Name of Woks: WORKS CONTRACT FOR STUD WELDING IN PANELS AND LOOSE ITEMS AT BHEL, TRICHY.
Enquiry No: 9001700017 /30.01.2017

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI-620 014
WORKS CONTRACTS MANAGEMENT

NOTICE INVITING TENDER

1.	Tender Ref No:	9001700017 /30.01.2017
2.	Name of works	WORKS CONTRACT FOR STUD WELDING IN PANELS AND LOOSE ITEMS AT BHEL, TRICHY.
3.	Location of work	BHEL, TRICHY.
4.	Period of contract	3 months from the date of award of contract.
5.	Earnest Money Deposit	₹ 5,810/- (Rupees five thousand eight hundred and Ten only)
6.	Tender Document details	A] Technical Bid (Part-I) ANNEX-1A (Technical Bid-Qualifying Criteria) - 01 Page ANNEX -1B (Scope of Work and Technical Terms & Conditions) - 01 Page ANNEX -1C (General Terms & Conditions of Contract) - 10 Pages Annexures : SIP:PP:03, QCP:004/04 & SQP:PP:08/09 - 45 Pages B] Price Bid (Part –II) ANNEX –II (Price bid) - 01 Page
7.	Address for Sending Tender Document along with EMD.	**Senior Manager** **Works Contracts Management (WCM)** **Building 53,First Floor,** **BHEL-High Pressure Boiler Plant,** **Trichy – 620 014**
8.	Last Date for submission of Tender Document	14.02.2017 / 10:00 Hrs.
9.	Date of Technical Bid Opening	14.02.2017 / 10:30 Hrs.
10.	Date of Price Bid Opening	Will be intimated separately to Technically qualified vendors.

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INSTRUCTIONS TO THE TENDERERS

The offer should be addressed to SENIOR MANAGER, Works Contracts Management, 53 Building, BHEL, Tiruchirappalli 620 014, to reach WCM Dept. on or before **14.02.2017 at 10:00 Hrs**. or the same may be dropped in the Tender Box kept at Works Contracts Management, 53 Building, BHEL, Tiruchirappalli 620 014.

Tenders will be opened on **14.02.2017 at 10:30 Hrs**. (IST) at Works Contracts Management, 53 Building, BHEL, Tiruchirappalli 620 014. BHEL shall not be responsible for any postal delay.

Bidder has to submit (1) Part-I (Techno-Commercial bid) (2) Part-II (Price bid) & (3) EMD draft in separate covers.

a. The first envelope shall contain DD / Pay order drawn in favor of BHEL, Trichy as EMD and super scribed as EMD Cover for NIT / Enquiry No.
   Note: **1. Offer without EMD will be rejected.**
   2. EMD may be submitted in the form of DD/Pay Order /Bankers cheque drawn in favor of BHEL, Trichy (along with offer) or Electronic Fund Transfer credited in BHEL account (before Tender opening). EMD in any other form (Like FD / One Time EMD etc.) is not acceptable.
b. The second envelope shall be sealed and super scribed as Part-I (Technical Bid for NIT/Enquiry No.)
c. The third envelope shall contain only Part-II (Price bid) for the above work as per scope and to be quoted as per the format given in price bid. Any other information in price bid will not be considered. The envelope shall be sealed and super scribed as Price Bid for NIT / Enquiry No.

All the above three envelopes shall be kept into one cover ,sealed and super scribed as Tender Document for the work as per NIT (NIT/Enquiry No).

Note:

1. The contract will be awarded for a period of **3 Months** from the date of ordering.
2. The quoted rates shall be valid up to six months from date of Tender opening.
3. The rates shall remain firm for the entire period of the contract in case WO is awarded.
4. If the Contractor back outs after opening of tender, the contractor is liable for forfeiture of the EMD paid.
5. **Evaluation of the offer shall be done on "Net Cash outflow to BHEL after taking into account applicable Taxes and Duties".**
6. BHEL reserves the right to increase or decrease the tendered quantity.
7. **BHEL does not guarantee any minimum quantity.**
8. Income Tax deduction at source as applicable in the IT Act from time to time will be made on the value of the bills in the absence of Income Tax Exemption Certificate from the concerned IT officer.
9. All the Statutory Obligations such as ESI, PF, Labor Acts, Factories Act, Service Tax, etc. will have to be taken care of by the vendor. BHEL will have no liability on them. Notwithstanding the above, if any demand notice is served by the concerned Statutory Authorities for recovery of any of their dues on BHEL, the same would be paid to the statutory authorities without notice to the vendor and recovered as a due from any pending / future bills.
10. In case contract is not executed by vendor after award and acceptance of contract, BHEL may exercise the right to forfeit EMD, Security Deposit / BG of such contractors and also suitable action will be taken by BHEL on those Contractors as deemed fit.

Name of Woks: WORKS CONTRACT FOR STUD WELDING IN PANELS AND LOOSE ITEMS AT BHEL, TRICHY.
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11. **MSE VENDORS:-**

MSE suppliers can avail the intended benefits only if they submit along with the offer, attested copies of either EM II certificate having deemed validity (Five years from the date of issue of acknowledgement in EM-II) or valid NSIC certificate or EM II certificate along with attested copy of a CA certificate (Format is provided as **Annexure-A** where deemed validity of EM II certificate of five years has expired) applicable for the relevant financial year (latest audited). Date to be reckoned for determining the deemed validity will be the date of bid opening (Part 1 in case of two part bid). Non submission of such documents will lead to consideration of their bids at par with other bidders. No benefit shall be applicable for this enquiry if any deficiency in the above required documents are not submitted before price bid opening. If the tender is to be submitted through e-procurement portal, then the above required documents are to be uploaded on the portal. Documents should be notarized or attested by a Gazetted officer.

Annexure – A

Certificate by Chartered Accountant on letter head

This is to Certify that M/S …….. (Here in after referred to as 'company') having its registered office at …….. is registered under MSMED Act 2006, (Entrepreneur Memorandum No. (Part – II) ……..
Dtd: ……., Category: …… (Micro/Small). (Copy enclosed).

Further Verified from the Books of Accounts that the investment of the company as per the latest audited financial year …….. As per MSMED Act 2006 is as follows:

1. For Manufacturing Enterprises: Investment in plant and machinery (i.e. original cost excluding land and building and the items specified by the Ministry of Small Scale Industries vide its notification No. S.O.1722 (E) dated October 5, 2006 :
   Rs….Lacs.

2. For Service Enterprises: Investment in equipment (original cost excluding land and building and furniture, fittings and other items not directly related to the service rendered or as may be notified under MSMED Act, 2006 :
   Rs…Lac.

(Strike off whichever is not applicable)

The above investment of Rs. ……..Lacs is within permissible limit of Rs. …….. Lacs for…….. Micro / Small (Strike off which is not applicable) Category under MSMED Act 2006.

Or

The company has been graduated from its original category (Micro/Small) (Strike off which is not applicable) and the date of graduation of such enterprise from its original category is …….. (dd/mm/yyyy) which is within the period of 3 years from the date of graduation of such enterprise from its original category as notified vide S.O. No. 3322€ dated 01.11.2013 published in the gazette notification dated 04.11.2013 by Ministry of MSME.

Date:
(Signature)
Name –
Membership Number –
Seal of Chartered Accountant.

Name of Woks: WORKS CONTRACT FOR STUD WELDING IN PANELS AND LOOSE ITEMS AT BHEL, TRICHY.
Enquiry No: 9001700017 /30.01.2017

ANNEXURE-1A

PART-I (TECHNO COMMERCIAL BID)

Bidder Profile

1.	Name of the Agency /Company /vendor.	
2.	Address:	
3.	Phone No.:	
4.	E-mail Address:	
5.	Name and Contact details of person for communication related to Tender	
6.	BHEL Vendor Code (If any)	
7.	**PF Registration (No. & Date)** (Copy of PF Registration to be attached)	
8.	**ESI Registration (No. & Date)** (Copy of ESI Registration to be attached)	
9.	**Service Tax Registration details.** (Copy of ST registration to be attached)	

Qualifying Criteria

A	**EMD(Earnest Money Deposit) :** Amount: ₹ 5,810 /- (₹ Five thousand eight hundred and ten only) (Offer without EMD will be rejected.) (EMD will be waived off for SME/NSIC/SSI vendors upon verification.) (Copy of valid Certificate to be enclosed)	AMOUNT : ₹ DD NO: DD DATE: ISSUING BANK :
B	Valid IBR certificate for carrying out welding, issued from IBR, Tamilnadu. (Copy of certificate to be enclosed)	(Enclosed / Not enclosed)
C	**Income Tax Registration :** Income Tax registration Number (Copy of PAN to be attached)	
D	**Acceptance to Scope of Work (Annexure-1B), General Terms & Conditions of Contract (Annexure-1C).**	

Note:
1. Vendors not having PF Registration /ESI Registration / Labour License (as applicable) shall immediately get registered after award of work to comply with statutory requirements.
2. If vendor fails to get PF / ESI Registration and Labour License (As applicable) within 30 days of award of work, EMD / SD shall be forfeited and penal action shall be taken as per Extant rules of BHEL.

Contractor Signature

Contractor Seal

Name of Woks: WORKS CONTRACT FOR STUD WELDING IN PANELS AND LOOSE ITEMS AT BHEL, TRICHY.
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ANNEXURE-IB

PART-I (TECHNO COMMERCIAL BID)

SCOPE OF WORK AND TECHNICAL TERMS &CONDITIONS

A. BILL OF QUANTITY

SN	Work Description	UOM	Material Description	Stud Quantity (Nos.).
1	Stud Welding in Panels and loose tubes	NO	STUD DIA 8 X 21	55,794

B.SCOPE OF WORK& TECHNICAL TERMS AND CONDITIONS

1. Work has to be carried out at BHEL-Trichy.
2. Firm should have Valid IBR certificate for carrying out welding, issued from IBR, Tamilnadu.
3. The welding shall be done by qualified welders. The welding procedure specification (WPS) shall be reviewed and approved by BHEL QC. The welding shall be qualified in the presence of BHEL QC.
4. Contractor shall provide the required personal protective equipment to their workmen and supervisor(s) and follow the safety rules and regulations as specified by BHEL.
5. Panels will be offered to the vendor for Stud welding at unit-I /TP/B-50 and loose tubes will be offered to the vendor for Stud welding at Unit-II/TP
6. Studs, ceramic ferrule and power supply will be supplied by BHEL.
7. Arrangement of power source for studding and stud welding gun is the responsibility of contractor.
8. Stud welding should be done as per the drawing issued by BHEL.

Note:- The following Quality requirements shall be adhered by sub-contractor:

A. A sample tube of about 300 mm shall be studded using the qualified WPS approved by BHEL, prior to production.
B. The welds shall be 100% visually checked for all-round fusion.
C. Conduct Hammer Test using a 250 grams hammer. The studs shall not break at the weld. Conduct 10% quantum of check for hammer test.
D. Insert a pipe to at least 2/3 depth of the stud and bend it by applying steady manual load to the lever for 15 degree. Failure shall not occur at weld.

9. To Conduct visual inspection of weld
10. To Offer for inspection to QC-BHEL & IBR.

Contractor Signature

Contractor Seal

PART-I (TECHNO COMMERCIAL BID)

ANNEXURE-IC

Name of Vendor:

GENERAL TERMS & CONDITIONS OF CONTRACT

1. Definition:

In these General Conditions of Contract, the following terms shall have, I meaning hereby assigned to them, except where the context otherwise requires:

a) The "Contract" means, the documents forming the tender and acceptance thereof, together with all the documents referred to therein including general and special conditions to contract. All these documents as applicable taken together shall be deemed to form one contract and shall be complementary to one another.

b) The "Work" means, the work described in the tender documents in individual work orders as may be issued from time to time to the contractor by the Officer-In charge within the power conferred upon him including all notified or additional items of works and obligations to be carried out as required for the performance of contract.

c) The "contractor" means, the individual Firm or Company whether incorporated or not, undertaking the work and shall include the legal personal representatives of such individuals or the persons composing the firm or Company or the successors of the firm or company and the permitted assigns of such individual or firm or Company.

d) "The Officer-In charge" means, the Officer deputed by the respective area **HOD** to supervise the work or part of the work.

e) "Approved" and "Directed" means, the approval or direction of the respective area **HOD** or person deputed by him for the particular purposes.

f) "BHARAT HEAVY ELECTRICALS LIMITED" (hereinafter referred to as BHEL) shall mean the Board of Directors, Chairman, Executive Director, General Manager or, other Administrative Officer of the said Company including Sr.Manager / WCM authorised to invite tenders and enter into contract for works on behalf of the Company.

g) The "Contract sum" means, the sum accepted or the sum calculated in accordance with the prices accepted in tender and / or the contract rates as payable to the contractor for the execution of the work during the currency of the contract.

h) A "week" means, Seven Days, without regard to the number of hours worked or not worked in any day in that week.

i) A "day" means, the day of 24 hours (TWENTY FOUR) irrespective of the number of hours worked or not worked in that day.

2. Heading to the Contract Conditions:

The heading to these conditions shall not affect the interpretations thereof.

3. Deviations:

The contractor shall carry out any Scope of work as per instructions of Executing official.

Contractor Signature

4. Work To Be Carried Out:
The Contract shall include all labour which may be required for the execution of the work.
The Contractor will be deemed to have satisfied himself as to the nature of the site, local facilities of access and all matters affecting the execution of the work. No. extra charges consequent on any misunderstanding in these respects or otherwise will be allowed.

5. Assignment of Transfer of Contract:
The Contractor shall not, without the prior written approval of the BHEL, assign or transfer the contract or any part thereof, or any share, or interest thereon to any other persons. No sum of money which may become payable under the contract shall be payable to any person, other than the contractor unless the prior written approval of the BHEL to the assignment or transfer of such money is given.

6. Sub-Contract:
The Contractor shall not sublet any portion of the contract without the prior written approval of the BHEL.

7. Compliance to Regulations and Bye-Laws:
The Contractor shall confirm to the provisions of any statute relating to the work and regulations and Bye-laws of any local authority. The Contractor shall be bound to give all notices required by statutory regulations or by-laws as aforesaid and to pay all fees and taxes payable to any authority in respect thereof.

8. Earnest Money Deposit (EMD) & Security Deposit (SD):
Earnest Money Deposit (EMD):
Tender must be accompanied by Earnest Money for the amount mentioned in tender notice, pledged to BHEL, Trichy in any of the forms mentioned below.

Modes of Deposit:
The EMD shall be accepted only in the following forms:
a) Cash deposit as permissible under the extant Income Tax Act (before tender opening)
b) Electronic Fund Transfer credited in BHEL account (before tender opening)
c) Banker's cheque/ Pay order/ Demand draft, in favour of BHEL (along with offer)
In case total EMD amount is more than ₹ 20 Lakh, the amount in excess of ₹ 20 lakh may be accepted in the form of Bank Guarantee from scheduled bank. The Bank Guarantee in such cases shall be valid for at least six months.

