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.

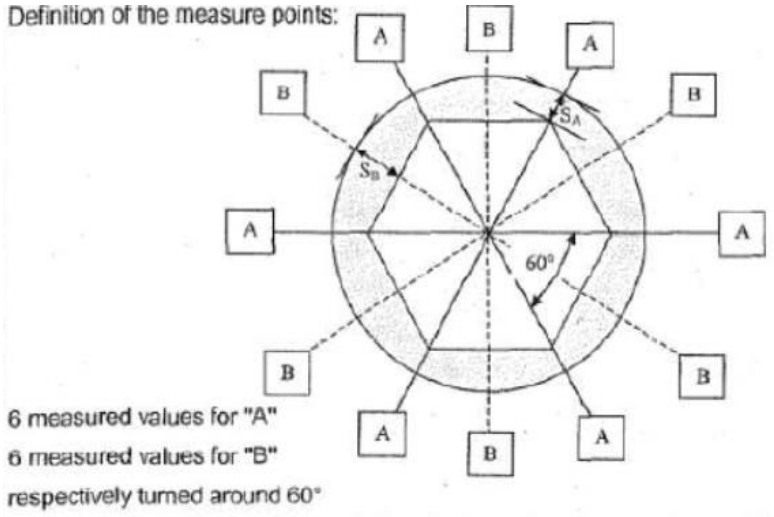

Fig. 1

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) **<u>Charpy Impact V-Notch Test at the mill as per SA 370 for SA 213 T23:</u>**

- **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 106.

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.

30/10/24	30/10/2024	30/10/2024	30/10/24	30/10/2024	30/10/2024
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
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	24.05.2018 Vaibhav Saxena	24/5/2018 J. V. V. Aruna Kumar	24/5/18 Amit Roy

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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Technical: Seamless Tubes & Pipes Suppliers
(Carbon / Alloy / Stainless Steel)
Supplier Facility Report

1. Name of the Company

2. Address of the Registered Office
(Telephone, E-Mail, Fax)

3. Factory Location and Address
(Telephone, E-Mail, Fax)

4. **Installed Capacity (Tonnes / Year)**

4.1) Carbon Steel

a) SA 192

b) SA 210 Gr. A1, C

c) SA 106 Gr. B, C

d) Riffled Tube / SA 210 Gr. C

4.2) Alloy Steel

a) SA 335 P11, P12, P22

b) SA 213 T11, T22

c) SA 335 P91, SA 213 T91

d) SA 335 P23, P92

e) SA 213 T23, T92

f) Riffled Tube /
SA 213 T12, T22, T23

4.3) Stainless Steel

a) SA 213 TP 304H

b) SA 213 TP 347H

c) SA 213 TP 347HFG

d) Super 304H

5. **Are you making your own steel (Bloom) for making Tubes / Pipes ?** YES ☐ NO ☐

6. If yes, for Sl. No. 5

   a) Type of Furnace

   b) Capacity of furnaces (Metric Tonnes / Melt)

   c) Facility for manufacture of Blooms

7. If No, for Sl. No. 5

   a) Source of Raw Material (Blooms)

8. **Tube / Pipe Manufacturing Facility details**

   8.1 Capacity of the rolling mill with respect to Diameter (Minimum and Maximum), Thickness (Minimum and Maximum) and Length (Maximum)

   a) Through Hot Finishing

   b) Through Cold Finishing

   8.2 Type & Make of Hot Mill along with the details of the Individual Equipments

   8.3 Type & Make of Cold Mill along with the details of the Individual Equipments

9. **Heat Treatment Facility Details**

   a) Capacity of the Furnaces

   b) Type of Heat Treatment Carried out (Batch or Continuous)

10. **In House Testing Equipments Details**

   a) Online UT Facilities

   b) Online Eddy Current (EC) Facility

   c) Hydro Test Facilities (Indicate the Maximum Pressure)

   d) Chemical and Mechanical Testing Facilities

11. **Details of Accreditation for Quality Systems (Like ISO, ASME, API etc.,)**

12. Are you Approved by any Third Party / Statutory Agency ?
If so, specify the Agency **(Attach details in ENGLISH)**

13. Have you manufactured the following Size / Specification / Length to BHEL or any other well-known Boiler Manufacturer for Boiler Application
Please provide the details of to whom, when and how much supplied.

