, 9 – modified; Cl 10 –Preservation requirements modified; Cl 11 – modified; Cl 12-changed as per latest IBR including MAWP requirements.

Rev 16: 13/10/2017: Clause 1 & 12 modified to include raw material requirements and certification in IBR Form IV. Clause 5 (f) added to include creep requirements.

Rev 17: Dt: 20/04/2018 - Cl 2 added to include Billet/Bloom Requirements, Cl. 3 modified, Cl. 6(f) modified, Cl. 13.3 (k) added to include mill TC certification

Rev 18: Dt: 05/08/2019 – Cl 2 modified based on feedback from user departments, suppliers and internal discussions, Cl 5 modified, Cl 6 added to include shot peening requirements, subsequent clauses renumbered, Cl 7 (f) & Cl 9 modified, Cl 14.3 (l) & Cl 15 added.

Rev 19: Dt: 09/03/2023 – Clause 1– Code case 2328 for S30432 deleted, for T91 (Type 1/Type2 included, Clause 2 -paragraph 3 revised, Clause 5- subclause (a) added in which Grain Size requirement for TP347H and S30432 (Super 304H) specified, Clause 6- Code case 2328 for S30432 deleted, Clause 7 – In subclause (d) - for T91 (Type 1/Type2) included and Subclause(f) errata corrected, Clause 9–Hydrostatic test pressure requirement modified and DM water quality requirement also included in note, Clauses 12 and 13 modified for clarity, Clauses 14.1 & 14.2 interchanged, Clause 14.3 - In subclause (j) cross reference corrected and subclause (k) revised.

Rev 20: Dt:01/02/2024 – Cl. 9 – Modified for clarity based on vendors feedback, Cl 10. Finish and repair condition is modified incorporating standard reference, Cl. 13 – existing clause renumbered as sub cl. a and modified for clarity wrt SS packing requirement. Cl.13 b added to include check for chloride, Cl.14.3 - Modified to include reporting of chloride levels, Cl. 16 – added for clarity

Rev 21: Dt:30/10/2024 – Cl. 3 (a) 1 **– t/D ratio modified for Carbon Steel tubes**

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1. MATERIALS

Specification: ASME (Latest as on the date of Enquiry/PO, whichever is earlier):

Carbon Steel (CS)	:	SA 192; SA 210 Gr. A1 & Gr. C
Alloy Steel (AS)	:	SA 209 Gr.T1, SA 213 Gr. T11, T12, T22, T23 (Code case: 2199), T91 (Type 1/ Type 2) and T92 (UNS K92460 Code Case: 2179).
Stainless Steel (SS)	:	SA 213 TP 304H, 316, 321, 321H, 347H; UNS No: S30432 (Super 304H).
Additional Requirement	:	As listed below (Supplementary to above material specifications)
Size and Quantity	:	As per Purchase order

2. BILLET/BLOOM REQUIREMENTS:

The billets/blooms shall be fully killed.

For carbon steel and alloy steel, billets/blooms shall be made by vacuum degassing. For Stainless steel, billets/blooms shall be made by vacuum degassing or argon oxygen decarburization (AOD).

Ladle analysis is required for all steels. Chemistry shall be controlled as given below for below specified grades. For all other grades, it shall be as per applicable material specifications:

i. Carbon Steel: Max. Carbon: SA 210 Gr.A1: 0.25%, SA 210 Gr.C: 0.30%
ii. For SA 213 T12: Aluminum: 0.025% max; Silicon: 0.20%min. on product analysis and the values shall be reported in the test certificate.
iii. Stainless Steel (SS): Boron: 0.01% max., Vanadium: 0.10% max.

The billet/bloom shall conform to the chemical and process requirements of respective tube specifications.

The billet/bloom shall be sourced from IBR well known steel makers or with inspection and certification by IBR authorized Inspecting Authority in case the mill is not approved by IBR. Mill test and IBR Form IV certificate shall be submitted to BHEL.

3. CHEMICAL COMPOSITION AND PROCESS OF MANUFACTURE OF TUBES

a) **Carbon Steel & Alloy Steel:** Tubes shall be seamless and made by processes specified below:

1. **Carbon Steel** tubes shall be cold formed in case of "t/D" ratios > 0.16, where "t" is the specified nominal wall thickness and "D" is the specified nominal OD of the tube.
   Alloy Steel tubes 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 tube.
2. Tubes may be cold formed or hot formed in case of "t/D" ratios upto and including the corresponding limits stated above.

3. 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:

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

where, P is the degree of polygonization in %
D is the specified nominal OD of the tube
$\sum S_B$ is the sum of maximum tube wall thicknesses measured at 6 locations 60 degrees apart and
$\sum S_A$ is the sum of minimum tube 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.

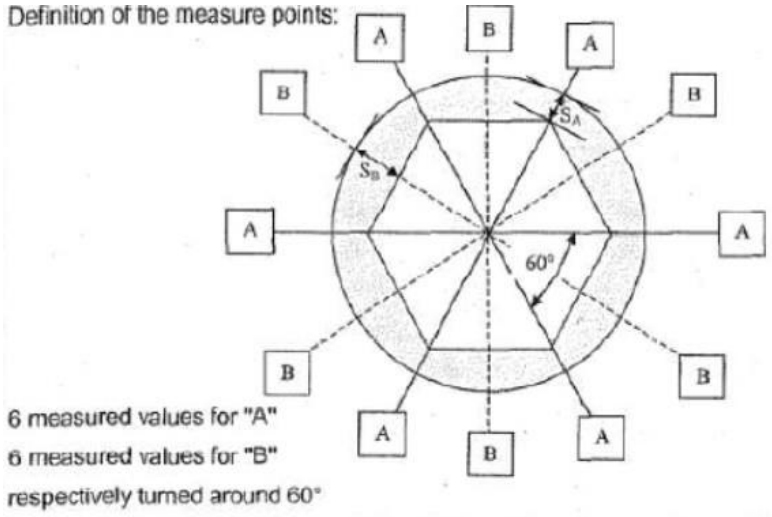

Fig. 1

Stainless Steel: Tubes shall be seamless and cold finished. All raw materials used in steel making including incoming scrap shall be checked by supplier to ensure freedom from radioactivity (Applicable for SS materials only).

b) **Product analysis** on tubes is required for all steels. Chemistry shall be controlled as per applicable material specifications and the elements including carbon for carbon steel, Aluminium (for T12), Boron & Vanadium (for Stainless steel) as indicated in Clause 2 shall also be reported in the product analysis.

4. DIMENSIONAL TOLERANCES

a) For Cold finished tubes: CS: as per SA 450; for AS & SS shall be as per SA 1016.
Tolerance on thickness shall be: For OD ≤ 38.1 mm: -0% to +20% and For OD > 38.1 mm: -0% to +22%

b) For hot finished tubes the tolerance shall be as follows:

For Outside Diameter:	± 0.4mm.
For Thickness:	-0% to +22% t > 4.5 mm
	-0% to +24% t between 3.6 and 4.5 mm (both inclusive)
	-0% to +28% t< 3.6mm

5. HEAT TREATMENT

CS Hot finished: No Heat Treatment required.
CS Cold finished: Subcritical annealed (temperature ≥ 650^{0}C), fully annealed or normalized.

AS: Normalized and Tempered. For SA213 T91 & T92: Normalizing: 1050-1080^{0}C & Tempering: 750-780^{0}C.
For SA213 T23: Normalizing: 1050-1080^{0}C & Tempering: 750-775^{0}C.

(The total thickness of the decarburized material (Both on ID & OD of the tube together) shall be measured once per Heat treatment lot. The measurement shall be determined from a representative sample that has been sectioned, polished, etched and examined at 100X. The total decarburization thickness shall not exceed 7% of the specified minimum wall thickness and shall be reported in the test certificate.)

