



PRODUCT STANDARD  
MANUFACTURING AND TESTING

HE – 54030

Rev.

00

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CONDENSER HEAT EXCHANGER  
ENGG. DIVISION - THERMAL GROUP  
B.H.E. L.  
BHOPAL

Technical Specification for

**INTERGAL LOW FIN CARBON STEEL U-TUBES**

**1.0 Material**

Integral Low Fin carbon steel U-Tubes to **DIN 17175** St 35.8 Grade III latest edition (as specified on ordering drawing). The tube shall conform to the applicable requirements of **DIN 17175**. Tubes shall be supplied in heat treated condition.

**2.0 Size**

As specified in Enquiry/Purchase Order / Tube ordering drawing.

**3.0 Quantity**

As specified in Enquiry/ Purchase Order.

**4.0 Application**

Integral low fin Carbon Steel U-tubes (as per drawing), are required for use as in High Pressure Steam Reheaters. Tubes when inserted in tube plate, shall withstand roller expansion, bending without showing cracks, or flaws and welding with tube plate.

**5.0 Process**

Carbon U-steel tubes shall be made by the seamless process and shall be cold drawn.

Hot bending to form U-Tubes is Not Acceptable.

**6.0 Finish & Workmanship**

6.1 The material shall be free from injurious defects, shall have a workman like appearance & shall conform to the designated finish.

6.2 The inside and outside surface of tubes shall be concentric, smooth and finish on both outside and inside surface of tubes shall be **1.6 microns** or, **better**

6.3 Permissible variation in dimensions of U-tube shall be as per the tube drawing.

6.4 The wall thickness of the tube in the U-bend section shall not be less than the value determined by the equation :

$$T = \frac{T_o \times 4 \times R}{(4 \times R + D)}$$

Where;

**T** = Wall thickness after bending, mm.

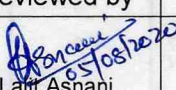
**T<sub>o</sub>** = Specified minimum tube wall thickness.

**R** = Centre line bend radius, mm

**D** = Nominal outside diameter of tube, mm.

**6.5 Integral fin profile / geometry :**

Integral fin shall be developed by rolling process. Fin geometry / parameters shall be as per the details indicated in the tube drawing. Dimensions / fin parameters shall be measured, recorded & furnished with the final report.

Date	Rev. history	Distribution	APPROVED BY : PRODUCT STANDARDIZATION COMMITTEE CDE BHEL BHOPAL			
		CDE	1	Prepared by	Reviewed by	Approved by
		HCM	1			Date
		QTF	1	 Brajendra Yadav Dy. Manager - CDE	 Lalit Ashani DGM - CDE	 S P Vatsa AGM- CDE
						05.08.2020



7.0 **Heat Treatment**

Straight tubes shall be cleaned before heat treatment. Heat treatment of straight tubes shall be carried out by normalizing.

7.1 **Normalising**

Tubes shall be normalized by uniformly heating to a temperature and cooled (as appropriate for the grade) to meet the requirement of spec. **DIN 17175** St 35.8 Grade III.

7.3 **Annealing of U-Bends**

U-bend portion of each tube shall be annealed. Annealing temperature shall be **as per DIN 17175**. Annealing shall include bend portion plus a minimum of 150 mm of straight length of each leg beyond the point of tangency to the bend. The tubes shall be cleaned thoroughly prior to annealing.

7.4 If annealing of U- bend is accomplished by electric resistance method, no arc burns or, copper deposits from clamps shall be allowed.

8.0 **Non-Destructive Examinations (NDE)**

8.1 Each finished plain straight tube shall be examined by **Non-Destructive Examinations** covering the entire length, as per **DIN 17175**. Supplier to submit procedure for BHEL/NPCIL approval

9.0 **Testing**

9.1 Tubes shall be tested for chemical composition and mechanical properties in finished condition as per **DIN 17175** St 35.8 Grade III: Latest.

9.2 All mechanical tests on finished tubes, shall be done as specified in material specification, as per requirements for quality grade III. All tests shall be performed in NABL /BHEL approved laboratories only (for indigenous supplier) / reputed international laboratories (for foreign suppliers).

9.3 Each finished finned straight tube or U-tube, upon completion of bending and annealing operations, shall be hydrostatically tested at the pressure specified on the tube ordering drawing, using chloride free/clean water.

9.4 One tube of minimum bend radius & one tube of maximum bend radius, shall be sectioned and checked for ovality & thickness at bend, before commencing bending operation.





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**10.0 Inspection**

10.1 Vendor shall institute and enforce quality measures.

10.2 Vendor shall prepare QA plan in line with the ref. QA plan. Manufacturing / Inspection shall be carried out as per BHEL/NPCIL approved QA Plan. All the facilities shall be provided by the vendor for stage wise and final inspection. The scope of QAP activities and inspection shall be as per approved QA plan only without commercial implication.