Forfeiture of EMD:
EMD by the tenderer will be forfeited as per tender documents if
i) After opening the Tender, the Tenderer revokes his Tender within the validity period or increase his earlier quoted rates.
ii) If only, a part of the work included in the tender has been awarded to the tenderer and the tenderer refuses to take up the work the amount of Earnest Money to be forfeited will be based on the value of the contract so awarded.
iii) The Tenderer does not commence the work within the period as per LOI / Contract. In case the LOI / Contract is silent in this regard then within 15 days after award of Contract.
General Terms related to EMD:
Earnest Money Deposit (EMD) will not carry any interest.
Earnest Money Deposit (EMD) of the successful tenderer will be retained as part of Security deposit.

Contractor Signature

Contractor Seal

The Earnest Money Deposit (EMD) will be refunded to the unsuccessful tenderers within 15 days of acceptance of the award of work by successful tenderer / expiry of offer validity period
Security Deposit (SD):
The contractor whose tender has been accepted shall, within seven days of receipt of the notification of acceptance of his tender, should deposit Security deposit @ 5 % of Contract value.
EMD of the successful tenderer shall be converted and adjusted towards the required amount of **Security deposit (SD):**

Modes of Deposit:

The balance amount to make up the required Security Deposit of 5% of the contract value may be accepted in the following forms:

i)Cash (as permissible under the extant Income Tax Act)

ii) Local cheques of Scheduled Banks (subject to realization)/ Pay Order/ Demand Draft/ Electronic Fund Transfer in favour of BHEL

iii) Bank Guarantee from Scheduled Banks/ Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format should have the approval of BHEL

iv) Fixed Deposit Receipt issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act (FDR should be in the name of the Contractor, a/c BHEL)

v) Securities available from Indian Post offices such as National Savings Certificates, Kisan Vikas Patras etc. (held in the name of Contractor furnishing the security and duly endorsed/ hypothecated/ pledged, as applicable, in favour of BHEL)

General Terms related to SD:
The security Deposit will not carry any interest.
Security Deposit shall be released to the contractor upon fulfilment of Contractual obligations as per terms of contract.
BHEL, shall not be responsible for any loss of securities due to liquidation or any other reason whatsoever or any depreciation in the value of the Securities while in their charge or for any loss of interest thereon.
NOTE: Acceptance of Security Deposit against Sl. No. (iii),(iv) and (v) above will be subject to hypothecation or endorsement on the documents (Signature of the Branch Manager must be present) in favor of BHEL. However, BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith.
All compensation or other sums of money payable by the contractor to BHEL under the terms of this contract or under any other contract with BHEL, may be deducted from the Security Deposit or realized by the sale of the securities of from the interest arising there from or from any sums which may be due or may become due to the contractor payable by BHEL, on any account whatsoever against this contract of any other contract with BHEL and in the event of his Security Deposit being reduced by reason of such deductions or sale as aforesaid, the Contractor shall within seven days thereafter make good in cash or in securities endorsed as aforesaid, any sum or sums by which the security Deposit has been so reduced.
In case of an Award of a Contract and if the Contractor fails to perform or does not comply with the Performance Evaluation Criteria, the Security Deposit will not be refunded / Bank Guarantee encashed.

The Bank Guarantee shall be kept valid until the due date for refund of Security Deposit.
Security Deposit has to be deposited within 15 days of LOI/WO. Else EMD will be forfeited and may also attract the provision of "Suspension of Business dealings with Suppliers/Contractors".

Contractor Signature

Contractor Seal

9. Orders under the Contract:

All orders, notices etc. to be given under the contract shall be in writing, typescript or printed and if sent by registered post to the address given in the tender of the Contract, shall be deemed to have been served on the date, when in the ordinary course they would have been delivered to him. The Contractor shall carry out without delay all orders given to him.

Contractor shall be deemed to have included in his tender price of all the plant, machinery and appliances required for the purpose of all operations connected with the work embraced under the contract to secure a satisfactory quality of work and rate of progress which in the opinion of the " Contract Signing Officer" will ensure the completion of the work within the time specified. BHEL is having every right to split the schedule and to award the work to single or many parties on the lowest offered rates basis. This is a time bound contract for period mentioned, and does not envisage any extension of time / period.

10. Contractor's Supervision:

1. The Contractor shall either himself supervise the execution of the contract or shall appoint a competent agent acceptable to BHEL Officials.
2. Orders given to the Contractor's agent shall be considered to have the same force as if they have been given to the Contractor himself.
3. The Contractor or his accredited agent shall attend when required without making any claim for doing so to the OFFICER-INCHARGE, to receive instructions.
4. The respective area HOD shall have full powers and without assigning any reason, requires the Contractor to immediately cease to employ in connection with this contract, any agent, servant or employee where continued employment is, in his opinion undesirable. The Contractor shall not be allowed any compensation on this account.

11. Labour:

1. The Contractor shall remain liable for the payment of all wages and other payments in connection with the employees engaged by him and with regard to the work.
2. The Contractor shall comply with the applicable provisions of Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees Liability Act. 1938, Employees' Compensation Act 1923, Payment of Bonus Act, EPF and Miscellaneous Provisions Act, 1952, Employees State Insurance Act, 1948 and other relevant Acts and rules framed, there under from time to time
3. Contractor shall be responsible for making payment of wages before expiry of 7days from the last day of wage period and shall ensure disbursement of wages in the presence of the authority's representative of contract operating division who shall record under his signature at the end of entries in the Register of wages.
4. Contractor shall have/ obtain license under CL(R&A) Act, 1970.
5. As per BHEL circular HR-Welfare circular dt 08.04.2014, the following additional wages per month has to be paid by the Contractor over and above minimum wages declared by Tamil Nadu Government to labors as:
   a) Unskilled : ₹. 3200/
   b) Semi-skilled : ₹. 3700/-
   c) Skilled : ₹. 4100/-
6. **"The contractor should remit the salary/wages for their workmen preferably through Bank. For monthly clearance, the relevant Bank statement/proof for Bank payment should be produced along with PF and ESI challans to Welfare Section every month."**

Contractor Signature

Contractor Seal

12. Precautions against Risk:
The Contractor shall be responsible for providing at his own expense for all precautions to prevent loss or damage from any and all risks and to minimize the amount of any such loss or damage and for the necessary steps to be taken for the said purpose.

13. Damage & Loss to Private Property & Injury to workmen:
The Contractor shall at his own expense reinstate and make good to the satisfaction of the respective area **HOD** and pay compensation for any injury, loss or damage occurred to any property or rights whatever including property and rights of BHEL (or agents) servants or employee of BHEL, the injury loss or damage arising out of or in any way in connection with the execution or purported execution of the contract and further the contractor shall indemnify BHEL against all claims enforceable against BHEL (or any agent, servant or employee of BHEL) or which would be so enforceable against BHEL, in respect of any such injury (including injury resulting in death) loss or damage to any person whomsoever or property including all claims which may arise under the Employees Compensation Act or otherwise.

14. Laws Governing the Contract:
The contract shall be governed by the Indian Laws for the time being in force.

15. Cancellation of Contract for Corrupt Acts:
BHEL, whose decision shall be final and conclusive, shall without prejudice to any other right or remedy which shall have accrued, shall accrue thereafter to BHEL cancel the contract in any of the following cases and the Contractor shall be liable to make payment to BHEL for any loss or damage resulting from any such cancellation to the same extent as provided in the case of cancellation for default.

If the Contractor shall:
a) Offer or give or agree to give to any person in BHEL service any gift or consideration of any kind, as an inducement or reward for doing or for bearing to do or for having done or for having borne to do any act, in relation to the obtaining or execution of this or any other contract for BHEL service,

OR

b) enter into a contract or understanding with any person in BHEL in connection with which commission has been paid or agreed to be paid by him or with his knowledge, unless the particulars of any such commission and the terms of payment thereof have previously been disclosed in writing to BHEL,

OR

c) To obtain' a contract with BHEL as a result of ring tendering or by non-bonafide methods of competitive tendering, without first disclosing the fact in writing to BHEL.

16. Cancellation of Contract for Insolvency Assignment of Transfer or Subletting Of Contract:
BHEL, without prejudice to any other right or remedy, which shall have accrued or shall accrue thereafter to BHEL, shall cancel the contract in any of the following cases:
If the Contractor,

Contractor Signature

Contractor Seal

a) Being an individual or if a firm any partner thereof shall at any time be adjudged bankrupt or have a receiving order for administration of his estate, made against him or shall take any proceedings for liquidation or composition under any bankruptcy Act or assignment of his effects of composition or arrangement for the benefit of his creditors or purport to do so, or if any application made under any Bankruptcy Act for the time being in force for the sequestration of his estate or if a trust deed be granted by him on behalf of his creditors.

OR

b) Being a Company, shall pass a resolution or Court shall make an order for the liquidation of its assets, or a receiver or Manager on behalf of the debenture holders shall be appointed or circumstances shall a rise which entitle the Court or debenture holders to appoint a receiver or Manager.

OR

c) Assigns, Transfers, Sublets or attempts to assign, transfer or sublet any portion of the work without the prior written approval of the BHEL.

d) Whenever BHEL exercises the authority to cancel the contract under these conditions, BHEL may have the work done by any means at the Contractor's risks and expenses provided always that in the event of the cost of the work so done (as certified by the respective area **HOD**) being less than the contract cost, the advantage shall accrue to BHEL and if the cost exceeds the money due to Contractor under the contract, the Contractor shall either pay the excess amount ordered by the respective area **HOD** or the same shall be recovered from the Contractor by other means.

e) In case BHEL carries out the work under the provisions of this condition, the cost to be taken into account in determining the excess cost to be charged to the Contractor under this condition shall consist of the cost of the materials, hire charges of tools and plants and / or labour provided by BHEL with an addition of such percentage to cover superintendence and establishment charges as may be decided by the respective area **HOD** whose decision shall be final and conclusive.

f) Labour engaged by the contractor should be disciplined & exhibit good behaviour in dealing with employees of BHEL. Any misbehaviour or undesirable conduct of any person engaged by the contractor is reported, contractor shall change that person immediately or else it may even lead to termination of the contract & in such case security deposit will be forfeited as penalty.

17. Cancellation of Contract In Part or Full for Contractor's Default:

If the contractor:

a) makes default in carrying out the work as directed and continues in that state after a reasonable notice from the respective area **HOD** or his authorized representative:

b) fails to comply with any of the terms & conditions of the contract or failure to comply orders after reasonable notice in writing with orders properly issued thereunder:

BHEL, May without prejudice to any other right or remedy which shall have accrued or shall accrue thereafter to BHEL CANCEL the contract as whole or in part thereof or only such work order or items of work in default from the contract. Whenever BHEL exercises the authority to cancel the contract as a whole or part under this condition, BHEL may complete the work at the contractor's risk and cost (as certified by the respective area

HOD which is final and conclusive) being less than the contract cost, the advantage shall accrue to BHEL. If the cost exceeds the money due to the Contractor under this contract, the Contractor shall either pay the

Contractor Signature

Contractor Seal

excess amount ordered by the respective area **HOD** or the same shall be recovered from the Contractor by other means. In case BHEL carries out the work or any part thereof under the provisions of the conditions the cost to be taken into account in determining the excess cost to be charged to the Contractor under this condition shall consist of the cost of the materials, hire charges of tools and plant and/or labour provided by BHEL with an addition of such percentage to cover the superintendence and establishment charges as may be decided by the respective area **HOD** whose decision shall be final and conclusive.

18. Termination of Contract on Death of Contractor:
Without prejudice to any of the rights or remedies under this contract, if the Contractor dies, or if the firm is dissolved or the company is liquidated, BHEL shall have the option of terminating the contract without compensation to the Contractor.

19. Special Power to Termination:
If at any time after the award of contract, BHEL shall for any reason whatsoever not require whole or any part of the work to be carried out the respective area **HOD** shall give notice in writing of the fact to the Contractor who shall have no claim to any payment of compensation or otherwise howsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of the foreclosing of the work.

20. Submission and Processing Of Bills:

Payment of Bills:
1. Payment will be made after completion of work on pro-rata basis on acceptance and certification of bills by BHEL Engineer.
2. Payment shall be made against Certification by respective area **Engineer in charge**.

The Contractor at the end of each month shall submit a bill in triplicate detailing the various items of work done during the month supported by the requisitions issued from time to time. The Contractor shall, once in every month, submit to the respective area **HOD** separately details of their claims for the work done by them up to and including the previous month which are not covered by their contract agreement in any of the following respects:

a) Deviation from the items provided in the contract documents.
b) Extra items / new items of work.
c) Items in respect of which rates have not been settled. He should in addition furnish a clear certificate to the effect that the claims submitted by him as aforesaid cover all his claims and that no further claims shall be raised by him in respect of the work done up to and including the period under report. Payment will be at the sole discretion of BHEL.

21. Along with bills, Contractors has to furnish copy of the following documents for further processing of bills:
a) Documentary proof for payment of PF/ESI with respect to the employees engaged by the contractor with payment details relating to individual names to be submitted.
b) Copy of payment challan of previous Month / Quarter as proof of deposit of Service Tax along with a certificate from the Contractor that tax collected from BHEL has been remitted to tax authorities.
c) Any other relevant document which is required from time to time as per BHEL requirement.
d) If the Contractor is not registered for any statutory obligation and not liable thereto, then a declaration shall be submitted along with offer that they are within the threshold limit.

Contractor Signature

Contractor Seal

22. Recovery from Contractor:
Whenever under the contract, any sum of money, shall be recoverable from or payable by the Contractor, the same may be deducted from or any sum then due or which at any time thereafter may become due to Contractor under the contract or under any other contract with BHEL or from his Security Deposit unless the contractor pays the claim on demand.

23. Post- Technical Audit of Work and Bills:
BHEL reserves the right to carry out the post-payment Audit and technical examination of the work and final bill including all supporting vouchers, abstracts etc., and enforce recovery of any sum becoming due as a result thereof in the manner provided in the presiding sub- paragraphs. However no such recovery shall be enforced after three years of passing the final bill.

24. Refund of Security Deposit:
The Security Deposit mentioned in condition **8** above may be refunded to the Contractor after a period of 6 months on termination or expiry of the contract provided always that the Contractor shall first have been paid the last and final bill and have rendered a "NO DEMAND CERTIFICATE".

25. Force Majeure Clause:
If, at any time during the continuance of this Contract the performance in whole or in part by either party of any obligations under this Contract shall be prevented or delayed by reason of any War, Hostile acts of the public enemy Civil Commotion, Epidemics, or Acts of God (Floods, Storm / Cyclone, Hurricane, Earthquake etc.) then provided notice of happening of any such event is given by either party to other within 7 days from the date of occurrence thereof neither of the parties shall by reason of such event be entitled
to terminate this Contract or claim for damages against the other in respect of such non-performance or delay for such period. Performance under the contract shall be resumed as soon as practicable after such event has come to an end or ceased to exist. If the performance in whole or part of any obligation under this Contract is prevented or delayed by reason of any such event, claims for extension of time may be granted for periods considered reasonable by the respective area **HOD** at his discretion subject to prompt notification by the contractor.