SS: Solution Annealed condition as per material specification.

a) The average grain size shall be controlled as given below for the below specified grades (determined as per ASTM E112):

SA 213 TP 347H	: 4 - 7
SA 213 S30432 (Super 304H)	: 6 -9

The values shall be reported in the test certificate.

6. INSIDE SHOT PEENING FOR ALL STAINLESS STEEL TUBES OF SA213 TP347H and SA213 UNS No: S30432 (Super 304H):

6.1 Shot peening shall be carried out inside the stainless steel tubes after solution annealing, unless specified otherwise in Enquiry/Purchase order

6.2 Qualification:

a) The qualification for tube inside shot peening shall be performed according to the below described test steps. The range of qualification covers tube internal diameters (Di) in the range of Di ± 2mm as well as the specific material grade and qualifies the shot peening process based on the used machine settings (peening parameters). Stainless Steel shots shall be used.

b) Qualification evaluations (hardness test and microstructure) shall be performed on at least one (1) sample tube, with evaluations at sections cut from the beginning, middle and end of the tube.

i) Metallographic examination for proof of thickness of cold worked microstructure across the entire tube circumference and a minimum depth of 70 µm from the inner surface shall be carried out and documentation of representative shot peened conditions at 500X magnification shall be submitted.

ii) Hardness test shall be carried out at a distance of 40 µm from the inner surface at quarter points (4x90°) spread around the tube circumference. Acceptance criteria: hardness values of the shot

peened zone shall be a minimum of 100 HV0.1 above the average hardness of the unaffected base material (2mm from outer surface).

iii) Almen strips representing acceptable shot peening conditions shall be produced during the qualification.
General requirements- Almen testing shall be in conformance with SAE J442 – Almen testing reading tolerances shall be in conformance with SAE AMS 2430 § 3.7.
For SS tube shot peening, where SS shots shall be used, C type Almen strip in conformance with SAE AMS 2431/4C shall be used.

6.3 **In-process tests –** Quantum of test shall be one test per heat no. and tube internal diameter

i) Hardness test shall be executed in accordance with the prior performed qualification at the beginning or end of tube {see point 6.1 (b) (ii)}.

ii) The Almen test (alternative test instead of the hardness test) shall be executed in accordance with the previously performed qualification {see point 6.1 (b) (iii)}. Almen test readings shall not be lower than the established "Minimum" shot peening intensity.

6.4 Marking & Certification:

a) After shot peening treatment, all tubes shall be marked with the letters "SP" for "shot peened".
b) Certification for Shot peening shall be done in Material Test Certificate (MTC).
c) Results of qualification shall be submitted as one time exercise for each internal diameter and material grade which shall include Almen test, Metallographic examination and Hardness test.
d) Results of In-process tests shall also be submitted for each heat and tube internal diameter.

7. MECHANICAL TESTS

a) As per specification. Quantum of test: As per specification – For each nominal size per heat per heat treatment batch (Minimum 2 tubes for first 100 tubes and 1 per 100 or part thereof for tubes over 100 numbers, as per IBR).

b) Tension test required for SA 192. **Acceptance:** explanatory note in Specification. Hardness for SA 192: 120 HBW (max).

c) For tension tests, the shape and size of the specimen shall be mentioned on the Test Certificate (viz., Full tube tensile or strip tensile or round tensile).

d) Additionally, the material supplied shall meet the requirements as below:
T91 (Type 1/ Type2) -Tensile strength:Min: 630MPa, Max: 850MPa; Yield Strength: Min: 450MPa; Hardness (HBW): Min: 195/Max: 250
T92-Tensile strength: Min: 620 MPa, Max: 850 MPa; Hardness (HBW): Min: 190 / Max:250
T23-Tensile strength: Min: 510 MPa, Max: 730 MPa; Hardness (HBW): Min: 150 / Max:220

e) **Charpy Impact V-Notch Test at the mill as per SA 370 for SA 213 T23:**

- **Impact testing frequency** - minimum of two tubes per each heat treatment lot produced.
- **V-Notch Impact test procedure & specimen size as per** ASME SA 370.
- **Test temperature:** 20^0C.
- **Acceptance:** All specimens shall absorb energies at or above 40 ft-lb (55Joules) for a full size specimen (10mm thickness). The energy requirement is proportionally reduced for sub-size specimens as specified in ASME SA 370, Table 9.
- The fracture surfaces on all specimens must exhibit 100% ductile appearance regardless of the absorbed energy values obtained.
- Any specimen exhibiting an absorbed energy less than 40 ft-lb (55Joules) or less than 100% ductile behavior shall constitute permanent rejection of the entire lot of tubing.

f) Creep testing shall be carried out for all alloy steel and stainless steel tubes as per SIP:RM:01 (latest revision).

8. NON DESTRUCTIVE TEST (In-house Automated Online Testing Only)

a) Each tube shall be examined full section over its entire length.
Ultrasonic Testing: For thickness ≥ 3.6 mm to be conducted as per ASTM E213. Calibration: 2 axial 50mm long notches, one in outer surface and the other in inside surface. For OD <30 mm, one notch in outer surface only. Notch depth: 5% of wall thickness (Min. 0.3 mm, Max: 1.5 mm). Scanning: clockwise & anti-clockwise.

Eddy current Test: For thickness < 3.6mm, as per ASTM E309 /E426 as applicable,
Calibration: Longitudinal notch depth: 5% of wall thickness (Min. of 0.3 mm) or drilled hole as per SA 1016.

b) SS: Finished tubes shall be checked for radioactive contamination and reported. Survey meter shall be used to measure at 5cm near the surface. **Acceptance limits:** Shall be less than 0.1 milli Rontgen (mR) per hour or 1 micro Sievert per hour.

c) The residual magnetism in all finished tubes, measured with field indicator, shall be limited to 5 gauss maximum.

9. HYDROSTATIC TEST

Extent of test: On all tubes of thickness < 3.6 mm:
Hydrostatic test pressure shall be calculated as follows:

i) for Carbon and low alloy steel tubes : as per clause no. 23.3 of SA-450
ii) for Ferritic alloy steels and Austenitic stainless Steels : as per clause no. 26.3 of SA-1016

The tube wall stress, "S", shall be determined as follows:

For Carbon steel, Low Alloy Steel and Ferritic Alloy steels:
S = 40% of the minimum specified tensile strength at room temperature.

For Austenitic SS:
S = 80% of the minimum specified yield strength at room temperature
The test pressure shall be held for a minimum of 5s.

For others (tubes of thickness≥ 3.6 mm): if specified in Purchase Order.

Acceptance: No leak shall be permitted.

Note:- For Hydrotest of Stainless Steel tubes, DM water shall be used and the water shall meet the following requirements:

1. The halide content (chlorides and fluorides combined) shall not exceed 25 ppm and
2. Conductivity shall not exceed 10 microsiemens/cm

10. FINISH AND REPAIR

Tubes inside and outside surface shall meet SA213 and SA1016 surface condition requirement. Tubes shall be free from defects like laps, seams, folds, cracks, pitting etc. Repairs by welding are prohibited. Surface defects can be removed mechanically, ensuring smooth curved surface and maintaining specified minimum thickness without affecting the workman like finish.

11. MARKING: (in English only)

a) Details to be identified: Tubes shall be marked repeatedly & continuously along its entire length with the following details as indicated below:

(1) PO Number, (2) Maker's emblem/code, (3) Specification & grade, (4) Code case (if applicable) (5) Heat number, (6) Size (OD x Thickness x Length, in mm), (7) No. of tubes, (8) Inspector's seal, (9)

Condition: Hot finished or Cold Finished, (10) Tube Minimum Wall Thickness Designation (For SA 213 Spec only).

