SUPPLIER LIST FOR MOTHER HOLLOWS			
MATERIAL CATEGORY	VENDOR NAME	COUNTRY	SIZE DETAIL
ALLOY STEEL UPTO GRADE 22	ISMT LIMITED,	India	OD>6; WT>0.5
ALLOY STEEL UPTO GRADE 22	SHENGTAK NEW MATERIALS CO LTD	China	UPTO GR. 22 - OD:UPTO 76.1 MM, WT: 3.6 TO 15.0 MM, LENGTH: MAX 18 MTR.
ALLOY STEEL UPTO GRADE 22	JINDAL SAW LTD.,	India	OD>21.3; WT>2.5;
ALLOY STEEL UPTO GRADE 22	HEAVY METALS & TUBES LTD UNIT-III,	India	OD: EQUAL TO OR LESS THAN 76.2 MM, THICK: UPTO 12 MM
ALLOY STEEL UPTO GRADE 22	CHANGZHOU CHANGBAO PRECISION	China	UPTO OD: 88.9MM
ALLOY STEEL UPTO GRADE 22	YANGZHOU LONTRIN STEEL	China	FULL RANGE
ALLOY STEEL UPTO GRADE 22	SUMITOMO CORPORATION (NSSMC)	Japan	OD > 15.9, WT > 1.4
ALLOY STEEL UPTO GRADE 22	JIANGSU CHENGDE STEEL TUBE SHARE CO	China	OD> 21.3; WT>2.5
ALLOY STEEL UPTO GRADE 22	VALLOUREC TUBES FRANCE	France	OD:21.3 TO 181.7 MM, WT: 2 TO 32 MM
ALLOY STEEL UPTO GRADE 22	TUBOS REUNIDOS INDUSTRIAL S.L.U.	Spain	OD > 6; WT > 0.5
ALLOY STEEL UPTO GRADE 22	BENTELER STEEL / TUBE GmBH	Germany	HFS: OD>21.3; WT>2; CDS: OD > 4; WT>0.5
ALLOY STEEL UPTO GRADE 22	HENGYANG STEEL TUBE GROUP INT'L	China	FULL RANGE

BHASKARNATH BISWAS

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Date: 2021.07.20 15:13:47 +05'30'

BHARAT HEAVY ELECTRICALS LIMITED
MM/RM/PURCHASE/TUBES

Ref: MM: Pur:Tubes:Rev 03 **Dt:01.03.2021**

Pre-Qualification requirements (POR) for the procurement of Seamless Carbon Steel/Alloy Steel/Stainless Steel Tubes through Open Tender (As per TDC: 102 Rev 18)

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. (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.

B) **Technical Competence:**

1. Point by point confirmation to the TDC requirements is mandatory for consideration of offer and signed TDC shall be submitted.

01/03/2021
AKHIL. K. DAS
Sr. Engineer
Materials Management / BHEL
BHEL, TRICHY - 620 014.

01/03/2021
SHYAMALADEVI.S
Deputy Manager
Quality Assurance
BHEL, TRICHY - 620 014

Pre-Qualification requirements (POR) for the procurement of Seamless Carbon Steel/Alloy Steel/Stainless Steel Tubes through Open Tender (As per TDC: 102 Rev 18)

2. Suppliers shall submit manufacturing process flow chart from Raw material (Billets or Blooms) to finished product 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): Either in SA213TP347H or SUPER 304 (UNS No. S30432).
   g. For Stainless Steel Tubes (SUPER 304 - UNS No. S30432): In respective grade SUPER 304 (UNS No. S30432)
   h. For other Stainless Steel Tubes: 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.

D) **Financial Soundness:**

1. Indigenous suppliers shall submit Audited copies of annual reports (Balance Sheets), Profit & Loss statement for the last four 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.

01/03/2021
AKHIL. K. DAS
Sr. Engineer
Materials Management /
BHEL, TRICHY - 620 014.

01/03/2021
SHYAMALADEVI .S
Deputy Manager
Quality Assurance
BHEL, TRICHY - 620 014

ANNEXURE - V

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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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.

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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 and T92 (Code Case: 2179).
Stainless Steel (SS)	: SA 213 TP 304H, 316, 321, 321H, 347H; UNS No: S30432 (Code Case: 2328, Super 304).
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 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. All 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 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:

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

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.

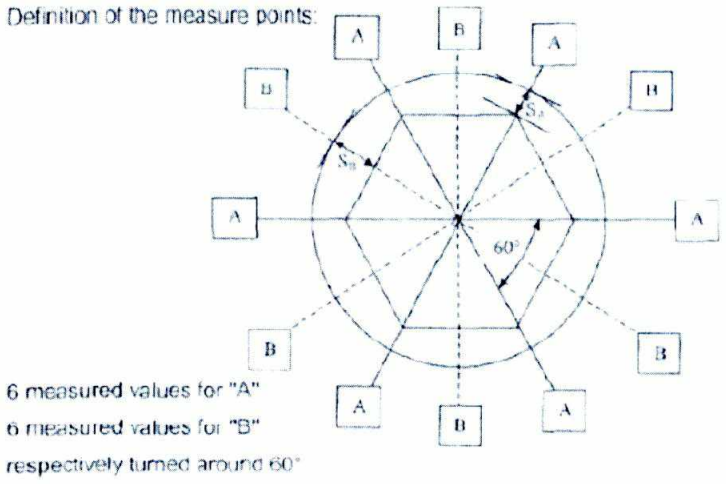

Fig. 1

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°C), fully annealed or normalized.

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

6. INSIDE SHOT PEENING FOR ALL STAINLESS STEEL TUBES OF SA213 TP347H and SA213 UNS No: S30432 (Code Case: 2328, Super 304):

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-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°C.
- **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 ***for all alloy steel and stainless steel tubes*** out 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 pressure for all grades shall be calculated*** as per SA 450 Cl ***23.3*** with S=80% of specified min. yield strength at room temperature. For others if specified in Purchase Order. Acceptance: No leak shall be permitted.

10. FINISH AND REPAIR

Inside and outside surfaces are shall be free from scales and 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 workmanlike 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. 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:

Tubes of thickness $\leq$ 2.5mm, shall be packed in boxes and others in bundles. Tubes of thickness $\geq$6.5 mm and OD $\geq$ 88.9 can be shipped loose. Bundles to be $\leq$ 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. Wooden pallets/cardboard to cover tubes are not permitted.

14. INSPECTION AND CERTIFICATION:

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

14.2 Certification in IBR Form III-B for finished tubes from "IBR-Well Known Tube 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: 4-03-000-00061 (Latest Rev) for MAWP values for various material grades & sizes at various temperatures.

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 minimum of 1,000 hours as per Cl. 5(f) (only for IBR applications).
k) Mill test certificate 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.

14.4 For SS: Measured Radioactivity levels shall 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.

05/08/2019	05/08/2019	S. Anand Kumar 5/8/19	05/08/19	5/8/2019
Abdur Rahman	M. Nadanakumar	S. Anand Kumar	R. Dharmar	JVV Aruna Kumar
Sr. Engr/QA	AGM/MM	SDGM/PE/FB	AGM/QC	SDGM/QA
Prepared By	**Reviewed by**			**Approved By**