26. Arbitration:
All disputes between the parties to the contract, arising out of or relating to the contract, other than those for which the decision of the respective area **HOD** or Accepting Officer or any other person is by the contract expressed to be final and conclusive shall after written notice by either party to the contract to the other party be referred to the Arbitrator, to be appointed by the GENERAL MANAGER of BHEL in his sole discretion. Unless the parties otherwise agree, such reference shall not take place until after the completion, alleged completion or abandonment of the work of the determination of the contract. The venue of Arbitration shall be such a place or places, as may be fixed by the Arbitrator in his sole discretion. The award of the Arbitrator shall be final, conclusive and binding on both parties to the contract.

27. Signing Of Contract:
Each contract document shall be signed by the Contractor with his usual signature. Contract by partnership or Hindu Joint Family firm, may be signed in the FIRM'S name by the Managing Partner or all /one of the Partners on behalf of the firm or the Karta or Manager for HUF as the case may be. Contract by a Company shall be signed with the name of the Company from a person authorised in this behalf and a Resolution or power of attorney or other satisfactory proof, showing that the person signing the Contract documents on behalf of the Company is duly authorised to do so, shall accompany the contract.

Contractor Signature

Contractor Seal

28. LIQUIDATED DAMAGES (LD)/PENALTY:

If the contractor fails to complete the service/work as per terms & conditions of the order within the delivery schedule,

a) LD shall be levied @ 0.5 % of the order value per week of delay or part thereof subject to a maximum of 10 % of the full order value.

b) In case of any change to the order value, the LD shall be @ 0.5 % of the revised order value per week of delay or part thereof subject to a maximum of 10% of the revised order value.

29. Biometric Entry/Exit System for Contract Workmen:

1. The Entry/Exit of the employees engaged by contractor is to be regulated only through Biometric system.
2. The Contractor initially will be issued with a temporary gang pass for his/her employees for a period of ten days.
3. The contractor should arrange photo coverage for all his/her employees within the above stipulated time.
4. The contractor has to submit FORM-I for all his/her contract employees. All the particulars required in FORM-I are to be provided by the contractor without fail.
5. Every employee of the Contractor shall be provided with Employment Card as per Form XIV (as per Rule 76 of the Contract Labour (Central) Rules, 1971 and the contractor shall instruct its employees to carry the Employment Card as well as Entry Card without fail, while entering/exiting factory.
6. The contractor should educate his employees in registering the attendance through the system.
7. Whenever a contract employee migrates or leaves service of the contractor, the contractor has to surrender the biometric card of the particular employee to Contract Cell with immediate effect, without fail.
8. On completion of the work, the contractor has to surrender all the biometric entry cards issued to its employees immediately to the contract cell. Otherwise, an amount of Rs.100/- per card will be deducted from the final bill/security deposit of the contractor.
9. If any contract employee lose his/her entry card, the contractor shall arrange a duplicate entry card for the employee by paying an amount of Rs.100/-.
10. The Contractor is totally responsible for the biometric cards issued to his/her employee.
11. The Contractor has to indemnify BHEL for all the damages and losses caused by his/her employees.

30. Common Terms and Conditions for Works Contract relevant to Safety:

1. All the Contract employees should be trained on Safety and certified by Safety/BHEL. New employees should undergo Safety Training before take up the work, without Safety Training no contract person is allowed to do any work.
2. Use of cell phones and other mobile electronic devices (including hands-free devices) in the work spot and during the operation of a vehicle in the BHEL premises is prohibited.
3. Contract employees working on BHEL premises must wear appropriate personal protective equipment. Strict adherence to all required Personal Protective Equipment (Helmet, Safety Shoes and Goggles) are mandatory, specific PPE requirements will be based on job type or tasks performed.
4. Excessively loose-clothing, dhoti/Lungi is prohibited especially around rotating or moving equipment.

Contractor Signature

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5. The contractors' work area should be kept clean and orderly, free of clutter and trash, so that work may proceed in a safe and orderly manner. Tools should be safely positioned during use and promptly put away when no longer required.
6. Fire-fighting, emergency shutdown devices, and life-saving equipment, should not be blocked by the contractor/employees and access to the path to this equipment should be maintained at all times.
7. Only approved equipment should be used in locations where flammable mixtures are present. A Hot Work Permit is required when open flames, or electric arcs are in the work area and while handling flammable materials.
8. Smoking is not allowed in work area.
9. BHEL operate under a comprehensive Emergency Response Plan.
   Contractors should be aware of the site Emergency Response Plan and communicate that plan to all their employees.
10. It is recommended that the contractor should know & display the emergency phone numbers like Fire, Ambulance, Safety, Security etc. at their work area.
11. It is the responsibility of the contractor to understand and use the appropriate Work Permits and to verify any permit requirements at the location. Contractor must make necessary arrangements with their Representative to acquire appropriate authorization to perform those operations at the site.

31. FRAUD PREVENTION POLICY

The Bidder along with its associate / collaborators / sub – vendors / consultants / service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website *http://www.bhel.com* and shall immediately bring to the notice of BHEL Management about fraud or suspected fraud as soon as it comes to their notice".
Fraud Prevention policy and List of Nodal Officers shall be hosted on BHEL website, vendor portals of Units / Regions intranet.

32. SUSPENSION OF BUSINESS DEALINGS WITH SUPPLIERS / CONTRACTORS:

Penal action can be initiated on the suppliers / Contractors in line with extant 'Guidelines for Suspension of Business Dealings with Suppliers/ Contractors. The abridged version of extant 'Guidelines for suspension of business dealings with suppliers/ contractors' has been uploaded on *http://www.bhel.com on* "supplier registration page".

33. RISK PURCHASE:

a) In the event of any successful Tenderer's failure to fulfil any of the tender / Contract obligations as per Contract / Agreement, BHEL may entrust the job to alternate vendor and get it completed to meet the BHEL requirement and additional expenditure, if any, including consequential cost viz., demurrage etc., will be fully recovered from the Contractor who failed to complete the job in line with the Contract.
b) The decision of BHEL with regard to the actual losses / consequential expenditure incurred by BHEL shall be final and binding on the Contractor.

In case vendor fails to fulfil any of the tender / Contract obligations as per Contract / Agreement, contract shall be cancelled and SD shall be forfeited

Contractor Signature

Contractor Seal

Name of Woks: WORKS CONTRACT FOR STUD WELDING IN PANELS AND LOOSE ITEMS AT BHEL, TRICHY.
Enquiry No: 9001700017 /30.01.2017

PART-II (PRICE BID)

ANNEXURE-II

01. Rates should be quoted in figures and words and are to be identical if not, the prices in the words will be considered as correct and the same shall be valid and binding.
    (a) If, in the price structure quoted for the required goods / services / works, there is discrepancy between the unit price and the total price (which is obtained by multiplying the unit price by the quantity), the unit price shall prevail and the total price corrected accordingly, unless in the opinion of the purchaser there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price corrected accordingly.
    (b) If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and
    (c) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject of (a) and (b) above.
    (d) If there is such discrepancy in an offer, the same will be conveyed to the bidder with target date up-to which the bidder has to send his acceptance on the above lines and if the bidder does not agree to the decision of the purchaser, the bid is liable to be ignored.
02. The Rate should be quoted exclusive of Service Tax and inclusive of any taxes and duties levied or to be levied both by Central and State Government authorities from time to time. Service Tax will be paid extra on production of documentary evidence.
03. Quotation should be valid for a period of three months from the date of Tender opening.
04. The contract will be awarded to only one contractor based on the total value of the offer. In case of more than one L1 bidders, BHEL gets fresh revised reduced price bids from all such L1 bidders & ranking will be decided based on these revised bids. The new rates quoted should be lower than their previous L1 rates.
05. The rate quoted shall remain firm and valid up to contract period and no extra payment will be reimbursed to the contractor by BHEL. Any increase of DA/ wages to the contract labor shall be absorbed by the contractor themselves during the period of contract.

SN	Work Description	UOM	APPROX. QTY	Rate/ UOM in ₹	Total in ₹
1	Stud Welding in Panels and loose tubes	Nos	55794	₹...../ Rupees..... .....only	₹...../ Rupees..... .....only
			Total Value (₹)		
			Service Tax @ _____ %(₹)		
			Total Value Including Service Tax(₹)		

Contractor Signature

Contractor Seal

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: QCP: 004 REV: 04

AMENDMENT SL NO: A2 DATE: 09.04.2013

DESCRIPTION: FABRICATION OF TUBULAR PRODUCTS

Clause No.	*New Clause*	*Remarks / Basis for Amendment*
3.2.1.4	**The colour coding of the attachments to be welded with pressure parts shall be ensured as per SIP:NP:13 (Latest)**	Based on the recommendations of Tubular products RCA committee.
NOTE	The above-mentioned changes will be incorporated in the QWI during the next revision of the document.	

Prepared by: V.Sampath Kumar	Reviewed & Approved by: S. Selvarajan
V. Sampath Kumar Signature & Dt: 09.04.2013	Signature & Dt: 09.04.2013

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT

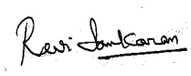
AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: QCP:004 REV: 04

AMENDMENT SL NO: A1 DATE: 04.06.09

DESCRIPTION: FABRICATION OF TUBULAR PRODUCTS

Clause No.	Amended as…	Remarks / Basis for Amendment
4.4.3.1	In case of butt joints, the defective joints shall be cut and re-welded. However, local repair may be permitted for defective joints of Manual TIG and Orbital TIG processes (Shop welds only), as marked on the job by NDTL. Repair shall be done after removing the defects and preparing the groove suitably by grinding. The entire joint shall be re-radiographed after repair in such cases. In case of fillet welds, defects noticed shall be removed by cutting and re-welding or by grinding followed by visual inspection and re-welding.	Modified based on Record Notes of Discussion dt. 02.06.2009
4.4.3.2	The repair weld shall be subjected to the same NDE as applicable for the welding process followed for repair.	Modified for clarity - Based on shop feedback
4.5.2.4	For stress relieving in Continuous Discharge Furnaces, still air (free from any fan or blower) shall be ensured upto the point where the job temperature is below 400 Deg. C. This shall be checked and ensured during the calibration heat treatment cycle by means of chart recording.	New clause added - Based on QC feedback
NOTE	The above-mentioned changes will be incorporated in the QWI during the next revision of the document.	

Prepared by: S. Selvarajan	Approved by: U. Revisankaran
	
Signature & Dt: 04.06.2009	Signature & Dt: 04.06.2009

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI 620 014 INDIA

QUALITY CONTROL PROCEDURE FOR	**QCP:004 / 04**
FABRICATION OF TUBULAR PRODUCTS	Page 1 of 11

Prepared by Quality Assurance	U. Revisankaran

Reviewed by	Signature
Engineering (P.S. Guruchandran)	
Manufacturing Shops (M. Balasubramanian)	
O P & C (R. Muthusamy)	
Quality Control (J. Kannan)	
Quality Assurance (C.R. Raju)	

Revision No.	Date	Approved by	Signature
00	01/01/95	SM / QA	
01	23/08/95	DGM / QA	
02	15/07/96	SM / QA	
03	01/04/03	SDGM / QA	
04	31/12/05	AGM / QA	

Proprietary Data - For Internal Use Only

RECORD OF REVISIONS

Rev. No.	Date	Clause No.	Details of revision
		--	
00	01/01/95		This document consolidates all the general requirements and technical disciplines related to tubular products extracted from QCP 001/00.
01	23/08/95	Annexure I	Sl.Nos. 08 & 23 colour code modified.
02	15/07/96	2.1, 3.2.2.1, 4.1.2, 4.2.2, 4.5.2.4, 4.5.6, 5.1.	The clauses refered were revised. PR:QEs were replaced with SIPs. Annexure I deleted.
03	01/04/03	4.3.6.5	Introduced from Amendment A1 dated 12/03/97 issued for Revision 02.
		4.3.3, 4.3.4.1 4.4.2.1,4.5.6, 4.5.7.2, 4.5.8.1	Modified.
		4.5.7.6	Added
04	31/12/05	3.0	Modified to include P-number grouping of materials.
		4.2.4, 4.4.1.2	Modified based on Amendment A1 dated 20/04/05.
		4.5.10	Guidelines for interruptions during heat treatment altered.
		Annexure I	Added.

1.0 **SCOPE**

1.1 This procedure details out the requirements for fabrication of tubular products with respect to:

a. material identification and traceability
b. process controls
c. inspection and testing
d. calibration/verification of equipments and instruments
e. handling, storage and preservation

1.2 This procedure is limited to various disciplines to be followed during fabrication and the specific product quality requirements are detailed out in the respective Standard Quality Plans(SQP) / Standard Inspection Procedures (SIP).

2.0 **REFERENCE DOCUMENTS**

2.1 Codes IBR, BS, ASME.

2.2 Collaborator documents as guidelines.

3.0 **MATERIALS** [Refer Annexure I for P-number grouping of materials]

3.1 INCOMING STAGE

3.1.1 The raw materials and sub deliveries are procured to the requirements as per relevant TDC/Specification with necessary Test Certificates. Materials specifically required for a Contract are procured under 6 series TDC and stored separately. All materials are ensured for correctness and Test certificates verified.

3.1.2 Customer supplied materials are verified for correctness as per Procedure SP 0626.

3.2 ISSUE STAGE

3.2.1 The requirements of material traceability are indicated in the respective drawings / material requisition slips/Material issue vouchers.

3.2.1.1 ATTEST items, indicated as "A" in drawings, are traceable to the test certificates and identified with Specification, grade & melt number as per TABLE - I. These items are issued with Attestation Form.

3.2.1.2 CERTIFIED items, indicated as "C" in drawings, are traceable to Specification / Grade only and identified by stamping/ engraving/ stenciling/ color coding/ marking.

3.2.1.3 Raw materials not covered by the above shall be identified by its W.O.No/ material code/ specification/ grade by painting or stenciling or engraving. All sub deliveries shall be identified by its material code by painting or through tags / name plates.

3.2.2 During issue, QC shall ensure the correctness of material to the MIV/MRS/CRS,freedom from visual damages (like pitting, dents, laminations, scales, warpages etc.), verification of TCs and identification, as required.

3.2.2.1 In case of stock raw materials, which are upgraded for special contract requirements, QC shall ensure that the respective TCs and laboratory reports satisfy specification/ Contract TDC, as applicable.

TABLE I

Product form	Identification	Method
Pipes ? < 80mm & Tubes >= 31.8mm	Specn., Melt No	Stenciling / Engraving and Colour code
Tubes < 31.8mm	Specn., Melt No	Lot wise on a tag Colour code on individual Tube
For Colour codes refer SIP:PP:21 (Latest)		

3.3 INPROCESS STAGE

3.3.1 When defects in raw materials are noticed the same shall be confirmed by visual examination or using appropriate NDE techniques and corrected before use, in consultation with QC.