- Below OD 31.8mm. (Excl.) – Sl Nos:1 to 10 to be stamped on metal/plastic tag attached to bundle.
- OD 31.8-76.1mm. (Incl.) - Sl Nos: 1 to 6, 9 and 10 to be paint stenciled, repeatedly through the entire length of each tube. Also Sl.No:1 to 10 to be stamped on Metal/Plastic tag attached to bundle.
- OD>76.1 mm- Sl Nos: 2 to 6 & 8 to be hard stamped with round edge stamp at 100mm from both ends and Sl No:1 to 6, 9 and 10 to be paint stenciled on each tube.

b) Colour Coding: Continuous longitudinal colour coding shall be done on the entire length of all tubes, without masking stenciling. If more than one color is to be applied on the tubes then, colour bands shall be adjacent. Colour coding scheme as per Procedure SIP: PP: 21 (latest).

12. PRESERVATION:

All tubes, except SS, shall have Rust Preventive Fluid (RPF) coating on the external surface as follows: The Tubes shall be coated with suitable RPF with minimum DFT of 50 microns. RPF coated steel surfaces shall be capable of withstanding salt spray corrosion test for minimum 1000 hours. The RPF coating should be sea worthy, ensuring freedom from corrosion when transported through sea voyage. The RPF coating shall get dried and shall be a transparent coating, so that it is possible to see the tube surface clearly as well as read any stenciled matter on tube surface. The inside surface of the tube shall be protected with volatile corrosive rust inhibitor. Rust preventive coating shall withstand at least one year storage at open yard from receipt of materials. The supplier shall stand guarantee for this. SS tubes to be surface treated as per ASTM A380 both inside and outside. After surface treatment, the tubes shall be rinsed with demineralised water and dried. Tube ends shall be closed with push type plastic end caps/plugs secured tightly to avoid entry of water during transportation and storage.

13. PACKING:

a) Tubes of thickness ≤ 2.5mm, shall be packed in boxes and others in bundles. Tubes of thickness ≥6.5 mm and OD ≥ 88.9 can be shipped loose. Bundles to be ≤ 4 tons of equal no. of tubes, fastened with galvanized strap (1x25mm.min.) or annealed wire for CS & AS and by Nylon strap for SS at both ends & at 1m interval in between. The stainless steel tubes shall be protected from coming into contact with carbon steel in any form. All SS tube bundles shall be wrapped with polythene. Wooden pallets/cardboard to cover tubes are not permitted.

b) For SS materials, check for presence of residual Chloride as per method IS 3025 Part 32. The residual chloride salt contamination of the inside and outside surface of the tubing at the time of packing for shipment from the mill shall not exceed a concentration of 10.7 mg/m² of tube surface as per ASTM A 688.
Test frequency: As a minimum, one tube in each five hundred pieces shall be checked immediately prior to packing for shipment for chloride salt contamination

14. INSPECTION AND CERTIFICATION:

14.1 Certification in IBR Form III-B for finished tubes from "IBR-Well Known Tube Maker" or "Inspecting Authority (refer to clause 14.2 below)", as applicable, shall be submitted to BHEL.

Also, certification in IBR Form IV for the raw material signed by "IBR-Well Known Steel Maker" or "Inspecting Authority", as applicable, shall be submitted to BHEL.

Refer to Drawing: 4-03-000-00061 (Latest Rev) and the drawings referred therein for MAWP values for various material grades & sizes at various temperatures.

14.2 IBR Form(s) must be countersigned by the Inspecting Authority as indicated below:

Imported Items: Inspecting Authority approved by IBR for the Country of origin (To be concurred by BHEL before placing PO).

Indigenously Supply: Director of Boilers/Chief Inspector of Boilers/Inspecting Authority approved by IBR, for the respective state.

14.3 **Additionally, Manufacturer's Test certificate(MTC)** (ORIGINAL in ENGLISH) with following details shall be submitted to BHEL:

a) Purchase Order No. (BHEL), TDC No and its Rev No, Test certificate No., Size and Quantity-Melt wise.
b) Specification and Grade with year of code, Code case number (if applicable), Heat Number, Steel & Tube making process, chemistry including incidental elements-Ladle and product Analysis.
c) Heat Treatment details with actual temperature and soaking time
d) Mechanical test results
e) Detailed NDE report with reference norms, acceptance standards and test results.
f) Grain size as applicable
g) Decarburization layer thickness
h) Certification for compliance to residual magnetism
i) Certification for minimum DFT of rust preventive coating
j) Creep test report for a minimum of 1,000 hours as per Cl. 7(f) (only for IBR applications).
k) Mill test certificate and IBR Form IV of the raw material (billets/blooms) as per Cl. 2.
l) Certification for Shot peening, as applicable. Also, results of Almen test, metallographic examination and hardness shall be reported along with acceptance norms on shot peened SS tubes as per Cl 6.4.

In the MTC a clause for Certificate of Compliance (as per SA 1016) shall be added stating that: All materials/components supplied to Purchase Order meet all requirements contained in the PO, this Technical delivery conditions and applicable ASME specifications.

For SS: Measured chloride levels (Ref. Cl. 13 b of this TDC) shall be reported. Measured Radioactivity levels shall also be reported in the Mill Test Certificate and shall be submitted to BHEL.

15. End use: These tubes are meant for use in subcritical and supercritical Boilers. These tubes shall be capable of undergoing forming, bending and welding operations necessary for the application without developing defects.

16. In case of NTPC projects, the specific approval conditions (mentioned in the approval letter) by NTPC shall also be complied with by the vendor.

T. Sriharsha	Deepesh V	N Nirmal Raj	Ramesh Kumar PK	S Krishna Kumar	JVV Aruna Kumar
Manager/QA	DGM/QA	DGM/PE/FB	Sr. DGM/MM	AGM/QC	AGM/QA & BE
Prepared By	**Reviewed by**				**Approved By**

BHARAT HEAVY ELECTRICALS LIMITED

MM/RM/PURCHASE/TUBES

Ref: MM: Pur: Tubes: Rev 06 **Dt:04.04.2025**

Pre-Qualification requirements (PQR) for the procurement of Seamless Carbon Steel, Alloy Steel & Stainless Steel Tubes through Open Tender (As per TDC: 102 Rev 21)

A) **Organizational Capability:**

1. Manufacturers having tube mill (both Hot Mill & Cold Mill facility) are only eligible to participate. Offers from traders, fabricators and stockists are not acceptable and will not be considered for evaluation.
2. If the vendor is not having steel making facility, then source of raw material for manufacturing shall be from **IBR** approved well known steel maker or certified by **IBR** approved inspecting authority (Form-IV to be attached). If the vendor is dependent on more than one source for steel making, all such sources shall be indicated, and the supplies shall be restricted to the indicated list of raw material sources only.
3. Offers with Mother Hollow sources as a raw material will not be considered.
4. Vendor to indicate the nature of the firm. Product catalogue shall be submitted.
5. Vendor shall submit filled in supplier facility report for Tube mill (Format enclosed). Vendors without basic manufacturing facilities in-house, shall not be considered for evaluation. In house facilities for Hot Piercing/ Extrusion, Pilgering/Cold drawing, Heat treatment & Non-Destructive Testing (On-line UT & Online Thickness Measurement facility for Tubes) are mandatory requirements for consideration of the offer.
6. Chemical, Mechanical testing shall be done in house or at Labs certified as per ISO 17025 or Government approved labs.
7. Vendor shall submit a valid ISO 9001 certificate or Quality Assurance Manual or Written down procedure.
8. Vendor shall submit a valid IBR Well-known tube maker certificate along with Offers.
9. BHEL/End customer reserves the right to inspect the first lot of materials at vendor's works for giving clearance before bulk production.
10. BHEL/End customer reserves the right to inspect the item ordered at any stage at vendor's works and if found not meeting the stipulated conditions, material is liable for rejection.

