

**SUGGESTIVE QUALITY ASSURANCE PLAN (QAP)-FOR
SEAMLESS ANNEALED INCOLOY-800 TUBES FOR D20 HXs
(SIZE: 12.6 mm OD x 1.15mm Thick).**

SR. NO.	DESCRIPTION OF OPERATION	REFERECE DOCUMENT	INSPECTION			REMARKS
			Mfg-QC	BHEL- QC	NPC-QS	
1.	Approval of documents-QAPS, drawings, procedures etc.	Tender document	H	H	H	
RAW MATERIAL MAUFACTURING						
2.	Primary melting in an electric furnace.	Mfg. Procedure	H	H		
3.	Ladle/Heat –Chemical analysis		H	H	R	
4.	Secondary re-melting i.e.,by Electro Slag Re-melting (ESR) or any other suitable method.		H	H		
5.	Ultrasonic Examination of round bars for internal soundness. (Sufficient discard on ends shall be made to ensure freedom from cavities and slag inclusions)	Std./Approved Procedure	H	H	H	
6.	Selection of test pieces	Spec/Std.	H	H	H	
6.1	Check (Chemical) analysis on bars	Spec/Std.	H	H	W	
6.2	Macro etching test from each end of bar	Spec/Std.	H	H	W	
7.	Release of raw material (bars) for further processing.		H	H	H	
HOT EXTRUDED HOLLOWS MAUFACTURING						
8.	Raw material receiving inspection- Documents correlations and visual.	Documents/SR	H	H	H	
9.	Billet preparation and degreasing	Mfg. Procedure	H	H		
10.	Billets heating in a non-oxidizing furnace for extrusion		H	H		
11.	Hot extrusion to Hollows		H	H		
12.	Salt bath pickling/deglassing/water rinsing		H	H		
13.	Straightening (Hollows conditioning OD and / or ID grinding).		H	H		

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14.	Hollows Visual Inspection		H	H	W	
15.	Release of hollows for further processing.		H	H	H	
TUBES MAUFACTURING						
16.	Hollows receiving inspection-documents correlations and visual.	Documents /SR	H	H	H	
17.	Cold Pilgering to produce tubes (Note: No. of pilgering stages shall be as per tube manufacturer's practice to achieve final product)	Mfg. Procedure	H	H		
18.	Degreasing after each stage of pilgering		H	H		
19.	Process annealing/intermediate stage heat treatment	Approved Procedure	H	H	R	
20.	Straightening	Mfg. Procedure	H	H		
21.	ID vacuum blasting and OD grinding		H	H		
22.	Tubes cleaning/water rinsing		H	H		
23.	Visual inspection		H	H		
24.	Final cold pilgering		H	H		
25.	ID and OD degreasing		H	H		
26.	Individual tube marking		H	H		
27.	Final Mill annealing / Bright annealing	Approved Procedure	H	H		
28.	Straightening	Mfg. Procedure	H	H		
29.	ID vacuum blasting (if required) and OD belt grinding and cleaning		H	H		
30.	Final cold drawing (12.6 mm OD x1.15mm Wall Thickness)		H	H		
31.	Straightening, OD degreasing		H	H		
32.	Straight tubes cutting to length, considering the additional requirements for testing etc.		H	H		
33.	NDE-Ultrasonic Examination for volumetric soundness and dimensions-OD, WT, etc.	Approved Procedure	H	H	H	

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			Mfg-QC	BHEL-QC	NPC-QS	
34.	Preparation of illustrated defects catalogue	Approved Procedure	H	H	H	
35.	Sampling for testing	Spec.	H	H	H	
35.1	Product (Chemical) analysis	Spec./Std.	H	H	R	
35.2	Tensile test at room temperature	Spec./Std.	H	H	H	
35.3	Tensile test at elevated temperature (350°C)	Spec./Std.	H	H	H	
35.4	Hardness test (cl-4.13.3 bend area: sampling plan – random)	Spec./Std.	H	H	H	
35.5	Micro structure and grain size	Spec./Std.	H	H	H	
35.6	Inter Granular Corrosion test (IGC)	Spec./Std.	H	H	H	
35.7	Stress Corrosion Cracking (SCC) test-100hrs. Also, SCC test to determine the time required for initiation of crack or maximum of 500 hrs.	Spec./Std.	H	H	H	
36.	Hydrostatic test of straight tubes which are not going to be bent.	Approved Procedure	H	H	H	
37.	Inspection of straight tubes (Visual, Straightness, OD, WT, etc.) before release for bending	Spec./Procedure	H	H	H	
38.	Ensure Bending procedure qualification is available.	Approved Procedure	H	H	H	
39.	Bending of tubes as per qualified procedure.	Approved Procedure	H	H	H	
40	Inspection of tubes for dimensions (OD,WT), Eccentricity, Ovality, Out of Roundness, bend radius, surface defects etc. as per specification requirements	Spec./Procedure	H	H	H	
41.	Cutting to length and marking	Mfg. Procedure	H	H	H	
42.	Flare test on both ends of each tube including discolorations checking (Note_ After cutting tubes for flare test, both ends shall be cleaned, de-burred etc.)	Spec./Procedure	H	H	H	
43.	Ball Pass Testing each tube with ball of dia. Given in tender documents.	Approved Procedure	H	H	H	