10.3 Plain tubes & finned tubes shall be subjected to stage & final inspected M/s BHEL TPIA & M/s NPCIL/NPCIL appointed agency (for indigenous supplier) & M/s LLOYDS/SGS/BVQI/TUV etc. (for foreign supplier) as per the approved QAP as mentioned in the purchase order and co-related test certificates duly signed by the inspection agency, shall also be furnished along with the other test certificates.

10.4 No shipment shall be made without specific clearance / approval by Inspection Agency, unless otherwise it is waived-off in writing by BHEL.

**11.0 Test Certificates**

Four (4) copies of test certificates, covering the following tests, duly signed by the Inspection Agency, shall be furnished.

- Chemical composition check ( product analysis)
- Heat Treatment Record.
- All mechanical test Reports.
- Fin Dimensions / parameters.
- Non-Destructive Examinations Report.
- UT report of Bare Tubes.
- Dimensional check Record.
- Hydrostatic Test reports.

***All the test certificates duly compiled, shall be submitted with index in a plastic cover file for ease in review, handling & maintaining record.***

**12.0 Packing & Marking**

12.1 All tubes shall be shipped in containers made up of well seasoned wood free from protruding nails and other objectionable projections. Tube shall be packed with bags of silica gel distributed along the length of the tube and on inside of the case to avoid movement and rubbing. Each layer shall be separated from other layers throughout the length. The case shall be suitable constructed so as to prevent excessive bending during lifting.

The lid of packing case shall be suitably fixed to the case, rendering the case completely water proof. Each package shall be of convenient weight for ease in handling. Weight of each case shall not normally exceed **3000 kgs.** (Gross).

Package detail shall generally comply to BHEL Corporate Spec. **AA-0490003.**





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12.2 Each tube shall be marked with following information on at least one plain ends of each tube.

"Material Specification, Tube size, Drawing Number & Item Number".

12.3 Each shipping unit shall be marked with the following;

"Purchase Order No., Material Specification, Overall Dimensions, Gross & Net Weight, Vendor's name & Heat No."

In case of box containing tubes of more than one heat, tubes of each heat shall be separately bundled and identified with the heat number.

12.4 Both ends of each tube to be provided with end caps.

### 13.0 Documents required with the Offer

- Tube manufacturing process indicating processing from raw material / mother hollows to finished product stage.
- Source of procurement of plain tubes.
- Heat Treatment procedure indicating type & details of furnace.
- Non-Destructive Examinations procedure.
- Tube Finning process details.
- Information required as detailed in Annexure-A to HE-54030.

## Annexure-A to HE-54030

### INFORMATION / CONFIRMATION REQUIRED FOR ALL POINTS

- 1.0 Vendor is having in-house facility to manufacture finished seamless **low integral finned tubes**. ..... Yes / No
- Indian vendor should carry out all the testing (as called in spec. HE-54030) in lab accredited by NABL only. .... Yes / No
- Foreign vendor should carry out all the testing (as called in spec. HE-54030) in lab accredited as per ISE / IEC-17025 / equivalent. In case testing to be done at own in house lab, same should be of international repute. .... Yes / No
- 2.0 If vendor is procuring base CS tube from sub vendor, the source should be mentioned and credentials of base tube vendor (i.e. manufacturer) shall be furnished. The base tube manufacturer should have supply experience for this particular or equivalent grade for at-least 2 projects during last 3 years (ending last day of month previous to the one in which applications are invited) for tube thickness of more than 2mm.
- Name and all credential of base tube supplier ..... Yes / No
- (e.g. facility, list of supplies, testing facilities, etc.) furnished
- 3.0 Vendor is having calibrated online HT Furnace ..... Yes / No
- 4.0 Vendor is having online eddy current testing facility (especially for base tube). ..... Yes / No
- 5.0 Only calibrated instruments (e.g. Thermocouple, Temp. recorder, gauges, etc.) shall be used during inspection. .... Yes / No
- 6.0 In case of order, BHEL shall require sample tubes (complying all PO/ Enq. Requirements) before accepting the bulk quantity. .... Yes / No
- Vendor shall send the same to BHEL before start of bulk production for final acceptance ..... Yes / No
- 7.0 Co-related shadow graphic report of sample tubes shall also be furnished along-with the sample tubes. .... Yes / No
- 8.0 NDT to be done by ISNT / ASNT Level-II personnel (as minimum) ..... Yes / No
- 9.0 Confirm all requirements as stated in Spec. HE-54030 Rev.00 ..... Yes / No
- 10.0 Submitted all documents as called in Cl.13.0 of HE-54030 Rev.00 ..... Yes / No
- 11.0 **List clearly for deviation if any from BHEL requirements.** ..... / No  
deviation.  
**Otherwise it will be presumed that the offer is in line with the enquiry / PO requirements.**

Signed and stamped by supplier