K. Dinesh 4/4/25
(K. DINESH KARUNAKAR
DM/MM)

T SRIHARSHA 04/04/25
Dr. T. SRIHARSHA
MANAGER
QUALITY ASSURANCE
BHEL, TRICHY - 620 014

Pre-Qualification requirements (PQR) for the procurement of Seamless Carbon Steel, Alloy Steel & Stainless Steel Tubes through Open Tender (As per TDC: 102 Rev 21)

11. BHEL reserves the right to visit Vendor's works to audit and inspect so as to ensure the vendor's technical competence.

B) Technical Competence:

1. Point by point confirmation to the TDC requirements is mandatory for consideration of offer and signed TDC shall be submitted.
2. Vendor shall submit Manufacturing Process Flow chart (Raw material to finished product) / manufacturing quality plan meeting the TDC requirements along with technical bid.
3. Vendor shall submit the experienced manpower details specific to Manufacturing, Quality and NDE requirements.
4. Vendor shall provide 100% compliance to additional approval conditions as specified in NTPC/Other Customer approval.

   In case of CAT-1 approval by customer,

   - Customer approved quality plan should be strictly adhered to.
   - Internal manufacturing process/inspection should be completed before raising an inspection call. All the corresponding documents for the offered quantity should be kept ready for inspection.
   - Detailed inspection plan for the month to be submitted within the first two days of the month.
   - Each Inspection call should be numbered with running serial numbers.
   - Inspection call should clearly specify the Customer name, PO No, QP No, TDC, inspection date, works address, contact person (name, designation, contact number and e-mail id), PO Sl.No, size & spec, PO qty., earlier inspected qty., pending for inspection, offered qty. for inspection, Heat number, scope of inspection as per the QP.
   - Inspection call shall be intimated to BHEL with 10 days prior in advance for taking up with customer.
   - Inspection call should not be given for dates falling nearby/on Holidays/weekends.

K. Dinesh Karunakar 4/4/25
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T. SRIHARSHA 04/04/25
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Ref: MM: Pur: Tubes: Rev 06 **Dt:04.04.2025**

Pre-Qualification requirements (PQR) for the procurement of Seamless Carbon Steel, Alloy Steel & Stainless Steel Tubes through Open Tender (As per TDC: 102 Rev 21)

C) Past Experience/ Performance:

1. Suppliers shall indicate their annual installed capacity for the tendered specifications & it shall be more than the tendered quantity for each specification.
2. Suppliers shall have supplied tubes as per the specification given below:
   a) For Carbon Steel Tubes: Either in SA192/SA210GRA1 /SA210GRC or any alloy steel Grades.
   b) For Alloy Steel Tubes (SA213T23): Either in SA213T23/SA213T91/SA213T92 grades
   c) For Alloy Steel Tubes (SA213T91): Either in SA213T91/SA213T92 grades.
   d) For Alloy Steel Tubes (SA213T92): In respective grade SA213T92
   e) For other Alloy Steel Tubes: Either in SA213T11/SA213T12/SA213T22 or any higher alloy steel grades.
   f) For Stainless Steel Tubes (SA213TP347H): Either in SA213TP347H or SUPER 304H (UNS No. S30432) Grades
   g) For Stainless Steel Tubes (SA213SUP304H): in respective grade SUPER 304H (UNS No. S30432) Grades
   h) For other Stainless Steel Tube Grades: Either in SA213TP304H, SA213TP316, SA213TP321, SA213TP32IH or any higher Stainless steel grades.
3. Details of supplies made in past 5 years indicating the Quantity, Size, Specification & Customer details shall be submitted year wise.
4. Unpriced PO copies & Proof of supply (such as invoice / bill of lading copies and sample test certificates) against the tendered specification & covering minimum and maximum sizes meeting the tendered size requirements shall be submitted as mentioned above in Clause C2.
5. The manufacturing size range shall be indicated in the offer. However, if credential is not available for any specific tendered size, then specific declaration shall be submitted by mill stating the capability to produce that quoted size/s.

K. Dinesh Karnakar 4/4/25
(K. DINESH KARNAKAR
DM/MM)

T. SRIHARSHA 04/04/25.
Dr. T. SRIHARSHA
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Ref: MM: Pur: Tubes: Rev 06 **Dt:04.04.2025**

Pre-Qualification requirements (PQR) for the procurement of Seamless Carbon Steel, Alloy Steel & Stainless Steel Tubes through Open Tender (As per TDC: 102 Rev 21)

D) **Financial Soundness:**

1. Indigenous suppliers shall submit **Audited copies of annual reports (Balance Sheets, Profit & Loss statement) for the last three years** (or from date of incorporation whichever is less).
2. Import suppliers shall submit latest report from a reputed third party business rating agency like Dun & Bradstreet, Credit reform etc...

Necessary supporting documents shall be submitted for meeting each of the above Pre-Qualification Criteria for evaluation of the offers. BHEL shall consider/Not-consider the offers based on the evaluation of documents submitted for the above Pre-Qualification Criteria. If required, BHEL shall make on-site assessment of the facilities at supplier's works during the bid evaluation.

4/4/25
(K. DINESH KARUNAKAR
DH/MM)

T. SRIHARSHA.
4/4/25

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Record of Revision:

Rev 10: 27/01/04 Cl.8 Hydraulic test removed, further clauses renumbered. Annexures introduced for Cl.11. In Cl.2 limits for carbon in Gr C modified. In Cl. 4 normalizing made mandatory for all pipes of Gr C& Gr B meant for fitting. In Cl.5.0 test coupon for pipes meant for fittings removed.

Rev 11: 29/12/07 Cl 1, P92 included. P2, P5, P9, 304L, 321 Deleted.Cl.4, 10, 11, modified.

Rev 12: 29/07/10 Cl 1, P91, P92 Deleted and included in TDC 0123; Cl: 4, 5, 7, 8, 10, 11 modified.

Rev 13: 26/10/12 Cl 2, 6 & 11 modified for SS material

Rev 14: 29/12/12 Cl 4 – Heat treatment for CS modified. Cl 6 – corrected.

Rev 15: 28/11/13 TDC 123 Rev 00 and TDG 32 Rev 03 merged with TDC 101 Rev 15 & Product description modified. Cl 3 added. Cl 5, Cl 8, Cl12 modified. SA335 Gr 91, 92 included (Cl 1) and subsequent dimensional tolerance (Cl 3), heat treatment (Cl 5), mechanical testing (Cl 6), and photomicrograph (Cl 7 iii) added. SA335 Gr 23 removed from TDC 123 Rev 00

Rev 16: Cl 3– OD & ID tolerance revised, Cl 5– temperature for Gr 91, 92 modified, Cl 6 – mechanical test values changed in-line with ALSTOM purchase specification, Cl 7 – PMI magnification & frequency clarified, Cl 9&11 – modified, Cl 12-changed as per latest IBR.

Rev 17: Dt: 13/10/2017: Cl 1 modified; Cl 4 modified to include finishing process and polygonization requirements for pipes of OD ≤ 76.1; Cl 5 modified; Cl 6(c) added to include creep requirements; Cl 8 & 9 modified; Cl 12-changed as per latest IBR to include MAWP requirements and IBR Form IV.

Rev. 18: Dt: 11/11/2017: Cl. 6(c), Cl.12.3 (vii)-creep requirements removed.