3.3.2 Ensure correctness of raw material identification and attestation to drawing requirements, as required. Traceability to the contract shall be ensured by stamping or marking / painting the WO No. and DU / Part no., as applicable.

3.3.3 In case of marking, cutting or machining, the transfer of material identification shall be ensured. In case of tubes, the color code shall be transferred.

3.3.4 In case of components/ part processed items received from Subcontracting/ other shops ensure the completeness and clearance by QC/ Customer Inspector through Inspection Report/ Dimensional reports/OPS.

3.4 Proper care shall be taken during handling of materials/ components at any stage of manufacture. Items stored in the shop floor shall be properly identified and preserved to prevent damages/ rusting/ warpages.

3.4.1 All welding consumables shall be properly identified and stored. Pre-treatment like baking/ drying of welding consumables before use shall be ensured as per recommendation of WTC. The issue of welding consumables shall be authorized by Shop.

3.4.2 Ensure correctness of welding consumables before use. Where specified, the batch traceability shall be maintained through records.

4.0 **FABRICATION**

4.1 MARKING, CUTTING AND MACHINING

4.1.1 The tubes shall be marked as required for cutting. Cutting may be done by flame/ saw/machine in the case of ferritic steel and by plasma/saw/machine in the case of stainless steel.

4.1.2 The gas cut edges, other than running meter tubes, shall be ground smoothly to a depth of atleast 1-2 mm to remove the surface irregularities, and heat affected zone (HAZ). Deep serrations, if any, shall be ground smooth without any sharp edges.

4.1.3 The ends prepared for welding shall conform to the relevant drawing. Removal of the burrs, chips etc. shall be ensured.

4.2 BENDING AND SWAGING OF TUBES

4.2.1 Bending and swaging shall be done using qualified tooling/process. The toolings, formers and other accessories shall be cleaned and free from high spots. In case of any hot forming, the material shall be heated uniformly to the specified temperature.

4.2.2 The process/tooling shall be qualified by a First off trial and the records shall be verified before production, as detailed out in SIP:PP:12 (Latest).

4.2.3 The method of bending/swaging - hot or cold shall be as specified in the OPS/Traveler. Heating parameters shall be as specified in the SQP.

4.2.4 The requirements for heat treatment after bending/swaging is detailed in the relevant SQP and process control requirements are detailed under Clause 4.5. Wherever normalizing / Tempering is indicated for T91 material, it shall be done encompassing the entire component.

4.2.5 Hot correction

4.2.5.1 Wherever hot correction is employed, the heating/heat treatment parameters shall be as specified in the SQP. Flame heating shall be done with neutral flame without touching the tube surface. The temperature shall be monitored using thermal chalks or other suitable means.

4.2.5.2 Hot correction of stainless steel shall be avoided to the extent possible. However, if done, the tube surface shall be heated to a minimum width of 100 mm for the full circumference.

4.3 WELDING

4.3.1 Welding shall be performed with qualified procedures using qualified welding personnel. Welding procedures are qualified to ASME Sec. IX and personnel to IBR/ASME Sec. IX, unless specified otherwise.

4.3.2 Welding area covering the base material to approximately 15mm on either side shall be thoroughly cleaned and ensured free from oil, grease, rust, scales etc.

4.3.3 Fit-up of the joints shall be ensured as per drawing. The surface alignment (mismatch) in case of butt welds shall be within 1/4 t, where " t " is the tube thickness.

4.3.4 Tack welds used to secure alignment shall either be removed completely when they have served their purpose or properly prepared by grinding or by other suitable means so that they may be incorporated into the final weld.

4.3.4.1 Tack welds shall be done using qualified procedure and personnel to a sufficient length (25 mm minimum) and width. Tack welds found defective during visual examination shall be removed.

4.3.5 The maximum misalignment at the root for butt welds shall not exceed 0.5 mm. However where additional requirements are specified, the same shall be detailed in the SQP/Drawing.

4.3.6 Preheating requirements for welding shall be as per the WPS and controls shall be exercised as detailed below;

4.3.6.1 Preheating must be applied before starting each cycle of welding and shall be maintained during the whole process of welding.

4.3.6.2 Preheating is to be done using gas burner or induction/resistance heating method. The temperature must be uniform and verified using thermal chalks or thermocouples prior to start of welding as well as at frequent intervals during welding.

4.3.6.3 Where inter pass temperature control is required during welding, the temperature must be ensured using thermal chalks (temperature indicating crayons)/ thermocouples.

4.3.6.4 Wherever post heating is specified, the preheat temperature shall continue after welding till attaining the post heat temperature and maintained for the required time and cooled slowly.

4.3.6.5 Wherever spool piece is introduced, the length of spool piece shall be 150 mm minimum except for inserts, which shall be as per drawing.

4.4 WELD INSPECTION AND REPAIRS

4.4.1 Visual Inspection

4.4.1.1 After completion of welding, visual inspection shall be done to ensure that the final layer fills the weld groove completely and encroaches the base material. The surface of the welds shall be free from coarse ripples, grooves, overlaps, undercuts, abrupt ridges and valleys to avoid stress raisers. Acceptance norms for visual inspection shall be as per SIP:PP:03 (latest).

4.4.1.2 Butt welds in the tubes shall not be permitted within the bends. Also, joints in the wear bars shall be avoided in the tube bending area.

4.4.1.3 After completion of welding, the welder number shall be identified by suitable records.

4.4.2 Nondestructive Examination

4.4.2.1 NDE shall be performed with qualified procedures and personnel only. NDE techniques are based on ASME Sec.V unless specified otherwise. The acceptance norms shall be based on the relevant code of construction, built into the respective NDE procedures and approved by the statutory authorities, as required.

4.4.2.2 The extent and type of NDE are specified in the SQP.

4.4.3 Repairs

4.4.3.1 In case of butt joints, the defective joint shall be cut and rewelded. In case of fillet welds, defects noticed shall be removed by cutting and rewelding or by grinding followed by visual inspection and re-welding.

4.4.3.2 The repair weld shall be subjected to the same NDE as the original weld.

4.5 POST WELD HEAT TREATMENT (PWHT)

4.5.1 The process controls for heat treatment shall cover the activities before, during and after heat treatment.

4.5.2 For heat treatment in batch type furnaces, the following requirements shall be met with:

4.5.2.1 All heat treatment shall be applied only after the temperature of the component falls below 200°C. The temperature of the furnace during loading shall be below 300°C.

4.5.2.2 All materials to be heat treated in a furnace shall be loaded such that they shall not be subjected to flame impingement during gas heating. They shall be preferably loaded on raised platforms so that no material or material projections are in the plane of burners.

4.5.2.3 For stress relieving, cooling shall be in the furnace up to 400°C and further in air.

4.5.2.4 The heating and cooling rates shall be 220°C/Hr maximum at temperatures above 400°C unless specified otherwise.

4.5.3 The weldment shall be cleaned to ensure free from grease/oil prior to heat treatment.

4.5.4 PWHT shall be done in a furnace or by locally heating a circumferential band including the entire weld and adjacent area of the base metal.

4.5.5 The thermocouples and recording instruments shall be calibrated and records maintained. The furnace shall have been qualified for temperature distribution.

4.5.6 The soaking time for heat treatment shall be as follows, unless otherwise specified. Soaking time is accounted as the time between the temperature reaching and leaving the minimum recommended temperature.

Normalising : 1/2 hour per inch of "t" (15 minutes minimum)

SR/Tempering: 1 hour per inch of "t" (15 minutes minimum for Carbon steel and 30 minutes minimum for Alloy steel)

Solution annealing: 15 minutes minimum.

Where "t" indicates the nominal thickness of the tube.

4.5.6.1 For tempering, cooling can be in air or in furnace.

4.5.6.2 In case of Normalising, cooling shall be in still air.

4.5.6.3 Tempering can be clubbed with final stress relieving of the product/component.

4.5.6.4 In case of solution annealing, cooling shall be as fast as possible.

4.5.7 The following rules shall apply to establish the thickness to be used in determining the soaking time for PWHT.

4.5.7.1 For Butt welds, the thickness shall be thickness of the material at the weld.

4.5.7.2 For fillet welds, the thickness shall be the throat thickness. If a fillet weld is used in conjunction with a groove weld, the thickness shall be the total of the depth of the groove plus the fillet throat thickness.

4.5.7.3 For partial penetration branch welds, the thickness shall be the depth of the groove prior to welding.

4.5.7.4 For repairs, the thickness shall be the depth of the groove as prepared for repair.

4.5.7.5 For combination of different welds in a component, the maximum thickness shall govern.

4.5.7.6 For IBR items having welded joint connecting parts of different thickness, the governing thickness (T) for determining the **soaking time for PWHT** shall be the maximum thickness of the part welded.

4.5.8 Local heat treatment can be carried out by resistance heating or induction heating.

4.5.8.1 When heat treating butt welds, The width of the circumferential heating band on either side of the weld must be at least 3 times the width of the widest part of the weld groove; but not less than twice the thickness of the thicker part welded.

4.5.8.2 In case of nozzles and attachment welds, the circumferential band shall extend around the entire tube, shall include the nozzle or welded attachment and shall extend atleast 6 times the base material thickness beyond welding which connects the nozzle or the attachment to the tube.

4.5.8.3 The width of the insulation band beyond the heating band shall be atleast twice the total width of the heating band.

4.5.8.4 Minimum two thermocouple shall be attached to the job for monitoring temperature during PWHT. If any thermocouple fails during local heat treatment, it shall be ensured that atleast one thermocouple monitoring the temperature of the weld zone shall be functioning. Otherwise, heat treatment shall be discontinued and restarted.

4.5.8.5 The winding arrangement shall be established to attain the required temperature. The rate of heating shall be maintained minimum such that it stabilises at the required rate before reaching 400°C.

4.5.9 The parameters for heat treatment shall be as provided in the SQP/OPS.

4.5.10 In case of interruption during heat treatment, the following action has to be taken depending on the stage of occurrence;

Type of Heat treatment	Stage of interruption	Type of furnace	
		Batch type	Continuous discharge
Stress Relieving	Heating	Heat treat subsequently as specified	Switch off roller movement. On resumption of power/ Gas supply, raise the temperature to the level at which the interruption occurred and then switch on roller movement after stabilizing for 5 minutes
	Soaking	Heat treat Subsequently for balance soaking	Switch off roller movement. On resumption of power/ Gas supply, raise the temperature to the level at which the interruption occurred and then switch on roller movement after stabilizing for 5 minutes
	Cooling	If the ROC during interruption the specified rate, cool subsequently at the required rate. Otherwise, reheat to the soaking temperature, hold for 15 minutes and then cool at the specified rate	Not applicable
Tempering	Heating	Heat treat subsequently as specified	Not applicable
	Soaking	Heat treat subsequently for balance soaking	Not applicable
	Cooling	Not applicable	Not applicable
Normalising & Solution annealing	Heating	Heat treat subsequently as specified	Not applicable
	Soaking	Heat treat subsequently for full soaking	Not applicable
	Cooling	Not applicable	Not applicable
Process annealing	Heating / Soaking	Not applicable	Repeat the operation from beginning
	Cooling	Not applicable	Not applicable

4.5.11 After heat treatment, the charts shall be correlated with the job with respect to cycle, date and work order details and cleared by QC.

5.0 FINAL INSPECTION

5.1 Wherever hydraulic test is specified, the same shall be performed in accordance with SIP:PP:04 (latest).

5.2 Ensure completeness of all final machining and EP. Dimensional inspection shall be performed in accordance with the relevant tolerance drawing as given below. Ensure usage of calibrated instruments/gauges.

5.2.1 TOLERANCE DRAWINGS (For Revision status, refer valid list of Standards).

Sl.NO	Drg no.	Description
01	1-03-000-00033	Fabrication tolerance for economiser
02	1-03-000-00036	Fusion welded panel construction - allowable bow Vs panel width
03	1-03-000-00037	- do - (for 12.7 mm web)
04	1-03-000-00038	Fabrication tolerance for fin welded panel construction
05	1-03-000-00039	Fabrication tolerance for fusion welded panel
06	1-03-000-00040	Fabrication tolerance for Fin Welded Panel with header construction
07	1-03-000-00041	Fabrication tolerance for Fusion Welded Panel with header construction (12.7mm web)
08	2-03-000-00003	Fabrication tolerance for SH & RH Horizontal spaced assembly
09	2-03-000-00016	Fabrication tolerance for SH & RH pendant spaced assembly
10	2-03-000-00017	Fabrication tolerance for SH pendant platen assembly

5.3 Inside cleaning of the products shall be done as detailed out in SIP:PP:15 (latest). Surface preparation, painting and preservation shall be in accordance with SIP:PP:22 (latest), unless otherwise specified.

5.4 Identification of WO no., DU No./Part No. and other details shall be done with bold paint/ stencil marking. Packing shall be done in accordance with relevant packing instructions.

5.5 The jobs shall be certified and data folder prepared as per the requirements of the SQP.

@@@@@@@

Annexure_I

ASME MATERIALS & P - NUMBER GROUPING

P-No.	PLATES	PIPES	TUBES	FORGINGS / FITTINGS
P1/Gr 1 (Carbon Steel)	SA 515 Gr 60 SA 516 Gr 60 SA 283 Gr A-D SA 285 Gr C SA 334 Gr 1,6	SA 106 GrA,B SA 333 Gr 1,6	SA 178 Gr A,C SA 179 SA 192 SA 210 Gr A1	SA 350 LF1 SA 266 Cl1
P1/Gr 2 (Carbon Steel)	SA 515 Gr 70 SA 516 Gr 70 SA 299 SA 537 Cl 1	SA 106 Gr C	SA 178 Gr D SA 210 Gr C	SA 105 SA 266 Cl2, Cl3 SA 350 LF2
P3/Gr 1 (L A S)	SA 204 Gr A SA 387 Gr2/Cl1	SA 335 P1,P2	SA 209 T1,T1A SA 213 T2	
P4/Gr 1 (L A S)	SA 387 Gr11 Cl 1 & Cl 2 SA 387 Gr12 Cl 1 & Cl 2	SA 335 P11 SA 335 P12	SA 213 T11 SA 213 T12 SA 199 T11	SA 182 F11 Cl 1,2,3 SA 182 F12 Cl 1,2 SA 234 WP11 Cl 1 SA 234 WP12 Cl 1 SA 336 F11 Cl 1,2,3 SA 336 F12 Cl 1,2
P5A/Gr 1 (L A S)	SA 387 Gr22 Cl 1 & Cl 2	SA 335 P22	SA 213 T22 SA 199 T22	SA 182 F22 Cl 1,3 SA 234 WP22 Cl 1
P5B/Gr 2 (A S)	SA 387 Gr 91	SA 335 P91	SA 213 T91	SA 182 F91 SA 234 WP91 SA 336 F91
P8/Gr 1 (S S)	SA 240 TP 304, 304L, 304H, 316, 316L, 321, 347, 347L, 347H	SA 312 TP 304, 304L, 316, 316L, 321, 347	SA 213 TP 304H, 316, 316H, 321H, 347H, 316 Ti	SA 182 F304H SA 182 F347H

For Non ASME Materials, refer to the respective Standard / Contract QPs.