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44.	Residual stress measurements on finished tubes.	Spec./Procedure	H	H	H	
45.	Contamination measurement such as chloride, SiO ₂ , halogens, sulphur and lead etc.	Spec./ Procedure	H	H	H	
46.	Surface roughness measurement (Inside and Outside surface)	Spec./ Procedure	H	H	H	
47.	Adjustment of U-bends, cutting to specified length and marking of U-bends.	Spec./ Procedure	H	H	W	
48.	Inspection of all U-bend tubes of each row simultaneously on surface plate for uniform gaps in free condition.	Approved Procedure	H	H	H	
49.	Liquid Penetrant Examination (LPE) of U-bend tubes including 150 mm straight length beyond the bend portion and at both open ends, length equal to tube sheet thickness of each type HX + 20mm.	Approved Procedure	H	H	H	
50.	Final dimensional inspection, visual & borescope (ID) inspection and material mix up/alloy mix up verification test of U-bend tubes	Spec./ Procedure	H	H	H	
51.	Final Cleaning (ID & OD) and Cleanliness check/swipe test	Spec./ Procedure	H	H	H	
52.	Final Identification Marking (Note: Tube identification shall be unique i.e., tube number shall not be repeated).	Spec./ Procedure	H	H	H	
53.	Special plugs insertion in each tube	Spec./ Procedure	H	H	H	
54.	Packing of tubes as per insertion sequence of tubes in Heat Exchange wise. (Note-One set of final documents shall be kept inside the first tube box of each HX set).	Approved Procedure	H	H	H	
55.	Documentations-checking of records /report, certified material test report (CMTR), certificate of compliance, documents compilations etc.	Spec.	H	H	H	
56.	Issue of Shipping Release (SR)	SR	H	H	H	

- **SCOPE AND PURPOSE:**

The purpose of this Quality Assurance Plan (QAP) is to describe general practices, resources and sequence of activities (such as raw material procurement, manufacturing/ fabrication, inspection, examination, testing, quality control, etc.) to be performed during the manufacture of the items/component. This QAP is a generic documents and should be tailored by suitable addition, deletions or modifications for specific work keeping in mind the capabilities of the manufacturer and the requirement of specifications and drawings. Inspections stages “H”/ “W”/ “R” are indicative and shall be decided by the manufacturer/vendor and NPCIL. Manufacture/Vendor shall submit detailed QAP (format attached as Annexure – 1), for items / activities including those which are not included here for approval from NPCIL. Wherever sub-contract is allowed, sub-vendor shall submit detailed QAP and other related documents for approval from equipment manufacturer and NPCIL.

- **REFERENCEDOCUMENTS (Latest Revisions):**

1. BHEL Tender Documents-Technical Specification, Tender drawings, Approved Manufacturing (MFG.) drawings, MFG Procedures and NDE Procedures etc.
2. Applicable sections of ASME code and ASTM Standards (Std.) etc.

- **INSPECTION NPCIL-QS/AUTHORISED INSPECTION AGENCY:**

- **H-HOLD – WITNESS MANDATORY.** Witness is mandatory before proceeding with further activities. This activity shall be kept under hold till inspection clearance is obtained from the agency responsible for this stage (NPCIL-QS/Authorized representative).
- **W-WITNESS NON-MANDATORY.** Witness points are critical steps in manufacturing and examinations/inspection/testing, where supplier is obliged to notify in sufficient advance of the start of the operation/test so that it may be witnessed. The supplier may proceed with the work past a witness point in consultation with NPCIL-QS or its authorized representative.
- **R-REVIEW- ONLY REPORT REQUIRED.** Report to be submitted for review.

- **INSPECTION BY MANUFACTURER/PERFORMER QC:**

- 100% Inspection by Manufacturer QC i.e., HOLD – WITNESS MANDATORY.

- **INSPECTION REPORT/ RECORD FORMATS AS APPROVED BY NPCIL.**