Rev. 19: Dt: 03/05/2018: Cl 2 added to include Billet/Bloom Requirements, Cl. 13.3 (vii) added to include mill TC certification

Rev. 20: Dt: 26/09/2019: Cl 2 modified based on feedback from user departments, suppliers and internal discussions, Cl 14 added

Rev. 21: Dt: 09/10/2023: Cl.1 modified to include Type 1 & 2 for P91, Cl.4 - Note added for clarity, Cl. 13.3 (viii) added to include certification for visual inspection in TC, Cl.* 15 *added to include supplementary requirement for P92 grade

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1. MATERIAL:

Specification	:	ASME (Latest as on the date of Enquiry/PO, whichever is earlier):
Carbon Steel (CS)	:	SA106 Gr B & C
Alloy Steel (AS)	:	SA 335 Gr P11, P12, P22, P91 *(Type 1 & Type 2)* & P92 (Code Case: 2179)
Stainless Steel (SS)	:	SA 312 Gr TP 316, TP 316L
Additional requirement	:	As listed below (Supplementary to above material specifications).
Pipe Size and Qty	:	As per Purchase Order

2. BILLET/BLOOM REQUIREMENTS:

The billets/blooms shall be fully killed.

For carbon steel and alloy steel, billets/blooms shall be made by vacuum degassing. For Stainless steel, billets/blooms shall be made by vacuum degassing or argon oxygen decarburization (AOD).

Chemistry shall be controlled as given below for below specified grades. For all other grades, it shall be as per applicable material specifications:

Ladle Analysis:	SA 106 Gr B:	Carbon: 0.25% Max.
	SA 106 Gr C:	Thickness ≤ 20mm Carbon: 0.25% Max.
		Thickness > 20mm Carbon: 0.30% Max.
	SA335 P92 :	Si: 0.10-0.50%; Ni: 0.30% max and Cu: 0.25% max

The billet/bloom shall conform to the chemical and process requirements of respective pipe specifications. The billet/bloom shall be sourced from IBR well-known steel makers or with inspection and certification by IBR authorized Inspecting Authority in case the mill is not approved by IBR. Mill test certificate shall be submitted to BHEL.

3. CHEMICAL COMPOSITION:

3.1 **Product analysis** on pipes is required for all steels. Chemistry shall be controlled as per applicable material specifications and the elements including Carbon (for SA 106 Gr B & C), Si, Ni & Cu (for SA335 GrP92) as indicated in Clause 2 shall also be reported in the product analysis.

3.2 All raw materials used in steel making including incoming scrap shall be checked by supplier to ensure freedom from radioactivity (Applicable for SS material only).

4. DIMENSIONAL TOLERANCES:

4.1 SA335 Gr P91, P92: For outside diameter (OD) controlled Pipes the tolerance on OD shall be: ±1% (Max: 4mm) of Nominal OD.

4.2 Other than SA335 Gr P91, P92: For outside diameter (OD) controlled Pipes the tolerance on OD shall be: ±1% (Max: 6 mm) of nominal OD.

4.3 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: +6.4mm, -0.0mm
Weight per metre: +10%, -5% on nominal weight **
** Nominal weight of ID pipe per metre shall be calculated as follows,
Weight $_{nom}$ = $(ID_{nom}+t_{nom}) * t_{nom}*0.02466$ kg/metre, where
ID $_{nom}$ = ID_{max}-1.6mm; $t_{nom}=t_{min}+3.2$mm

Note: In case of variance in tolerance between TDC and material specification/statutory requirements, the more stringent of the two shall be followed.

5. 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 > 76.1mm. 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 ≤ 76.1mm, the pipes shall be made by process 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.
2. Pipes may be cold formed or hot formed in case of "t/D" ratios upto and including 0.15.
3. 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.

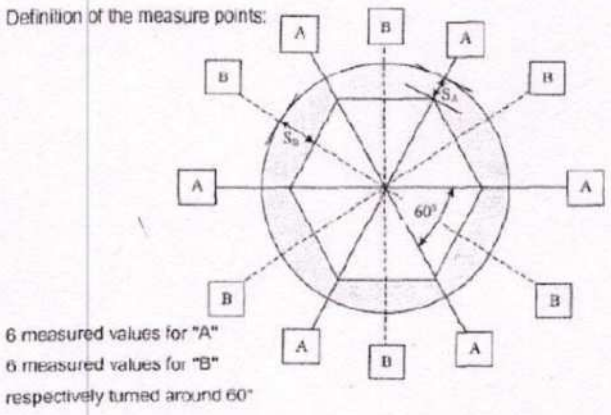

Fig. 1

6. HEAT TREATMENT:

The heat treatment temperatures and soaking time shall be reported in the test certificate.

6.1 CS: Hot Finished: OD ≤ 76.1mm no heat treatment required. OD > 76.1mm shall be in Normalized condition.
CS: Cold Finished: All sizes – In sub critical annealed, fully annealed or in Normalised condition.

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

6.3 AS: All sizes – SA335 Gr P91 & P92: All pipes Normalised as per material specification and Tempered at 750-780 °C.

6.4 SS: All sizes – Solution Annealed condition as per material specification.

7. MECHANICAL TESTS:

a) As per specification. Quantum of test: As per specification – For each nominal size per heat per heat treatment batch. (Minimum 2 pipes for first 100 pipes and 1 per 100 or part thereof for pipes over 100 numbers, as per IBR).

b) For alloy steel pipes meant for fitting (As indicated in the Purchase order), test coupon shall be in normalised and tempered condition.
P91- TS: Min: 630MPa, Max: 850MPa; YS: (0.2% offset):450MPa Min; Hardness (HB): Min: 195 Max: 250
P92- TS: Min: 630MPa, Max: 850MPa; Hardness (HB): Min: 190 Max: 250
P91, P92 hardness shall be checked on each pipe and values reported in MTC.

8. NON DESTRUCTIVE TEST:

8.1 ULTRASONIC TEST : ASTM E213
Calibration: Axial 50 mm long V or Square notch, one in OD and the other in ID. Notch Depth: 5% of Max.Thickness.(Min. 0.3 mm, Max. 1.5mm).
For ID<16mm one notch in OD is enough. Scanning:Clockwise and Anti clockwise.

8.2 SS: Finished pipes shall be checked for radioactive contamination and reported. Survey meter shall be used to measure at 5cm near the surface.
Acceptance limits: Shall be less than 0.1 milli Rontgen (mR) per hour or 1 micro Sievert per hour.

8.3 Photomicrograph test for P91 & P92 pipes - Photomicrograph test shall be carried out from a specimen of pipe in the as finished condition for individual size (OD and wall thickness) per 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 and delta ferrite (to be maintained within 3% for Gr92 and within 2% for Gr91 when measured as per VD TUV 1272). Photomicrograph with 400x (Min) magnification along with Photomicrograph report to be provided. The actual magnification and structure shall be indicated in the report.

9. FINISH AND REPAIR:

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 grinding or skin machining only, ensuring the wall thickness, inside and outside diameter to provide workmanship like finish. Local depressions or ground spots are not acceptable. Loose scales shall be removed by blast cleaning in both inside and outside surface. Repair by welding is prohibited.

10. MARKING:

(In English only): All mandatory marking shall be done as per material specification (latest).

10.1 **Details to be identified:** On Each Pipe (1) PO Number (2) Maker's emblem/code (3) Specification & grade (4) Code case, if applicable (5) Heat number (6) Size (OD x Thickness x Length, in mm), (7) No. of pipes (8) Inspector's seal

- Upto OD 31.8 (Excl.) – Sl.No: 1 to 8 to be stamped on metal or plastic tag attached to bundle.
- OD 31.8 to OD 76.1 (Incl.) – Sl.No:1 to 6, 8 to be paint stenciled on each pipe, 1 to 8 to be stamped on metal or plastic tag attached to bundle.

- OD > 76.1- Sl.No: 2 to 6 & 8 to be hard stamped with round edged stamp at 100mm from an end of each pipe and 1 to 6 to be paint stenciled on each pipe.

10.2 **Colour Coding:** Continuous longitudinal colour coding shall be done on the entire length of all pipes, without masking stencilling. Colour coding scheme shall be as per Procedure SIP: PP: 21 (latest).