@@@@@@@

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: SQP: PP: 08 REV.: 09

AMENDMENT SL NO: A5 DATE: 06-05-2016

DESCRIPTION: TUBULAR PRODUCTS

<table>
<tr><th>Clause No</th><th>Amended as</th><th>Basis for amendment</th></tr>
<tr><td>Table- 2 (pre heat & post weld heat treatment temperatures (°c) for pipes/tubes of od ≤108 & t≤ 19mm) under Note 9.0</td><td>PWHT requirement for attachment welding for SA213 T23 material has been revised as below:
<table>
<tr><th rowspan="3">Tube/Pipe Material</th><th rowspan="3">Thickness in mm</th><th colspan="2">BUTT welds</th><th colspan="4">Attachment welds</th></tr>
<tr><th rowspan="2">Preheat (PH)</th><th rowspan="2">PWHT</th><th colspan="2">Fillets Length ≤100mm</th><th colspan="2">Others</th></tr>
<tr><th>PH</th><th>PWHT</th><th>PH</th><th>PWHT</th></tr>
<tr><td>SA 213 T91
SA 213 T92
SA213 T23</td><td>All T</td><td>220°C

150°C</td><td>745±15°C</td><td>220°C</td><td>745±15°C</td><td>220°C</td><td>745±15°C</td></tr>
</table></td><td>Based on shop feedback</td></tr>
<tr><td>NOTE</td><td colspan="2">The above-mentioned changes will be incorporated in the relevant QWI during the next revision of the document.</td></tr>
<tr><td colspan="2">Prepared by: Vaibhav Saxena</td><td>Approved by: Manu Shankar H</td></tr>
<tr><td colspan="2">Saxena 06.05.2016
Signature & Date: 06-05-2016</td><td>Manushankar 06/05/16
Signature & Date: 06-05-2016</td></tr>
</table>

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: SQP: PP: 08 REV.: 09

AMENDMENT SL NO: A4 DATE: 19-02-2016

DESCRIPTION: TUBULAR PRODUCTS

Clause No	**Amended as**	**Basis for amendment**
Note-D under Table-1 (COLD AND HOT WORKING OF TUBULAR PRODUCTS) in Amendment A1 to SQP:PP08/ Rev 09	Soaking time for normalizing operation shall be as per QCP:004 with a minimum of 15 minutes. The components shall be cooled from normalizing temperature, rapidly and continuously, to ambient temperature, by forced air cooling using 8 man coolers minimum (4 numbers on either side of the furnace bogie) along with water spraying assisted by compressed air using two manifold headers with multiple nozzles (one header on either side of the furnace bogie). Subsequently, tempering shall be done with a minimum soaking time of 120 minutes. Rate of heating for normalizing and tempering shall be 220°C/hour maximum. For tempering, cooling shall be done in air.	1. Revision of Alstom design Standard (Document No. 20-2005 Rev 09) 2. Trials conducted in BHEL for establishing the normalizing and tempering process for T23 material

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: SQP: PP: 08 REV.: 09

AMENDMENT SL NO: A4 DATE: 19-02-2016

DESCRIPTION: TUBULAR PRODUCTS

<table>
<tr><th>Clause No</th><th>Amended as</th><th>Basis for amendment</th></tr>
<tr><td>Note-E under Table-1 (COLD AND HOT WORKING OF TUBULAR PRODUCTS) in Amendment A1 to SQP:PP08/ Rev 09</td><td>A test coupon of one extra piece of T23 bend tube of same size and R/D ratio (least R/D ratio in case of different bend radii) as in the Heat treatment lot shall be placed in every normalizing and tempering cycle and the cycles shall be cleared only after ensuring satisfactory results based on the Lab tests conducted on the test coupon.
Applicable tests and acceptance limits for the test coupon:
<table><tr><th>Sl. No</th><th>Tests</th><th>Requirements</th></tr><tr><td>1</td><td>Micro examination</td><td>Presence of fine grains of Tempered Bainite</td></tr><tr><td>2</td><td>Hardness</td><td>160 – 260 HB</td></tr><tr><td>3</td><td>Impact Test</td><td>Charpy V- Notch impact toughness at 20°C as per ASTM A 370.
Six longitudinal specimens, three each from bend and straight portions, shall be cut from the test coupon and tested. The energy levels shall be as per Table 9 of A 370</td></tr></table></td><td>1. Revision of Alstom design Standard (Document No. 20-2005 Rev 09)
2. Trials conducted in BHEL for establishing the normalizing and tempering process for T23 material</td></tr>
<tr><td>NOTE</td><td colspan="2">The above-mentioned changes will be incorporated in the relevant QWI during the next revision of the document.</td></tr>
</table>

Prepared by: Vaibhav Saxena	Approved by: U Revisankaran
Saxena 19-02-2016 Signature & Date: 19-02-2016	Revisankaran Signature & Date: 19-02-2016

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT
AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: SQP: PP: 08 REV.: 09

AMENDMENT SL NO: A3 DATE: 26-08-2015

DESCRIPTION: TUBULAR PRODUCTS

Clause No 2.5.1

Amended as

The following clause has been modified to include RT requirement as below:

Component & operation	Characteristics	Class	Type of check	Quantum of check	Reference document	Acceptance norms	Format of records	Agency			Remarks
								M	C	N	
2	3	4	5	6	7	8	9 D*	**10			10
Straight tube butt welding	Weld Quality	A	Fluoroscopy/ ***RT***	100%	BHE:NDT:PB:FT-01/ ***BHE:NDT:PB:RT-01***		R	ND			
	Finish	C	Visual	100%	SIP:PP:03			QC			

Basis for amendment

Based on Shop and QC feedback

NOTE: The above-mentioned changes will be incorporated in the relevant QWI during the next revision of the document.

Prepared by: Vaibhav Saxena

Saxena 26-08-2015

Signature & Date:26-08-2015

Approved by: S. Selvarajan

Signature & Date: 26-08-2015

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT
AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: SQP: PP: 08 REV.: 09

AMENDMENT SL NO: A2 DATE: 04-08-2015

DESCRIPTION: TUBULAR PRODUCTS

Clause No: Table 1 under Note 2.0

Amended as

COLD AND HOT WORKING OF TUBULAR PRODUCTS

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	Sizing, Squeezing	Hot Bending	Sizing & Squeezing	Swaging & Upsetting	Hot correction
P4 Group 1 SA213T11, T12	R/D<2 or t>13mm SR ***665±15°C*** for fin welded panel if R/D < 3	SR at ***665±15°C*** (see note 2.9)	Hot bend at 870-900°C R/D < 2 SR at ***665±15°C***	Hot form at 790-950°C SR NIL	Hot form at 820-1090°C SR ***665±15°C***	No SR if Hot Correct # at < 720°C Else SR @***665±15°C***

Basis for amendment: HT cycle for P4 material changed to meet IBR & ASME.

Clause No: Table 2 under Note 9.0

PRE HEAT & POST WELD HEAT TREATMENT TEMPERATURES (°C) FOR PIPES/TUBES OF OD <=108 & t <= 19mm

Tube/Pipe Material	Thickness in mm	BUTT welds		Attachment welds			
		Preheat (PH)	PWHT	Fillets Length <=100mm		Others	
				PH	PWHT	PH	PWHT
P4 Group 1	T<=13	150	***665±15°C*** only 1) for IPW 2) for Bifurcates 3) if not pre heated	NIL	NIL	150	@@ ***665±15°C***
	T>13	150	***665±15°C***	Nil	Nil	150	***665±15°C***

Basis for amendment: HT cycle for P4 material changed to meet IBR & ASME.

9.8 Following options to be carried out for the below mentioned combinations.

Sl. No	For Coil Assembly	
1	SA210 Gr C coil+ SA 213 T11/T12 hanger tube	**Option A:** 1. Coil bends only with R/D <=1.3mm or t>19mm, SR @610+15 deg C separately. 2. Hanger tube attachment welding is done without preheating and PWHT carried out at ***665±15°C.*** 3. Now the heat treated bends and hanger tubes shall be used for coil assembly without further PWHT. **Option B:** 1. Hanger tube attachment welding is carried out without preheating. 2. Hanger tube and coil is assembled and as a whole assembly, PWHT @ ***665±15°C*** **to** be carried out.
2	SA 213 T23 coil+ SA 213 T11/T12 hanger tube	**Option A:** 1. Cold coil bends only with a. R/D <10 & T<13 mm or b. T>=13 mm Normalize @ 1040-1070 deg C, temper @ 745+/-15 deg C to be carried out separately. 2. Hanger tube attachment welding is done without preheating and PWHT carried out at ***665±15°C.*** 3. Weld the joints of T23 and separately SR @745+/-15 deg C. 4. Now the heat treated bends and hanger tubes shall be used for coil assembly without further PWHT. **Option B:** 1.Cold coil bends only with a. R/D <10 & T<13 mm or b. T>=13 mm Normalize @ 1040-1070 deg C, temper @ 745+/-15 deg C to be carried out separately. 2. Hanger tube attachment welding is carried out without preheating. 3. Hanger tube and coil is assembled and as a whole assembly, PWHT @ 720-745 deg C to be carried out.

HT cycle for P4 material changed to meet IBR & ASME.

Table 3 under Note 10.0

Material	P1 (Carbon Steel)			P4 (1 or 1.25 Cr, 0.5 Mo Steel)			P5A (2.25 Cr, 1 Mo Steel) & Gr. 23			P15 E Group 1 & Gr.92			P8 (Stainless Steel includes super 304)		
	Thickness	parameter	variable	Thickness	parameter	variable	Thickness	parameter	variable	Thickness	parameter	variable	Thickness	parameter	variable
P1	P1<=38	Preheat	NIL	P4<=13 P1<=38	Preheat	NIL	P5A<=13 P1<=38	Preheat	150				P8 All P1<=38	Preheat	NIL
		PWHT	NIL		PWHT	NIL		PWHT	NIL					PWHT	NIL
				P4>13 &<=25 P1<=38	Preheat	120	P5A>13 &<=25 P1<=38	Preheat	150						
					PWHT	NIL		PWHT	695+/-15						
				P4>25 &<=38 P1<=38	Preheat	120									
					PWHT	*665±15*									
P4				P4 <= 13	Preheat	NIL	P5A<=13 P4<=25	Preheat	150				P8 All P4<=13	Preheat	NIL
					PWHT	NIL		PWHT	NIL					PWHT	NIL
				P4>13 &<=25	Preheat	120	P5A<=13 &P4>25& <=38	Preheat	150				P8 All P4>13& <=25	Preheat	120
					PWHT	NIL		PWHT	695+/-15					PWHT	NIL
				P4>25 &<=38	Preheat	120	P5A>13 &<=25 P4<=38	Preheat	150				P8 All P4>25& <=38	Preheat	120
					PWHT	*665±15*		PWHT	695+/-15					PWHT	*665±15*
P5A & Gr 23							P5A<=13	Preheat	150				P8 All P5A<=13	Preheat	150
								PWHT	NIL					PWHT	NIL
							P5A>13& <=25	Preheat	150				P8 All P5A>13&<=25	Preheat	150
								PWHT	695+/-15					PWHT	695+/-15
P15E Group 1 & Gr 92							All t	Preheat	220	All t	Preheat	220	All t	Preheat	220
								PWHT	745+/-15		PWHT	745+/-15		PWHT	745+/-15
P8 & Super 304													P8 All	Preheat	NIL
														PWHT	NIL

- For T23 welding, preheat is 150 deg C.

HT cycle for P4 material changed to meet IBR & ASME.

NOTE: The above-mentioned changes will be incorporated in the relevant QWI during the next revision of the document.

Prepared by: Vaibhav Saxena

Signature & Date:04-08-2015

Approved by: S. Selvarajan

Signature & Date: 04-08-2015

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: SQP: PP: 08 REV.: 09

AMENDMENT SL NO: A1 DATE: 14-03-2015

DESCRIPTION: TUBULAR PRODUCTS

Clause No	Amended as	Basis for amendment
Table 1 under Note 2.0	Table 1 has been amended to include guidelines for Normalising and Tempering of T23 bends as below	Based on shop feedbacks
NOTE	The above-mentioned changes will be incorporated in the relevant QWI during the next revision of the document.	

Prepared by: Vaibhav Saxena	Approved by: Manu Shankar H
Signature & Date: 14-03-2015	Signature & Date: 14-03-2015

TABLE 1: COLD AND HOT WORKING OF TUBULAR PRODUCTS

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	Sizing, Squeezing Swaging & Upsetting	Hot Bending	Sizing & Squeezing	Swaging & Upsetting	Hot correction
P1Group1&2 SA178 A,C, SA192, SA210 GrA1, Gr C Steel 20	R/D<=1.3 or t > 19mm SR 610 +/- 15°C @@	SR at 610+/-15 °C (Anneal if required see note 2.8)	Hot bend at 870-900°C ** SR - Nil	Hot form at 790-950°C SR - Nil	Hot form at 790-950°C SR - Nil	Hot Correct at < 950°C [650 °C if welds are involved]

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	**Sizing, Squeezing**	**Hot Bending**	**Sizing & Squeezing**	**Swaging & Upsetting**	**Hot correction**
P3 Group 1 SA209T1	All bends SR 635+/-15°C	SR at 635+/-15°C (see note 2.9)	Hot bend at 870-900°C All bends SR at 635+/-15°C	Hot form at 790-950°C SR - Nil	Hot form at 790-950°C SR - Nil	No SR if Hot Correct # at < 720°C. Else SR at 635+/-15°C
P3 Group 2 SA213T2 P4 Group 1 SA213 T11, T12	R/D<2 or t>13mm SR 655+/-15°C for fin welded panels if R/D < 3	SR at 655+/-15°C (see note 2.9)	Hot bend at 870-900°C R/D < 2 SR at 655+/-15°C	Hot form at 790-950°C SR NIL	Hot form at 820-1090°C SR 655+/-15°C	No SR if Hot Correct # at < 720°C Else SR @655+/-15°C
			Minimum SR temperature shall be 650 deg C for ASME jobs.			
P5A Group1 SA213 T22	R/D<2 or t>13mm SR 695+/-15°C	SR at 695+/-15°C (see Note 2.9)	Hot bend at 870-900°C All bends SR at 695+/-15°C	Hot form at 790-980°C SR 695+/-15°C	Hot form at 850-1090°C SR 695+/-15°C	Hot Correct# at < 760°C ,no HT. if > 760,SR at 695+/-15°C
12X1МΦ	R/D<2 or t>13mm SR 745+/-15°C	SR at 745+/-15°C	Hot bend at 950-1100°C Normalize at 950-980°C & Temper at 745+/-15°C	Hot form at 950-1100°C Normalize at 950-980°C & Temper at 745+/-15°C	Hot form at 950-1100°C Normalize at 950-980°C & Temper at 745+/-15°C	Hot Correct# at < 760°C ,no HT. if > 760,SR at 745+/-15°C

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	**Sizing, Squeezing**		**Cold Bending**	**Sizing & Squeezing**	**Hot correction**
P15E Group 1 SA 213 T91,T92	I) For Design Temperature ≤540 deg.C (A) R/D <2.5 SR at 745+/-15°C (B) R/D≥2.5, No HT. II) For Design Temperature >540 & ≤600 deg.C (A) R/D <2 - Normalize at 1040-1070°C & Temper at 745+/-15°C B) R/D ≥2 & <10 – SR at 745+/-15°C C) R/D ≥10, No HT. III) For Design Temp. >600 deg.C (A) R/D <2.5 - Normalize at 1040-1070°C & Temper at 745+/-15°C B) R/D ≥2.5&<10 – SR at 745+/-15°C C) R/D≥10, No HT.	Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot bend at 950-1050°C Normalize at 1040-1070°C & Temper at 745+/-15°	Hot form at 950-1050°C Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot form at 950-1050°C Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot Correct at < 760°C, no HT. if > 760 °C , Normalize at 1040-1070°C and Temper at 745+/-15
	1. Ensure the tube ends are covered by SS end caps during normalizing to avoid scaling. 2. Normalizing and tempering shall be done encompassing the entire component.					