a) TUBES:

TUBES REQUIREMENT- LENGTH : 6500 mm to 13800 mm			
SL. NO.	**OUTER DIAMETER**	**WALL THICKNESS**	**SPECIFICATION**
1	21.3 to 73.01 mm	2.11 to 14.02 mm	SA 106 Gr B / Gr C (Carbon Steel) SA 335 P12, P22, P23, P91, P92 (Alloy Steel)
2	28.6 to 76.1 mm	3.2 to 12.5 mm	SA 192 / SA 210 Gr A1 / Gr C (Carbon Steel) SA 210 Gr. C (Rifle Tubes) SA 213 T12, T22, T23 (Alloy Rifle Tubes)
3	14 to 76.1 mm	3.2 to 12.5 mm	SA 213 T11, T22, T23, T91, T92 (Alloy Steel) SA 213 TP 304 H, TP 347 H, TP 347 HFG, Super 304 H (SS)

b) PIPES:

PIPES REQUIREMENT – LENGTH 3000 mm to 9000 mm			
SL. NO.	**OUTER DIAMETER**	**WALL THICKNESS**	**SPECIFICATION**
1	88.9 to 864.00 mm	3.96 to 148.0 mm	SA106 Gr B / Gr C (Carbon Steel)
2	88.9 to 965.00 mm	3.96 to 130.0 mm	SA335 P11, P12, P22, P23 (Alloy Steel)
3	127.0 to 812.8 mm	11.50 to 100.00 mm	SA335 P91, P92 (Alloy Steel)
4	88.9 to 323.9 mm	3.05 to 12.5 mm	SA312 TP304H, 321 H, 316 (SS)

14. Please go thro the attached **Technical Delivery Condition (TDC)** and give point-by-point confirmation.

a) For Tubes: TDC: 0:102, 0:105, 0:119

b) For Pipes: TDC: 0:101, TDG: 32, TDG: 100, TDG: 101, TDG: 26, TDG: 6876

PLACE :

DATE :

SIGNATURE WITH SEAL

NOTE: Enclose Additional Sheets / Annexures wherever required referring the Sl. No. of this format.

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BHARAT HEAVY ELECTRICALS LIMITED
MM/RM/PURCHASE/TUBES

Ref: MM: Pur:Tubes:Rev 06 **Dt:19.02.2024**

Pre-Qualification requirements (POR) for the procurement of Seamless Carbon Steel/Alloy Steel/Stainless Steel Tubes through Open Tender (As per TDC: 102 ~~Rev 20~~) Rev 21.

A) **Organizational Capability:**

1. Manufacturers having tube mill are only eligible to participate. Offer from traders, fabricators and stockists are not acceptable and will not be considered for evaluation.

2. If the supplier is having only cold mill facility for conversion of mother hollows to finished tubes, the raw material mother hollows shall be sourced from BHEL approved tube suppliers only. However for NTPC projects mother hollows shall be sourced from NTPC approved tube suppliers only (List attached). The source of mother hollow shall be declared along with the offer for BHEL approval. For the submitted mother hollow sources, the supplier shall submit original test certificate/s of mother hollow along with product test certificate/s.

3. If the supplier is not having steel making facility, then source of raw material for the 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 the sources should be indicated, and the supplies should be restricted to the indicated list of raw material sources.

4. As per the Steel and Steel Products (Quality Control) Order-2020 dt 27.05.2020 issued by Ministry of Steel, Government of India, all stainless steel tubes shall be made from the stainless steel products (billets/blooms) confirming to equivalent IS standards. IS marked raw material MTC (billets/blooms) shall be submitted along with product test certificate/s

5. Vendor to indicate the nature of the firm. Product catalogue shall be submitted.

6. Suppliers shall submit filled in supplier facility report for Tube mill (Format enclosed). Suppliers without basic manufacturing facilities in-house, shall not be considered for evaluation. In house facilities for Heat treatment & Non-Destructive Testing (On-line UT & Online Thickness Measurement facility for Tubes) are mandatory requirements for consideration of the offer.

7. Chemical, Mechanical testing shall be done in house or at Labs certified as per ISO 17025 or Government approved labs.

8. Suppliers shall submit a valid ISO 9001 certificate or Quality Assurance Manual or Written down procedure.

9. BHEL/End customer reserve 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.

10. BHEL/End customer reserves the right to inspect the first lot of materials at vendor's works for giving clearance before bulk production.