11. PRESERVATION:

All pipes except SS shall be applied with resin type rust preventive coating with visibility to stencilled details on outside and either with rust preventive coating or rust inhibitor inside. Thick black coating which camouflages the surface of the pipes is not permitted. SS pipes to be surface treated as per ASTM A380 both inside and outside. Ends to be closed with end caps for secured storage.

12. PACKING:

1) Thickness ≤ 2.5mm in boxes.
2) OD ≤ 159 mm in bundles.Others in loose condition.
   Pipe bundles to be < 4 tons of equal no.of pipes,fastened with galvanised strap/ anti-rust coated (1x25mm.min.) for Carbon Steel & Alloy Steel and by Nylon strap for Stainless Steel at 2 ends & at 1m interval. Wooden pallets to cover pipes are not permitted.

13. INSPECTION AND CERTIFICATION (In English Only):

13.1 Products shall be inspected at works and the applicable IBR Form must be countersigned by the Inspecting Authority as indicated below:
Imported Items: Inspecting Authority approved by IBR for the Country of origin (To be concurred by BHEL before placing PO).
Indigenously Supplied items: Director of Boilers/Chief Inspector of Boilers/Inspecting Authority approved by IBR, for the respective state.

13.2 Certification in IBR Form III-A for finished pipes from "IBR-Well Known Pipe Maker" or "Inspecting Authority", as applicable, shall be submitted to BHEL.

Also, certification in IBR Form IV for the raw material signed by "IBR-Well Known Steel Maker" or "Inspecting Authority", as applicable, shall be submitted to BHEL.

Refer to BHEL Engineering Drawing: 4-03-000-00062 (Latest Rev) for MAWP values for various material grades & sizes at various temperatures.

13.3 Additionally, Manufacturer's Test certificate (MTC) (ORIGINAL in ENGLISH) with following details shall be submitted:

i) Purchase Order No. (BHEL), TDC No. and its Rev No, Test certificate No. & TC Date, Size and Quantity-Melt wise.
ii) Specification and Grade with year of code, Code case number (if applicable), Heat Number, Steel & Pipe making process, chemistry including incidental Elements-Ladle and product Analysis.
iii) Heat Treatment details with actual temperature and soaking time
iv) Mechanical test Results.
v) For P91, P92 supplies – the Photomicrograph test report along with photomicrograph with 400X (min) magnification shall be furnished.
vi) Detailed N.D.E. report with reference norms, Acceptance standards and test results.
vii) Mill test certificate of the raw material (billets/blooms) as per Cl. 2.
viii) Supplier shall certify in the TC by Visual examination attesting to freedom of the pipe surfaces from imperfections and defects. This visual examination shall be performed on the finished pipes after surface preparation before performing UT.

13.4 For SS: Measured Radioactivity levels shall be reported in the Mill Test Certificate and shall be submitted to BHEL (Not to be recorded in IBR Form).

14. End use: These pipes are meant for use in subcritical and supercritical Boilers. These pipes shall be capable of undergoing forming, bending and welding operations necessary for the application without developing defects.

15. *The following Supplementary requirements for SA 335 P92 pipes shall be complied with (in addition to all of the above requirements mentioned from Cl. 1 to 14), unless otherwise exempted in the P.O.*

15.1 Supplementary tests S1, S2, S3 and S4 as per ASTM A 335 shall be done. However, quantum of tests shall be at least 5% of the pipes per heat or minimum 2 pipes per heat from one end/both ends of the pipe as specified in ASTM A335

15.2 Certificate of Conformity shall be submitted by supplier for microstructure and delta ferrite (to be maintained within 3% max when measured as per VD TUV 1272).

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Prepared By	**Reviewed by**				**Approved By**

BHARAT HEAVY ELECTRICALS LIMITED

MM/RM/PURCHASE/TUBES

Ref: MM: RM Planning: Small bore pipes: Rev 01 **Dt:19.07.2025**

Pre-Qualification requirements (PQR) for the procurement of Seamless Carbon Steel & Alloy Steel Pipes through Open Tender (As per TDC: 101 Rev 21)

A) Organizational Capability:

1. Manufacturers having Pipe mill (both Hot Mill & Cold Mill facility) are only eligible to participate. Offer from traders, fabricators and stockists are not acceptable and will not be considered for evaluation.
2. If the vendor is not having steel making facility, then source of raw material for manufacturing shall be from **IBR** approved well known steel maker or certified by **IBR** approved inspecting authority (Form-IV to be attached). If the supplier is dependent on more than one source for steel making, all such sources shall be indicated, and the supplies shall be restricted to the indicated list of raw material sources only.
3. Offers with Mother Hollow sources as a raw material will not be considered.
4. Vendor to indicate the nature of the firm. Product catalogue shall be submitted.
5. Vendor shall submit filled in supplier facility report for Pipe mill (Format enclosed). Suppliers without basic manufacturing facilities in-house, shall not be considered for evaluation. In house facilities for Hot Piercing/ Extrusion, Pilgering/Cold drawing, Heat treatment & Non-Destructive Testing (On-line UT & Online Thickness Measurement facility for Pipes) are mandatory requirements for consideration of the offer.
6. Chemical, Mechanical testing shall be done in house or at Labs certified as per ISO 17025 or Government approved labs.
7. Vendor shall submit a valid ISO 9001 certificate or Quality Assurance Manual or Written down procedure.
8. Vendor shall submit a valid IBR Well-known Pipe maker certificate along with Offers.
9. BHEL/End customer reserves the right to inspect the first lot of materials at vendor's works for giving clearance before bulk production.
10. BHEL/End customer reserves the right to inspect the item ordered at any stage at vendor's works and if found not meeting the stipulated conditions, material is liable for rejection.

DINESH KARUNAKAR
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Date: 2025.07.19 15:40:39 +05'30'

BHARAT HEAVY ELECTRICALS LIMITED

MM/RM/PURCHASE/TUBES

Ref: MM: RM Planning: Small bore pipes: Rev 01 Dt:19.07.2025

Pre-Qualification requirements (PQR) for the procurement of Seamless Carbon Steel & Alloy Steel Pipes through Open Tender (As per TDC: 101 Rev 21)

11. BHEL reserves the right to visit Vendor's works to audit and inspect so as to ensure the vendor's technical competence.

B) Technical Competence:

1. Point by point confirmation to the TDC requirements is mandatory for consideration of offer and signed TDC shall be submitted.
2. Vendor shall submit Manufacturing Process Flow chart (Raw material to finished product) / manufacturing quality plan meeting the TDC requirements along with technical bid.
3. Vendor shall submit the experienced manpower details specific to Manufacturing, Quality and NDE requirements.
4. Vendor shall provide 100% compliance to additional approval conditions as specified in NTPC/other customer approval.

   In case of CAT-1 approval by customer,

   - Customer approved quality plan should be strictly adhered to.
   - Internal manufacturing process/inspection should be completed before raising an inspection call. All the corresponding documents for the offered quantity should be kept ready for inspection.
   - Detailed inspection plan for the month to be submitted within the first two days of the month.
   - Each Inspection call should be numbered with running serial numbers.
   - Inspection call should clearly specify the Customer name, PO No, QP No, TDC, inspection date, works address, contact person (name, designation, contact number and e-mail id), PO Sl.No, size & spec, PO qty., earlier inspected qty., pending for inspection, offered qty. for inspection, Heat number, scope of inspection as per the QP.
   - Inspection call shall be intimated to BHEL with 10 days prior in advance.
   - Inspection call should not be given for dates falling nearby/on Holidays/weekends.