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	Sizing, Squeezing	Hot Bending	Sizing & Squeezing	Swaging & Upsetting	Hot correction
SA213 T23 (UNS K40712) Also grouped under P5Agroup1) $ Refer Notes A to G below	(A)R/D<2.5 &T<13mm (B)For T≥13mm Normalize at 1040-1050°C & Temper at 750-760°C (C)R/D≥2.5 to <10 & T<13mm – Refer below Note-A under T23 (D)R/D≥10 & T<13mm No HT	Normalize at 1040-1050 °C & Temper at 750-760°C	Hot bend at 870-900°C Normalize at 1040-1050°C & Temper at 750-760°C	Hot form at 790-980°C Normalize at 1040-1050°C & Temper at 750-760°C	Hot form at 850-1090°C Normalize at 1040-1050°C &Temper at 750-760°C	Hot Correct at < 605°C, no HT. if > 605 °C, Normalize at 1040-1050 °C & Temper at 750-760°C
P8Group 1 SA213 TP304H SA213 TP316 SA312 TP316	R/D ≥2.5 No HT R/D < 2.5 Solution HT	Solution HT (see note 2.9)	Hot bend at 980-1120°C	Hot form at 980-1120°C	Hot form at 980-1120°C	Hot correct>980°C
		Solution HT: 1040-1090 °C/15 minutes' minimum. Ensure the tube ends are covered by SS end caps during solution annealing.				
P8Group 1 SA213 TP347H Super 304 (S304 H)	R/D ≥ 3.33 No HT R/D < 3.33 Solution HT	Solution HT (see note 2.9)	Hot bend at 980-1120°C	Hot form at 980-1120°C	Hot form at 980-1120°C	Hot correct > 980°C
		Solution HT: 1100-1150 °C/30 minutes' minimum Ensure the tube ends are covered by SS end caps during the solution annealing.				

@@ For fin welded panel bending if R/D < 2.5, SR shall be done for all thickness
# Temperature shall not exceed the value given in this column, if weld joints are getting heated during hot correction
** 920 - 950 °C for Steel 20 materials.

$ T23 (UNS K40712):

(A) If R/D≥2.5 to <10 and cold strained portion of the part is likely to be exposed to temperature between 720 to 1040°C during fabrication whether purposefully or incidentally (or) if a weld is to be made on the cold strained portion, then cold strained part shall be Normalized at 1040°C-1050°C & Tempered at 750°C-760°C after bending.

(B) Tube bends made separately shall be heat treated as per the above table before welding to the panel/coil.

(C) The entire tube containing the area to be heat treated must be normalized and tempered as a unit. Alternatively, the section requiring normalizing & tempering can be removed, heat treated and re welded into the component

(D) Soaking time for normalizing operation shall be as per QCP: 004 with a minimum of 15 minutes. The Component has to be cooled rapidly and continuously (Forced air cooling using 8 man coolers minimum (4 numbers on the either side of the furnace bogie)) to ambient temperature before tempering. Tempering shall be done

with a minimum soaking time of 120 minutes. Rate of heating for normalizing and tempering shall be 220°C/hour maximum. For tempering, cooling shall be done in air.

(E) A test coupon of one extra piece of T23 bend tube of same size and R/D ratio (least R/D ratio in case of different bend radii) as in the Heat treatment lot shall be placed in every Normalising and Tempering cycle and the cycles shall be cleared only after ensuring satisfactory results on the Lab tests conducted on the test coupon

Applicable tests and acceptance limits for the test coupon:

Sl. No	Tests	Requirements
1	Micro examination	Presence of fine grains of Tempered Bainite
2	Hardness	160 – 260 HB
3	Impact Test	Charpy V- Notch impact toughness at 20°C as per ASTM A-370. Six longitudinal specimens **three each** from **bend** and **straight** portions shall be cut from the test coupon and tested. The energy levels shall be as per Table 9 of A 370
4	Percentage Shear Fracture	100% ductile appearance

(F) Precautions to be taken before and during Heat treatment:

1. Normalising and tempering heat treatment shall be done only in furnaces qualified in line with the above requirements. The furnaces shall be re-calibrated every six months to ensure temperature uniformity at different zones.
2. The tube bends shall be applied with chalk power on the external surface to reduce the oxidation during normalising heat treatment.
3. Tube bends shall be properly stacked to avoid distortion during heat treatment. There shall be sufficient gap between tubes to ensure proper air flow between the stacked tubes.
4. Adequate measures shall be taken to avoid direct impingement of flame on the tubes.
5. The sample shall be kept at slightly elevated location to avoid any possibility of direct flame impingement.
6. The tube ends shall be covered with SS end caps during heat treatment to avoid scale formation inside the tubes.

(G) No hot correction shall be done after Normalising & Tempering.

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014 (INDIA)

STANDARD QUALITY PLAN FOR	SQP: PP: 08 / 09
TUBULAR PRODUCTS	Page 1 of 20

Prepared by Quality Assurance	V. Sampath Kumar

Reviewed by	Signature
Engineering (K. Ravishankar)	
Manufacturing Shops (U. Revi sankaran)	
O P & C (K. Srinivasan)	
Quality Control (M.V.Selvan)	
Quality Assurance (S. Selvarajan)	

Revision No.	Date	Approved by	Signature
00	01/04/93	SM / QA	
01	08/11/93	DGM / QA	
02	20/01/95	SM / QA	
03	15/07/96	SM / QA	
04	10/09/03	SDGM / QA	
05	31/12/05	DGM / QA	
06	31/12/07	C. R. Raju SDGM/QA	
07	23/01/10	V.Ravi Kumar SDGM/QA	
08	19/09/11	V.Ravi Kumar AGM/QA	
09	11/06/13	V.Ravi Kumar AGM/QA	

RECORD OF REVISIONS

Rev.No.	Details of revision	Remarks
00	This SQP has been prepared by merging the documents listed in the Remarks column.	SQP 09/00, QCP 2:2:018/01, QCP 2:2:024/04, QCP 2:2:042/03 QCP 2:2:075, QCP 2:2:455, QCP 2:5:314 & HT SCHEDULE Table 8,9,10
01	Document revised based on comments from QC, Shop and OP&C etc. Requirements altered mainly in Tables of Heat treatment for forming & PWHT and in NDE. Editorial corrections made to rearrange clause Nos. and notes.	
02	Totally revised based on feedback from OP&C, Shop and QC.	
03	Cl. 2.1, 2.6.2 & 2.6.4 modified. Notes 1.0 & 2.2.1 Modified to include Steel 20 and update the TDC numbers. Notes 9.7 & 9.9 deleted. Note 9.8 renumbered as 9.7. Amendment A1 dt. 11.09.95 and A2 dt. 20.03.96 merged with this revision. Steel 20 material included in Tables 1 & 2. PR:QEs replaced with SIPs as applicable.	
04	Clauses 2.5.2, 2.5.4, 2.5.5, 2.5.8, Notes 2.1, 2.2, 2.4.3, 2.5, 2.8.1, 2.8.2, 4.0 & Table 2 of Note 9.0 modified. Clause 2.3.2 modified incorporating Amendment A3 dt. 07.04.2000 issued for Rev. 03. Clause 2.5.9.4 added. Amendment A2 dt. 05.06.97 issued for Rev. 03 incorporated in Table 1 of Note 2.0. Notes 10.1 & 10.1.1 modified and 10.1.2.1 added based on Amendment A1 dt. 01.11.96 and Amendment A4 dt. 23.01.2002 issued for Rev.03	
05	Editorial corrections in Clauses 2.2.2, 2.5.1, 2.5.2, 2.5.3 to 2.5.6, 3.2 & 3.3. Clauses 2.6.5 & 2.6.6 modified for clarity. Note 1.0 – TDC Nos. updated. Table 1 Amended to modify the HT requirements (based on Amendments A1 & A2 issued) for SS & T91 bends after cold bending. Also, HT requirement for T91 tubes after cold swaging altered. Note 2.2 under Table 1 - Range of temperature For CDF altered. Note 2.4.3 deleted. Table 2 – Note modified to change the PWHT cycle for burner panel. Minimum SR temp. For ASME jobs (P4 material) altered in Tables 1 & 2.	
06	Amendment A1 dated 05.01.2007 is merged with this revision. Note 2.3 is modified Note 2.4.2 is removed as it is already covered in Table-I and Note- 2.4.1 is merged with Note 2.4. A new Note-2.9 is added for hardness value of AS & SS tubes. A new Note 2.10 is added for bifurcates. A new Note-2.11 is added for PEMA panel's heat treatment before pullout. PWHT requirement for the welds between support members (Lug-to-Lug) in tube supports has been added as a new Note 10.0. Existing Notes 10.0 to 11.1 are renumberd as Notes11.0 to 12.1.	
07	1. For clauses 2.6.1& 2.6.5, Note 4.0 also added as a reference document. 2. For clause 2.7, Note10.0 & table 3.0 also added as a reference document. 3. In note 1, for tubes, New materials T23 with UNS number as per ASME sec I, Super 304 as per code case 2328-1, T92 as per code case 2179-7 included. 4. Based on the revision made in addenda of ASME 2009b, sec I, PG 19, point 3, the solution annealing for the P8 group products in note 2 is revised for the R/D factor and split into two specifications. 5. In all the places of Pno 5B group 2 is changed to P15 E as per the record number of 06-780 of ASME sec I. 6. In note 2, table 1, P3 group 2 for T2 is changed to P3 group-1 T2. (Editorial correction). Also T23, T92 and Super 304 included. 7. In Clause 2.2,soaking time for solution annealing for super 304 included. 8. Clause 2.8 modified mentioning the annealing temperature. 9. In clause 2.9, Hardness values for T2, T23, T92 and Super 304 introduced. Also stainless steel removed and all the materials mentioned. 10. P15 E also included in the table 3.0.	

08	1. Clause 2.1 quantum of check for dimensions changed 2. Clause 2.5.4 activated TIG added. 3. Clause 2.5.6 deleted and subsequent numbers updated. 4. Clause 2.5.6, format of record changed. 5. Clause 2.5.6 and 2.5.7 remarks removed. 6. Clause 2.6.2, transverse word added before flatness of the characteristics for better clarity. 7. Clause 2.6.8, type of check modified, quantum of check changed and remarks removed. 8. Spectro test added in clause 3.2. 9. Note 9.2, 9.6, modified. 10. Note 2.12 included. 11. Table 1, changed based on the code requirements and some notes have been added after table 12. Table 2 and table 3 changes made for P15E group 1. Gr T92 & T23 Included. 13. Notes after table 2.0 modified.
09	1. Amendment – A1 & A2 details included. Already released amendment A2 modified and added. 2. Remarks of 2.6.2 modified. 3. Note 2.10 – Revised for clarity 4. Spectral test in clause 3.2 has been changed to Spectro. 5. Note 11.1.1 (ii) & (iii) – Merged and revised Rest of the sub notes renumbered. 6. Note 11.1.2 – Revised 7. Table-2 – Revised 8. Table-1 – Cold working parameters for P15 E Group1, T23 and SS materials modified as per ASME. Also point C of $ added under table I. 9. Note 9.6 modified. 10. Note 9.8 – Added.

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
										M	C	N	SQP:PP:08/ 09 Page 4 of 20
1	2	3	4	5	6	7	8	9	D*	**	10		11
1.0	**MATERIAL**												
1.1	Tubes	Chemical & Mechanical Properties, Soundness	A	Review of documents	100%	Material procured as per TDC to specification indicated in Drawing.		TC		QC			See Note :1.0
1.2	Plates, sheets & bars, Fittings	Chemical & Mechanical Properties	A	Review of documents	100%	Material procured as per TDC to specification indicated in Drawing.		TC		QC			See Note :1.0
2.0	**INPROCESS** (Refer QCP:004 (Latest) for process control requirements)												
2.1	Marking, cutting & Preparation	Edge preparation	B	Visual, Dimensions	100% *	Cutting plan/ Drawing		R		QC			*FOI shall be done for each setting.
2.2	PROCESS QUALIFICATION												
2.2.1	Bending, Hot Squeezing and sizing	Thinning, Ovality, Flow Area	B	Measurement	Set of three	Drawing & SIP:PP:12		R		QC			Only in case where FOT has not been done already
2.2.2	Swaging	OD, ID, Hardness	B	Measurement	-do-	Drawing & SIP:PP:12 & Note 2.8 & Note 2.9		R		QC			
2.2.3	Welding	Procedure Qualification	B	Review of documents	100%	ASME Sec. IX		WPS		QC			To be qualified if the existing qualification does not meet the requirements
		Personnel Qualification	B	Review of documents	100%	IBR/ASME Sec. IX		WQR		QC			
2.3	**Forming** SEE NOTE 2.0 FOR PROCESS CONTROL												
2.3.1	Heating & Heat Treatment	Time/Temp Control	B	Review of HT Charts/log/ movement sheet	100%	Note 2.0, Table 1		R		QC			

LEGEND : CI: Class (A: Criitical B: Major , C: Minor) * D : Records for Data folder ** M : BHEL C : Customer N : TPI agency QC : Quality Control ND: NDT Lab. R : Record