11. BHEL reserves the right to visit supplier's works to audit and inspect to ensure the capability for technical evaluation.

K BHUVANADEVI
Senior Manager / Planning / RM
Materials Management
Bharat Heavy Electricals Limited
Tiruchirappalli, Tamil Nadu - 620 014

Dr. T. SRIHARSHA
MANAGER
BUSINESS EXCELLENCE
BHEL TRICHY 620 014
19/02/2024

Ref: MM: Pur:Tubes:Rev 06 **Dt: 19.02.2024**

Pre-Qualification requirements (POR) for the procurement of Seamless Carbon Steel/Alloy Steel/Stainless Steel Tubes through Open Tender (As per TDC: 102 ~~Rev 20~~ Rev 21)

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. Suppliers shall submit manufacturing process flow chart (Raw material to finished product) & manufacturing quality plan to meet the TDC requirements along with technical bid.

3. Suppliers shall submit the experienced manpower details specific to Manufacturing, Quality and NDE requirements.

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, SUPER 304 – UNS No. S30432): Either in SA213TP347H or SUPER 304 (UNS No. S30432) Grades
   g. 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 shall be submitted as mentioned above in Clause C2.

5. Unpriced PO copies & Proof of supply (such as invoice / bill of lading copies and sample test certificates) covering minimum and maximum sizes meeting the tendered size requirements shall be submitted as mentioned above in Clause C2.

6. 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 BHUVANADEVI
Senior Manager / Planning / RM
Materials Management
Bharat Heavy Electricals Limited
Tiruchirappalli, Tamil Nadu - 620 014

Dr. T. SRIHARSHA
MANAGER
BUSINESS EXCELLENCE
BHEL, Trichy - 620 014
19/02/2024

Ref: MM: Pur:Tubes:Rev 06 **Dt:19.02.2024**

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 earlier).

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.

K BHUVANADEVI
Senior Manager / Planning / RM
Materials Management
Bharat Heavy Electricals Limited
Tiruchirappalli, Tamil Nadu - 620 014

19/02/2024

Dr. T. SRIHARSHA
MANAGER
BUSINESS EXCELLENCE
BHEL, Trichy - 620 014

LIST OF BHEL APPROVED RAW MATERIAL MOTHER HOLLOW SUPPLIERS

HEAVY METALS & TUBES LTD
KIRLOSKAR FERROUS INDUSTRIES LTD
MAHARASHTRA SEAMLESS LIMITED
JINDAL SAW LTD
SHENGTAK NEW MATERIALS CO LTD / CHINA
CHANGZHOU CHANGBAO PRECISION / CHINA
YANGZHOU LONTRIN ENERGY EQUIPMENT / CHINA
JIANGSU CHENGDE STEEL TUBE SHARE CO / CHINA
HENGYANG VALIN STEEL TUBE CO LTD / CHINA
VALLOUREC TUBES / FRANCE
SUMITOMO CORPORATION (Mill : NIPPON STEEL/ JAPAN)
TUBOS REUNIDOS GROUP S.L.U. / SPAIN

Description	Package	Total Quantity	Lot 1 (50% of ordered quantity)	Lot 2 (25% of ordered quantity)	Lot 3 (25% of ordered quantity)
TUBE 50.8 X 7.62 X 10000 SA210GRC	Package 1	293000	146500	73250	73250
TUBE OD 57.15 X 9.6 X 10000 SA210GRC	Package 2	28440	14220	7110	7110
TUBE OD 57.15 X 9.6 X 10200 SA210GRC		11546.4	5773.2	2886.6	2886.6
		Delivery Schedule	60 days from PO date	75 days from PO date	90 days from PO date

Considering the above, restrictive delivery condition is applicable and LD will be applicable as per delivery date of each Lot as detailed above. If any bidder quote more than above delivery period, their offer will not be considered.

Item No. 2 & 3 combined will be considered as a package and bidder has to submit the quote for both the items mandatorily in case submitting bid for any of these two items. Otherwise, the offer will be rejected for Item No. 2 & 3.

The ordering for line item No.1 will be split in the ratio of 60% and 40% between L1 and L2 vendor provided L2 vendor matches the L1 price. Otherwise, the entire quantity will be ordered on L1 vendor.