DINESH KARUNAKAR Digitally signed by DINESH KARUNAKAR Date: 2025.07.22 16:52:43 +05'30'

Dr. Sriharsha Theerdhala Digitally signed by Dr. Sriharsha Theerdhala Date: 2025.07.19 15:41:00 +05'30'

BHARAT HEAVY ELECTRICALS LIMITED

MM/RM/PURCHASE/TUBES

Ref: MM: RM Planning: Small bore pipes: Rev 01 Dt:19.07.2025

Pre-Qualification requirements (PQR) for the procurement of Seamless Carbon Steel & Alloy Steel Pipes through Open Tender (As per TDC: 101 Rev 21)

C) Past Experience/ Performance:

1. Suppliers shall indicate their annual installed capacity for the tendered specifications & it shall be more than the tendered quantity for each specification.
2. Suppliers shall have supplied Pipes as per the specification given below:
   a) For Carbon Steel Pipes (GRB/GRC):
      Either in SA106GRB or SA106GRC or any alloy steel Grades.
   b) For Alloy Steel Pipes (P11,P12,P22):
      Either in SA335P11/SA335P12/SA335P22 grades
   c) For Alloy Steel Pipes (P91): Either in SA335P91/SA335P92 grades.
   d) For Alloy Steel Pipes (P92): In respective grade SA335P92
3. Details of supplies made in past 5 years indicating the Quantity, Size, Specification & Customer details shall be submitted year wise.
4. Unpriced PO copies & Proof of supply (such as invoice / bill of lading copies and sample test certificates) against the tendered specification & covering minimum and maximum sizes meeting the tendered size requirements shall be submitted as mentioned above in Clause C2.
5. The manufacturing size range shall be indicated in the offer. However, if credential is not available for any specific tendered size, then specific declaration shall be submitted by mill stating the capability to produce that quoted size/s.

DINESH KARUNAKAR
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BHARAT HEAVY ELECTRICALS LIMITED

MM/RM/PURCHASE/TUBES

Ref: MM: RM Planning: Small bore pipes: Rev 01 Dt:19.07.2025

Pre-Qualification requirements (PQR) for the procurement of Seamless Carbon Steel & Alloy Steel Pipes through Open Tender (As per TDC: 101 Rev 21)

D) Financial Soundness:

1. Indigenous suppliers shall submit **Audited copies of annual reports (Balance Sheets, Profit & Loss statement) for the last three years** (or from date of incorporation whichever is less).
2. Import suppliers shall submit latest report from a reputed third party business rating agency like Dun & Bradstreet, Credit reform etc...

Necessary supporting documents shall be submitted for meeting each of the above Pre-Qualification Criteria for evaluation of the offers. BHEL shall consider/Not-consider the offers based on the evaluation of documents submitted for the above Pre-Qualification Criteria. If required, BHEL shall make on-site assessment of the facilities at supplier's works during the bid evaluation.

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BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPALLI 620 014

QUALITY ASSURANCE

COLOUR CODES FOR TUBES AND PIPES
(FOR BOILERS, PRESSURE VESSELS & HEAT EXCHANGERS)

REVISION	DATE	PREPARED	REVIEWED	APPROVED
01	05-02-1999	R. Sasikumar	A. R. Reddy	K. Rengachari
02	22-07-2004	K. Ganesan	U. Revisankaran	C. R. Raju
03	20-01-2009	V. Kalyanaraman	S.Selvarajan	U. Revisankaran
04	13-05-2011	C. Haritha	V. Kalyanaraman	S. Selvarajan
05	27-05-2015	Vaibhav Saxena	S. Selvarajan	U. Revisankaran
06	28-10-2015	Vaibhav Saxena	Manu Shankar. H	S. Selvarajan
07	21-12-2016	Vaibhav Saxena	S. Selvarajan	U. Revisankaran
08	24-05-2018	Vaibhav Saxena 24.05.2018	J. V. V. Aruna Kumar 24/5/2018	Amit Roy 24/5/18

RECORD OF REVISIONS

Rev. No	Clause No.	Details of Revision	Remarks
01		New Specifications included based on TDC revision.	--
02		Amendment A1 dt. 26.04.01 issued for Rev. 01 incorporated. Colour code for SA 213 Gr. T23 added.	--
03		1) Colour code for SA 213 Gr. T92, P23, P92, SA178 Gr. D added. 2) Colour code for SA 210 Gr. C modified to BLUE only.(From BLUE & GREEN)	--
04		Colour code for super 304H added	--
05		1) First para modified for clarity for colour codes containing more than one colours. 2) UNS number for Super 304H added.	--
06		Colour code for super 304H corrected in line with Revision 04.	--
07		1) First paragraph modified to include Instructions for sequence for colour code bands. 2) Sl. No. column added in table. 3) Colour code for SA 312 Gr. TP 304H added.	--
08		Revised to include color code for Inconel SB 167 UNS N06617 (Alloy 617) material	--

Following Colour codes are to be applied as longitudinal bands (if not specified in other documents) on tubes & pipes to identify them to specification during receipt, storage, issue and processing. For heat exchanger tubes circumferential colour code can be provided at both ends of tubes (300 mm away from end). If the Colour code contains more than one Colour then bands of Colours shall be applied adjacent to each other without any overlap. In case of multiple colour bands, the sequence shall be maintained as indicated in the table.

Sl. No.	Specification	Colour 1	Colour 2	Colour 3
1.	12 X 1 MØ	RED	YELLOW	
2.	13 Cr Mo 44	ALUMINIUM	BLACK	
3.	A 200 Gr. T5	ALUMINIUM	RED	YELLOW
4.	A 200 Gr. T9	ALUMINIUM	GREEN	YELLOW
5.	AISI 602	WHITE	YELLOW	
6.	API 5L Gr. B	ALUMINIUM		
7.	BS 3059 PART2 CDS/HFS 360	ALUMINIUM	BLACK	BROWN
8.	BS 3059 P2 S2 440	ALUMINIUM	BLACK	RED
9.	BS 3059 P2 S2 622 Gr. 490	ALUMINIUM	BLACK	GREEN
10.	BS 3602 PART1 CDS 360	ALUMINIUM	BLACK	BLUE
11.	NFA49-213 42C	ALUMINIUM	BLUE	BROWN
12.	NFA49-213 TU 10CD9.10	ALUMINIUM	BLUE	RED
13.	NFA49-213 TU 15CD2.05	ALUMINIUM	BLUE	GREEN
14.	NFA49-213 TU Z10CD9	ALUMINIUM	BLUE	YELLOW
15.	NFA49-213 TU Z10CDVNB09.01	ALUMINIUM	GREEN	RED
16.	SA 106 Gr. B	RED		
17.	SA 106 Gr. C	BLUE		
18.	SA 178 Gr. D	ORANGE		
19.	SA 179	BLACK	BLUE	GREEN
20.	SA 192	WHITE		
21.	SA 199 T5	BLUE	BROWN	RED
22.	SA 209 Gr. T1	ALUMINIUM	RED	
23.	SA 210 Gr. A1	YELLOW		
24.	SA 210 Gr. C	BLUE		
25.	SA 213 Gr. T11	ALUMINIUM	YELLOW	
26.	SA 213 Gr. T12	BROWN	YELLOW	
27.	SA 213 Gr. T2	BROWN	GREEN	
28.	SA 213 Gr. T22	GREEN	RED	
29.	SA 213 Gr. T23	RED	WHITE	
30.	SA 213 Gr. T5	BLACK	BROWN	GREEN
31.	SA 213 Gr. T9	BROWN	WHITE	
32.	SA 213 Gr. T91	GREEN	YELLOW	
33.	SA 213 Gr. T92	BROWN	BLUE	
34.	SA 213 Gr. TP 304	BLUE	GREEN	YELLOW
35.	SA 213 Gr. TP 304H	BLACK	BLUE	YELLOW
36.	SA 213 Gr. TP 304L	BLUE	WHITE	YELLOW
37.	SA 213 Gr. TP 309H	BLACK	BROWN	YELLOW
38.	SA 213 Gr. TP 316	BROWN		
39.	SA 213 Gr. TP 316 Ti	BLACK	BLUE	
40.	SA 213 Gr. TP 316L	BLUE	BROWN	YELLOW
41.	SA 213 Gr. TP 321	BLUE	WHITE	
42.	SA 213 Gr. TP 321H	BLACK	WHITE	
43.	SA 213 Gr. TP 347H	BLACK	YELLOW	