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9	D*	** 10			11
2.3.2	Tube bends, Swaged Ends & Bifurcates	Surface quality Dimensions	B	Visual Measurement	100% 10%	Free from damages Drawing		R		QC			Refer Note 4.0
2.3.3	Inspection of Swaged ends	Hardness Surface Quality	B	Measurement NDE-LPI	10% 10%	Note 2.8 & 2.9 BHE:NDT:PB:PT-01		R R		QC ND			After HT
2.4	**Preproduction Trials for machine welding**												
2.4.1	Induction Pressure Welding	Weld Bond	B	Bend Test/ Cold Impact	As per SIP:PP:13	SIP:PP:13		R		QC			
2.4.2	Flash Butt welding	Weld Bond	B	Bend Test	As per SIP:PP:14	SIP:PP:14		R		QC			
2.4.3	Studding	Weld Bond	B	See Note 3.0				R		QC			
2.5	**Weld Inspection**												
2.5.1	Straight Tube Butt welding	Weld Quality Finish	A C	Fluoroscopy Visual	100% 100%	BHE:NDT:PB:FT-01 SIP:PP:03		R		ND QC			
2.5.2	IPW	Weld Quality Finish	A C	NDE-UT Visual	100% 100%	BHE:NDT:PB:UT-01 SIP:PP:03		R		ND QC			
2.5.3	FBW	Weld finish inside Diameter	C B	Visual Ball Test	100% 100%	SIP:PP:03 SIP:PP:15		R		QC			
2.5.4	Orbital TIG/ Activated TIG	Weld Quality Weld finish	A C	NDE-RT Visual	100% 100%	BHE:NDT:PB:RT-01 SIP:PP:03		R		ND QC			
2.5.5	GTAW or GTAW+SMAW	Weld Quality Weld finish	A C	NDE-RT Visual	100% 100%	BHE:NDT:PB:RT-01 SIP:PP:03		R		ND QC			
2.5.6	Fusion welded panels and I Pass OTSC panels	Weld Quality Ball Passage	C B	Visual Ball Test	100% 100%	SIP:PP:03 SIP:PP:15		R		QC			

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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9 D*	** 10			11

2.5.7	Flat Fin welded panels	Weld Quality	C	Visual	100%	SIP:PP:03		R	QC			
2.5.8	**Attachment Welds**											
2.5.8.1	Peg Fin Welding	Weld Quality	C	Visual& Hammer Test	100% 10%	SIP:PP:03 #		R	QC			# No breakage when struck with 250 g Hammer
2.5.8.2	Stud Welds	Weld Quality	C	Hammer Test & Visual	10% 100%	Note 3.2 SIP:PP:03		R	QC			
2.5.8.3	Structural Attachments	Weld Quality	C C	Visual NDE-LPI/MPI	100% 10%	SIP:PP:03 BHE:NDT:PB:PT-01/MT-01		R R	QC ND			
2.5.8.4	Finned Economizer	Weld Quality	C	Visual	100%	SIP:PP:03		R	QC			
2.6	**Dimensional Control**											
2.6.1	Straight panels	Length, width Opening location, Orientation, bow, EP	B	Measurement	100%	Drawing and Note 4.0 &5.0		R	QC			
2.6.2	Gang bent panels	Length, Angle, EP, Transverse flatness, Surface quality	B	Layout check NDE-LPI*	100% 10%	Drawing <=12.5 mm BHE:NDT:PB:PT-01		R R	QC ND			*Only Tension side of bend portion if R/D <2.5
2.6.3	Bank Tubes	Dimension, Angle	B	>10 Nos. Layout <=10 Nos. Measurement $	10% @ 100%	Drawing		R	QC			@FOI& further 10% layout. $ Measurement if terminal dimension given
2.6.4	Wall RH panel	Length, width, Bow, Bore, EP	B	Layout Check Measurement	10%	Drawing and Note 5.0		R	QC			

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
										M	C	N	SQP:PP:08/ 09 Page 7 of 20
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.6.5	Burner panel	Length, openings, Flange straightness & bend	B	Measurement	100%	Drawing, Note 4.0 and 6.0		R		QC			
2.6.6	Scalloped Bar	Dimensions	B	Measurement /Layout	10%	Drawing, Note 7.0		R		QC			
		Weld Quality	C	Check NDE-LPI	10%	BHE:NDT:PB:PT-01		R		QC			
2.6.7	Coils and Elements	Terminal dimension, EP, Pitch, Orientation	B	Conformance to fixture	100%	Drawing Note 8.0		R		QC			Fixture shall be inspected.
2.6.8	Loose Tubes	Dimensions, Angle, Bore Diameter	B	Measurement /Layout	10%	Drawing & Note 8.0		R		QC			
2.7	PWHT	Time/Temp Control	A	Review of charts/log	100%	Note 9.0 & Table 2 Note 10.0 & Table 3		R		QC			
2.8	Butt welds (T23)	Soundness	A	Hardness	10%*	150-331 BHN		R		QC			*Per PGMA
3.0 Final													
3.1	Hydraulic Test	Strength & leak tightness	A	Visual	100 % $	Drawing & SIP:PP:04		R		QC			$ See Note 11.0
3.2	Final Inspection	Free from Damages	B	Visual	100%	Drawing		-		QC			
		Passage Freedom		Sponge Test Visual	100%	SIP:PP:15		R		QC			

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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	SQP:PP:08/ 09 Page 8 of 20
1	2	3	4	5	6	7	8	9 D*	** 10			11
		VCI & End Capping	B	Visual	100%	SIP:PP:22		-	QC			
		Identification: Colour Code, WO details, Top/Bottom identity		Visual	100%	Drawing		R	QC			
		Spectro test #		Spectro#	100% #	Drawing Specn		R	QC			# For Alloy steels
3.3	Painting	Paint Finish, DFT	C	Visual Measurement	100% Random	SIP:PP:22		- R	QC			
3.4	Packing and Crating	Protection & stability	C	Visual	100%	Drawing & Packing procedure as applicable		-	QC			
3.5	Certification	Code Compliance	B	Compilation of records	100%	IBR and Note 12.0		R	QC			

NOTE 1.0 The Materials normally used and their TDC Nos. are given below:

MATERIAL	SPECIFICATION	TDC NO.
Tubes	SA 192, SA 210 Gr. A1, Gr. C, SA 209 Gr. T1, SA 213 Gr. T2, T11, T12, T22, T91, SA 213 TP 304H, 316, 321, 321H & 347H	0:102, 0:111,
	SA312 TP316	As per specification.
	Super 304 (S304 H), SA 213 T23, T92	0:124
	GOST 12X1MΦ, Steel 20	0:103
Rifled tubes	SA 210 Gr.A1, Gr. C	0:105
Wear bars	IS 2062, SAE 1070	As per specification.
Bars	SA 182 F12, F22	As per Specification.
Plates	ASTM A36	0:301
	ASTM A576 Gr. 1008 to 1016	0:303
	SA 387 Gr. 12, Gr. 22, SA 588 Gr. A SA 240 TP 304, 310, 309, 309S IS 2062 Gr A, Gr. B, IS 1875 Gr. 2, IS 1079 St. 34	As per Specification.
Fittings/Forgings	SA182 F12, F22, F23, F91	0:404

NOTE 2.0 FORMING

2.1 Bending and swaging can be done cold or hot. Cold working means operation carried out below 590 deg.C. The temperature for bending, swaging and subsequent heat treatment is detailed in Table 1.

TABLE 1: COLD AND HOT WORKING OF TUBULAR PRODUCTS

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	Sizing, Squeezing Swaging & Upsetting	Hot Bending	Sizing & Squeezing	Swaging & Upsetting	Hot correction
P1Group1&2 SA178 A,C, SA192, SA210 GrA1, Gr C Steel 20	R/D<=1.3 or t > 19mm SR 610 +/- 15°C @@	SR at 610+/-15 °C (Anneal if required see note 2.8)	Hot bend at 870-900°C ** SR - Nil	Hot form at 790-950°C SR - Nil	Hot form at 790-950°C SR - Nil	Hot Correct at < 950°C [650 °C if welds are involved]

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	Sizing, Squeezing	Hot Bending	Sizing & Squeezing	Swaging & Upsetting	Hot correction
P3 Group 1 SA209T1	All bends SR 635+/-15°C	SR at 635+/-15°C (see note 2.9)	Hot bend at 870-900°C All bends SR at 635+/-15°C	Hot form at 790-950°C SR - Nil	Hot form at 790-950°C SR - Nil	No SR if Hot Correct # at < 720°C. Else SR at 635+/-15°C
P3 Group 2 SA213T2 P4 Group 1 SA213 T11, T12	R/D<2 or t>13mm SR 655+/-15°C for fin welded panels if R/D < 3	SR at 655+/-15°C (see note 2.9)	Hot bend at 870-900°C R/D < 2 SR at 655+/-15°C	Hot form at 790-950°C SR NIL	Hot form at 820-1090°C SR 655+/-15°C	No SR if Hot Correct # at < 720°C Else SR @655+/-15°C
			Minimum SR temperature shall be 650 deg C for ASME jobs.			
P5A Group1 SA213 T22	R/D<2 or t>13mm SR 695+/-15°C	SR at 695+/-15°C (see Note 2.9)	Hot bend at 870-900°C All bends SR at 695+/-15°C	Hot form at 790-980°C SR 695+/-15°C	Hot form at 850-1090°C SR 695+/-15°C	Hot Correct# at < 760°C ,no HT. if > 760,SR at 695+/-15°C
12X1MΦ	R/D<2 or t>13mm SR 745+/-15°C	SR at 745+/-15°C	Hot bend at 950-1100°C Normalize at 950-980°C & Temper at 745+/-15°C	Hot form at 950-1100°C Normalize at 950-980°C & Temper at 745+/-15°C	Hot form at 950-1100°C Normalize at 950-980°C & Temper at 745+/-15°C	Hot Correct# at < 760°C ,no HT. if > 760,SR at 745+/-15°C

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	Sizing, Squeezing	Hot Bending	Sizing & Squeezing	Swaging & Upsetting	Hot correction
P15E Group 1 SA 213 T91,T92	I) For Design Temperature ≤540 deg.C (A) R/D <2.5 SR at 745+/-15°C (B) R/D≥2.5, No HT. II) For Design Temperature >540 & ≤600 deg.C (A) R/D <2 - Normalize at 1040-1070°C & Temper at 745+/-15°C B) R/D ≥2 & <10 – SR at 745+/-15°C C) R/D ≥10, No HT. III) For Design Temp. >600 deg.C (A) R/D <2.5 - Normalize at 1040-1070°C & Temper at 745+/-15°C B) R/D ≥2.5&<10 – SR at 745+/-15°C C) R/D≥10, No HT.	Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot bend at 950-1050°C Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot form at 950-1050°C Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot form at 950-1050°C Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot Correct at < 760°C, no HT. if > 760 °C , Normalize at 1040-1070°C and Temper at 745+/-15
		1. Ensure the tube ends are covered by SS end caps during normalizing to avoid scaling. 2. Normalizing and tempering shall be done encompassing the entire component.				

Material	COLD WORKING (TEMP < 590°C)		HOT WORKING			
	Cold Bending	Sizing, Squeezing	Hot Bending	Sizing & Squeezing	Swaging & Upsetting	Hot correction
SA213 T23 (UNS K40712. Also grouped under P5Agroup1) $	(A)R/D<2.5 &T<13mm (B)For T≥13mm Normalize at 1040-1070°C & Temper at 745+/-15°C (C)R/D≥2.5 to <10 & T<13mm – Refer below Note-D under T23 (D)R/D≥10 & T<13mm No HT.	Normalize at 1040-1070 °C & Temper at 745+/-15°C	Hot bend at 870-900°C Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot form at 790-980°C Normalize at 1040-1070°C & Temper at 745+/-15°C	Hot form at 850-1090°C Normalize at 1040-1070°C &Temper at745+/-15°C	Hot Correct at < 605°C, no HT. if > 605 °C, Normalize at 1040-1070 °C & Temper at 745+/-15°C
		Ensure the tube ends are covered by SS end caps during normalizing to avoid scaling.				
P8Group 1 SA213 TP304H SA213 TP316 SA312 TP316	R/D ≥2.5 No HT R/D < 2.5 Solution HT	Solution HT (see note 2.9)	Hot bend at 980-1120°C	Hot form at 980-1120°C	Hot form at 980-1120°C	Hot correct>980°C
		Solution HT: 1040-1090 °C/15 minutes' minimum. Ensure the tube ends are covered by SS end caps during solution annealing.				
P8Group 1 SA213 TP347H Super 304 (S304 H)	R/D ≥ 3.33 No HT R/D < 3.33 Solution HT	Solution HT (see note 2.9)	Hot bend at 980-1120°C	Hot form at 980-1120°C	Hot form at 980-1120°C	Hot correct>980°C
		Solution HT: 1100-1150 °C/30 minutes' minimum Ensure the tube ends are covered by SS end caps during the solution annealing.				

@@ For fin welded panel bending if R/D < 2.5, SR shall be done for all thickness
# Temp. Shall not exceed the value given in this column, if weld joints are getting heated during hot correction
** 920 - 950 °C for Steel 20 materials.

$ T23 (UNS K40712:

(A) Soaking time for normalizing operation shall be as per QCP: 004 with a minimum of 15 minutes. The Component has to be cooled rapidly and continuously (Forced air draft) to 205 °C before tempering. Tempering shall be done for one hour per inch of thickness with minimum 30 minutes.

(B) The entire tube containing the area to be heat treated must be normalized and tempered as a unit. Alternatively, the section requiring normalizing & tempering can be removed, heat treated and re welded into the component.

(C) Tube bends made separately shall be heat treated as per the above table before the tubes being welded to the panel/coil.

(D) If R/D≥2.5 to <10 and cold strained portion of the part is likely to be exposed to temperature between 720 to 1040˚C during fabrication whether purposefully or incidentally (or) if a weld is to be made on the cold strained portion, then cold strained part shall be Normalized at 1040-1070°C & Tempered at 745+/-15°C after bending..

2.2 For SR /Tempering in CDF furnace the temperature ranges shall be as follows instead of +/-15°C shown in Table 1.

Steel 20, P1, P3 Grp 2, P4, P5 Grp 1 = +25 / -15°C
P3 Grp 1 = 620 - 660°C
P15E Group1, Gr.92, 12X1MΦ = +/- 15°C

Soaking time shall be as follows:

Normalizing - 1 minute/mm (15 minutes min.)
Tempering / Stress relieving (SR) - 2.5 minute /mm with 15 minutes minimum for P1 and 30 minutes minimum for other ferritic materials.
Solution annealing - minimum 15 minutes for 304H & 316 and 30 minutes for 347H & Super 304.

2.3 Inter stage Heat treatment shall be done at the same temperature and soaking time as SR for multi-stage cold swaging, squeezing and sizing.

2.4 Post forming heat treatment is exempted for all cold bends of P1 material for t </=19 mm R/D > 1.3 except gang bending of fin welded panels with R/D < 2.5.

2.5 Post forming heat treatment may be combined with final PWHT of welds. However this is not applicable in case of swaging and upsetting operations, except in cases where swaged / upset area is at the erection weld end or at least 300mm away from the shop weld end.

2.6 For the purpose of heat treatment, the R/D ratios can be rounded off to the nearest integer as given below.

Diameter (mm)	Bend Radius (mm)	R/D Ratio
38/38.1	75	2
42	80	2
44.5	90	2
51	100	2
51	151	3
54	105	2
54	159	3
60.3	120	2
63.5	190	3
76.1	225	3

2.7 Heating band for strip heated bends:

Heating shall be done on compression side
Width : 50 mm minimum
Length : 50 mm beyond the tangent points
Temperature : As per Table 1

2.8 All swaged ends of carbon steel tubes after forming shall be process annealed as detailed below @ 680-720 deg C for 15 minutes minimum.

2.8.1 Swaged ends of carbon steel tubes meant for welding need not be annealed if the hardness is within 20% in excess of the following:

Material	Hardness Value
SA 210 A1	143 BHN
SA 210 C	179 BHN
SA 192	137 BHN (Thickness >= 5 mm)
SA 178 A	137 BHN
SA 178 C	143 BHN
Steel 20	143 BHN

2.8.2 Swaged ends of carbon steel material meant for bank tubes (undergoing expansion) shall be process annealed and the hardness ensured to be 120 BHN max. Process annealing shall be carried out at 680-720°C for 15 minutes minimum.

2.9 Maximum Hardness after swaging and Heat treatment in case of alloy steel tubes shall be as follows:

Material	Hardness Value
T1, T2, T11, T12, T22	163 BHN
T23	220 BHN
T91, T92	250 BHN
TP304H, TP 316, TP347H	192 BHN
Super 304 (S304H)	219 BHN

2.10 All bifurcate bends shall be stress relieved after pull out at temperature indicated in Table 1. Machining to be carried out before 3rd leg welding.

2.11 Panels made in PEMA shall be stress relieved at temperature indicated in Table1 before pullout openings, if thickness is 7.1mm and above.

2.12 All panels meant for gang bending shall be stress relieved before bending at the temperature indicated in Table 1.

NOTE 3.0 PRE-PRODUCTION TRIALS FOR STUDDING

3.1 A sample tube of about 300 mm shall be studded using the qualified WPS, prior to production.

3.2 The welds shall be visually checked for all round fusion. Conduct hammer test using a 250g hammer. The studs shall not break at the weld. Insert a pipe to at least 2/3 of the depth of the stud and bend it by applying a steady manual load to the lever for 15°. Failure shall not occur at the weld.

NOTE 4.0 OPENINGS IN PANELS

4.1 The openings in panels for peep holes; wall blowers and instrument openings shall be made by pull out bends, wherever feasible. Inserts shall be provided only in unavoidable cases due to size change or location restrictions.

NOTE 5.0 STRAIGHT PANELS

5.1 Establish a reference line square to the edge of the tube at one end of the panel. Mark the panel with required length (specified length + 6 mm) square to the reference line. Transfer both lines to the rear side of the panel. All tubes short of line will be marked for extension.

5.2 The difference between the diagonal shall not be more than 5 mm for panels up to and including 10 m long, and 8mm for longer panels.

NOTE 6.0 BURNER PANEL

6.1 Ensure that temporary cross stiffeners are provided to minimise distortion during handling, HT and transportation. Stiffeners shall be welded on edge bars only.

6.2 Scalloped bars profile and pitches shall be ensured as per drawing.

6.3 Cold side of fusion-welded panel shall be coincided with the cold side of burner panel.

6.4 The maximum permissible longitudinal bow shall be 12.5mm measured on edge bar plane and edge bar tip.

6.5 The wind-box frame straightness shall be within 5 mm for its full length after welding.

NOTE 7.0 SCALLOPED BARS

7.1 Scalloped plates/sheets can be made from more than one piece when length exceeds 1.5 M, but minimum length of splicing shall be more than 500 mm.

7.2 Profile shall be checked by template of at least three profiles and two pitches.

7.3 Scalloped bars having shapes shall be pressed to shape only after scalloping.

7.4 Tolerance on radius for manufacture of scalloped bar is ± 0.5 mm, individual pitch difference is ± 1 mm & cumulative pitch difference is ± 2 mm. However the profile has to be matched with the tubes during panel/coil assembly.

NOTE 8.0 COILS AND LOOSE TUBES

8.1 End out of squareness of terminal ends shall be <= 0.5 mm.

8.2 Tolerances for un-tolerance dimensions shall be:

Up to 1 metre : ± 1mm
Above 1 m & up to 5 m: ± 2mm
Above 5 metres : ± 5mm

NOTE 9.0 POST WELD HEAT TREATMENT

Products of materials falling within the ranges indicated for each P No. in Table 2 below are to be heat treated in the temperature ranges shown.

TABLE 2 : PRE HEAT & POST WELD HEAT TREATMENT TEMPERATURES (°C) FOR PIPES/TUBES OF OD <=108 & t <= 19mm

Tube/Pipe Material	Thickness in mm	BUTT welds		Attachment welds			
		Preheat	PWHT	Fillets Length <=100mm		Others	
				Preheat	PWHT	Preheat	PWHT
P1 group 1 SA 178 A,C SA 192, SA 210A1, Steel 20	All	NIL	610+/-15 deg C For bifurcates and flash butt welds only	NIL	NIL	NIL	610+/-15 deg.C For Fusion Welded Panel, Burner panel** and attachments of throat >13mm only
P1 Group 2 SA210Gr C	1) T<=9 & C≤0.3% 2) T>9 to ≤20 & C≤0.25	NIL	610+/-15 deg C For bifurcates and flash butt welds only	NIL	NIL	NIL	610+/-15 deg.C For Fusion welded Panel, burner panels** and attachments of throat >13mm only

Tube/Pipe Material	Thickness in mm	BUTT welds		Attachment welds			
		Preheat (PH)	PWHT	Fillets Length <=100mm PH	Fillets Length <=100mm PWHT	Others PH	Others PWHT
P1 Group 2 SA210Gr C	3) T>9 to ≤20 & C>0.25 to ≤0.3% 4) All "T" if C > 0.3%	NIL	610+/-15 deg C	NIL	NIL	NIL	610+/-15 deg.C For Fusion welded Panel and attachments of throat >13mm only
P3 group 1	T<=13	NIL	635+/-15 deg C A) For IPW & B) For bifurcates	NIL	635+/-15 deg C For P8 attachments only.	NIL	635+/-15 deg C
	T>13	Nil	635+/-15 deg C	NIL	635+/-15 deg C For P8 attachments only.	NIL	635+/-15 deg C
P3 Group 2 **P4 Group 1**	T<=13	150	655+/-15 only 1) for IPW 2) for Bifurcates 3) if not pre heated	NIL	NIL	150	@@ 655+/-15
	T>13	150	655+/-15	Nil	Nil	150	655+/-15 deg C
	Minimum SR temperature for ASME jobs shall be 650 deg C.						
P5A group 1 **OD<=102**	T<=8	150	695+/-15 only 1) for IPW 2) for Bifurcates 3) if not pre heated	Nil	Nil	150	695+/-15 If throat >13mm or if not preheated.
	T>8	150	695+/- 15	Nil	Nil	150	695+/-15 deg C
SA 213 T91 **SA 213 T92** **SA213 T23**	All T	220 150	745+/-15	220 150	745+/-15 720-745(T23+Gr12 attachment)	220	745+/-15 720-745(T23+Gr12 attachment)

Tube/Pipe Material	Thickness in mm	BUTT welds		Attachment welds			
		Preheat (PH)	PWHT	Fillets Length <=100mm		Others	
				PH	PWHT	PH	PWHT
SA 213 TP304H SA213 TP316 SA312 TP316	All T	NIL	NIL	NIL	NIL	NIL	Solution annealing if throat >13mm at 1040-1090 deg C
SA213 TP347H Super 304							Solution annealing if throat >13mm at 1100-1150 deg.C

@@ For peg fin welds of P4, P5 fins, FW Panel, Fin welded Panel and All P8 attachments only. For all other attachments -only if not pre heated or if throat thickness is > 13mm.

** For PWHT of burner panels done in batch type furnaces. 510 ± 15°C cycles shall be followed with a soaking time of 25 minutes per mm of thickness

9.1 Heat treatment soaking time shall be as given in Note 2.2.

9.2 When scheduled for PWHT, pre heating is not required except for Gr.23, P15E group 1, Gr.92 and12X1MΦ.

9.3 For butt welds of different P-number group combinations, PWHT temperature of higher P-number group shall be applied.

9.4 For attachment welds of different P group No. on Tubes, PWHT temperature of tube material shall apply. However for welding of Austenitic materials with ferrite materials, pre heat & PWHT of ferrite materials shall apply.

9.5 PWHT of stud welding shall be as per approved WPS.

9.6 PWHT of Bifurcate leg welding, except for Gr.23/ P15 E group1/Gr.92 group materials, can be clubbed with Heat treatment of assembly / panels. However, the combination of any of these Gr.23/ P15 E group1/Gr.92 can be clubbed together for PWHT.

9.7 When a number of attachments are welded to tube, each length of weld shall be separated from one another by a length of at least equal to the longer of the adjacent weld. Otherwise, total length of all such welds must be considered for PWHT.

9.8 Following options to be carried out for the below mentioned combinations.

SL NO	For Coil Assembly	
1	SA210 Gr C coil+ SA 213 T11/T12 hanger tube	**Option A:** 1. Coil bends only with R/D <=1.3mm or t>19mm, SR @610+15 deg C separately. 2. Hanger tube attachment welding is done without preheating and PWHT carried out at 655+/-15 deg C. 3. Now the heat treated bends and hanger tubes shall be used for coil assembly without further PWHT. **Option B:** 1. Hanger tube attachment welding is carried out without preheating. 2. Hanger tube and coil is assembled and as a whole assembly, PWHT @ 655+/-15 deg C to be carried out.
2	SA 213 T23 coil+ SA 213 T11/T12 hanger tube	**Option A:** 1. Cold coil bends only with a. R/D <10 & T<13 mm or b. T>=13 mm Normalize @ 1040-1070 deg C, temper @ 745+/-15 deg C to be carried out separately. 2. Hanger tube attachment welding is done without preheating and PWHT carried out at 655+/-15 deg C. 3. Weld the joints of T23 and separately SR @745+/-15 deg C. 4. Now the heat treated bends and hanger tubes shall be used for coil assembly without further PWHT. **Option B:** 1.Cold coil bends only with a. R/D <10 & T<13 mm or b. T>=13 mm Normalize @ 1040-1070 deg C, temper @ 745+/-15 deg C to be carried out separately. 2. Hanger tube attachment welding is carried out without preheating. 3. Hanger tube and coil is assembled and as a whole assembly, PWHT @ 720-745 deg C to be carried out.
3	SA 213 T23 coil+ SA 213 T22 hanger tube	**Option A:** 1. Cold coil bends only with a. R/D <10 & T<13 mm or b. T>=13 mm Normalize @ 1040-1070 deg C, temper @ 745+/-15 deg C to be carried out separately. 2. Hanger tube attachment welding is done without preheating and PWHT carried out at 695+/-15 deg C. 3. Weld the joints of T23 and separately SR @745+/-15 deg C. 4. Now the heat treated bends and hanger tubes shall be used for coil assembly without further PWHT. **Option B:** 1.Cold coil bends only with a. R/D <10 & T<13 mm or b. T>=13 mm Normalize @ 1040-1070 deg C, temper @ 745+/-15 deg C to be carried out separately. 2. Hanger tube attachment welding is carried out without preheating. 3. Hanger tube and coil is assembled and as a whole assembly, PWHT @ 745+/-15 deg C deg C to be carried out.

NOTE 10.0 PWHT requirement for the welds between tubes support are given in Table 3.

TABLE 3: PWHT requirement for the welds between support members (Lug-to-Lug) in tube supports (Not applicable for welds on tubes)

Material	P1 (Carbon Steel)			P4 (1 or 1.25 Cr, 0.5 Mo Steel)			P5A (2.25 Cr, 1 Mo Steel) & Gr. 23			P15 E Group 1 & Gr.92			P8 (Stainless Steel includes super 304)		
	Thickness	parameter	variable	Thickness	parameter	variable	Thickness	parameter	variable	Thickness	parameter	variable	Thickness	parameter	variable
P1	P1<=38	Preheat	NIL	P4<=13 P1<=38	Preheat	NIL	P5A<=13 P1<=38	Preheat	150				P8 All P1<=38	Preheat	NIL
		PWHT	NIL		PWHT	NIL		PWHT	NIL					PWHT	NIL
				P4>13 &<=25 P1<=38	Preheat	120	P5A>13 &<=25 P1<=38	Preheat	150						
					PWHT	NIL		PWHT	695+/-15						
				P4>25 &<=38 P1<=38	Preheat	120									
					PWHT	655+/-15									
P4				P4 <= 13	Preheat	NIL	P5A<=13 P4<=25	Preheat	150				P8 All P4<=13	Preheat	NIL
					PWHT	NIL		PWHT	NIL					PWHT	NIL
				P4>13 &<=25	Preheat	120	P5A<=13 &P4>25& <=38	Preheat	150				P8 All P4>13& <=25	Preheat	120
					PWHT	NIL		PWHT	695+/-15					PWHT	NIL
				P4>25 &<=38	Preheat	120	P5A>13 &<=25 P4<=38	Preheat	150				P8 All P4>25& <=38	Preheat	120
					PWHT	655+/-15		PWHT	695+/-15					PWHT	655+/-15
P5A & Gr 23							P5A<=13	Preheat	150				P8 All P5A<=13	Preheat	150
								PWHT	NIL					PWHT	NIL
							P5A>13& <=25	Preheat	150				P8 All P5A>13&<=25	Preheat	150
								PWHT	695+/-15					PWHT	695+/-15
P15E Group 1 & Gr 92							All t	Preheat	220	All t	Preheat	220	All t	Preheat	220
								PWHT	745+/-15		PWHT	745+/-15		PWHT	745+/-15
P8 & Super 304													P8 All	Preheat	NIL
														PWHT	NIL

- For T23 welding, preheat is 150 deg C.

NOTE 11.0 HYDRAULIC TESTS

11.1 Hydraulic test shall be carried out as per SIP: PP:04 (latest) to the pressure specified in the drawing / SIP: PP:04, for the following:

11.1.1 All tubular assemblies such as:

i) SOFA and Burner panels
ii) Other Panels (100% for thickness ≤5.5mm, 20% for thickness>5.5 mm and <7mm, Nil for thickness ≥7 mm)
iii) Economizer, Super heater & Reheater coils.
iv) For loose tubes or loose bends, following table is applicable.

Length	**Thickness of the Tube**	**Butt Weld**	**Butt weld cleared by FT/RT/UT as applicable**	**Attachment weld**	**Hydro**
>1000 mm	T<7 mm	√	√	√	100%
		X	X	√	100%
		√	√	X	Not Required
	T≥7 mm	For all combinations			Not Required
≤1000 mm	All T	For all combinations			Not Required

11.1.2 All categories of spares involving butt or Attachment weld. When hydraulic test is not feasible due to practical constraints, hydro test can be substituted by 100% NDE of welds (provided Hydro test is not called for in the drawing).

NOTE 12.0 RECORDS

12.1. The following reports shall be maintained by QC:

FOT reports for forming, Dimensional/inspection reports, All material attestation cards, All NDE, Heat treatment, Hydro test reports, as applicable and Ball / Sponge test details.

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