Sl. No.	Specification	Colour 1	Colour 2	Colour 3
44.	SA 268 Gr. TP 405	ALUMINIUM	GREEN	
45.	SA 268 Gr. TP 410	BROWN	RED	YELLOW
46.	SA 268 Gr. TP 443	BLUE	GREEN	WHITE
47.	SA 269 TP 316	GREEN	RED	YELLOW
48.	SA 312 Gr. TP 304	BLUE	YELLOW	
49.	SA 312 Gr. TP 304L	BLUE	RED	YELLOW
50.	SA 312 Gr. TP 304H	BLACK	BLUE	YELLOW
51.	SA 312 Gr. TP 316	BLACK	GREEN	
52.	SA 312 Gr. TP 316L	BLACK	BLUE	BROWN
53.	SA 312 Gr. TP 321	BLUE	BROWN	
54.	SA 312 Gr. TP 347	BLUE	RED	WHITE
55.	SA 333 Gr. 1	BLACK	BROWN	RED
56.	SA 333 Gr. 3	BLACK	GREEN	RED
57.	SA 333 Gr. 6	BLUE	GREEN	RED
58.	SA 334 Gr. 1	BROWN	GREEN	RED
59.	SA 334 Gr. 3	BLACK	RED	YELLOW
60.	SA 334 Gr. 6	BLACK	BLUE	RED
61.	SA 335 Gr. P1	BROWN	GREEN	YELLOW
62.	SA 335 Gr. P11	GREEN	WHITE	
63.	SA 335 Gr. P12	BLACK	RED	
64.	SA 335 Gr. P2	BLUE	BROWN	GREEN
65.	SA 335 Gr. P22	BLUE	RED	
66.	SA 335 Gr. P23	RED	WHITE	
67.	SA 335 Gr. P5	BLACK	BROWN	
68.	SA 335 Gr. P9	ALUMINIUM	BROWN	
69.	SA 335 Gr. P91	BROWN	RED	
70.	SA 335 Gr. P92	BROWN	BLUE	
71.	SB 163 Inconel	BLACK	GREEN	YELLOW
72.	ST 35.4	ALUMINIUM	BLUE	
73.	Steel 20	GREEN		
74.	Structural Tubes & Pipes	BLUE	BROWN	WHITE
75.	X20 Cr Mo V 121	BLACK		
76.	SA 213 UNS S30432(Super 304)	BLACK	RED	GREEN
77.	SB 167 UNS N06617 (Alloy 617)	BLACK	WHITE	BROWN

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BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014, INDIA

QUALITY ASSURANCE

CREEP TESTING (STRESS-RUPTURE TEST) REQUIREMENTS AS PER IBR

Prepared by	
	Md. Fahad 03/05/2023 Md.Fahad Dy Manager/Quality Assurance

Reviewed by	Signature
Product Engineering – Fossil Boilers (N Nirmal Raj, DGM/PE/FB)	16/05/23
Product Engineering- Valves (Mallemala Sujana Vinod, SM/Valves/Engg)	03/5/23
Quality Assurance (V Deepesh, SM/QA)	03/05/2023
Approved by	**Signature**
AGM/QA & BE (JVV Aruna Kumar)	16/05/2023

RECORD OF REVISIONS

Rev. No.	DATE	Clause No.	Details of Revision
00	20/11/2017	---	Fresh issue
01	03/09/2018	1.0	Scope modified to bring more clarity
		2.0	Cl. 2 modified to bring creep requirements for all suppliers, additional labs are listed and Table 2 modified in line with the changes proposed in the new IBR draft.
02	01/03/2021	2.0	i. Table 1 Creep Stress rupture testing Requirements modified in line with the creep data values as per latest ASME BPVC 2019 Section IID ii. d) Modified the sample requirement
03	***16/05/2023***	***2.0***	***i. Table 1 Creep Stress rupture testing Requirements modified in line with service temperature.*** ***ii. Creep rupture stress for Forgings included***

1.0 SCOPE

a) Creep testing is required as per IBR for all alloy & stainless steels materials which are to be used in furnace or in super heater zone of boilers being erected in India.
Hence, for our current boiler design, creep testing is required for tubes & forged finned elbows only.

b) If the creep properties are established either by the mill on the starting raw material or by supplier on the finished product, then creep test reports shall meet the requirements of Clause 2.

c) If the starting material is sourced from any mill which has not established creep properties, then creep testing shall be done as per Clause 2 on the product. If the Test results are meeting the requirements, then it can be treated as an approval of the creep values for the Mill which has supplied the starting material.

2.0 CREEP TESTING REQUIREMENTS

Creep testing shall be done in line with the following:

For the starting raw material (Ingot, billet, bloom, etc.), supplier/s shall produce the Creep (stress rupture) test report for each material grade being supplied by them as per the Table 1 given below:

Table 1. Creep Stress rupture testing Requirements

Sl. no	Grade	Testing temperature(°C)	Min Rupture Stress, S_{Rmin} *(in MPa)*
A	Tubes		
1	SA213 T11	540	115
2	SA213 T12	585	84
3	SA213 T22	610	66
4	SA213 T23	600	128
5	SA213 T91	665	60
6	SA213 T92	665	93
7	SA213 TP347H	695	81
8	SA213 S30432	705	105
B	Forgings		
1	SA182 F22 Cl.3	550	127
2	SA336 F22 Cl.3	550	127
3	SA182 F91	550	160
4	SA336 F91	550	160
5	SA182 F92	550	164
6	SA336 F92	550	164
7	SA182 F304	550	120
8	SA182 F316	550	129

a) For steels produced indigenously, creep testing shall be carried out at National Metallurgical Laboratory, Jamshedpur, Corporate Research & Development Laboratory of Bharat Heavy Electricals Limited, Hyderabad, Well Known Steel Makers or any other Material Testing Laboratory recognized by the Central Boilers Board.

b) For steels produced outside India, creep testing shall be carried out at Well Known Steel Makers, nationally recognized / accredited testing laboratory in the country of manufacture. Alternatively, the testing can also be done in any other laboratory if the tests are witnessed by a Competent Person working with IBR Authorized Inspection Agencies.

c) Creep testing shall be done as per ASTM E139 (latest) or BS EN ISO 204 (latest).
d) Two Test specimens each shall be prepared from the test bar preferably M10 round sample. Test bars for sampling shall be stamped by BHEL or BHEL authorised TPIA, as necessary.
e) **Acceptance Criteria:** Both the samples tested shall not rupture and shall meet the creep requirements at 1,000 hours of testing at indicated temperatures & stress values as per Table 1.
f) Reporting: As per Table 2.

Table 2. Suggested/Recommended Format for Reporting the Creep Testing Data:

Sl No	Description	Details/Results
1	Report No. Date:	
2	Name and Address of the Tube/ Forged Finned Elbow/ forgings Manufacturer	
3	Name and Address of the Raw Material Supplier	
4	Material Specification & Grade (Code Case, if applicable)	
5	Heat/Melt No, Sl No (if applicable)	
6	Heat treatment details (Type & Temperature)	
7	Name and Address of Testing Laboratory	
8	Testing method/ Standard (ASTM E139 or BS EN ISO 204) & Revision/Edition	
9	Test Sample Size	
10	No. of test samples	
11	Temperature at which test is conducted (^{0}C)	
12	Stress value observed (MPa)	
13	Test Start Date & Time	
14	Test End/Reporting Date & Time	
15	Test duration (hours of creep testing)	
16	Test witnessed by (Name of Inspector & Agency)	
17	Test Result (Accepted/Not Accepted)	