An ISO 9001 Company

# Bharat Heavy Electricals Limited

**(**High Pressure Boiler Plant**)**
Tiruchirappalli – 620014, TAMIL NADU, INDIA
CAPITAL EQUIPMENT / MATERIALS MANAGEMENT

| **ENQUIRY**<br><br>**NOTICE INVITING TENDER** | Phone: +91 431 257 79 38<br>Fax : +91 431 252 07 19<br>Email : tvenkat@bheltry.co.in<br>Web : www.bhel.com |
|---|---|

| **TWO PART BID**<br><br>Tender to be submitted in two Parts | **Enquiry Number:**<br><br>**2620900189** | **Enquiry Date:**<br><br>**15.09.2009** | **Due date for submission of quotation:**<br><br>**27.10.2009** |
|---|---|---|---|

You are requested to quote the Enquiry number date and due date in all your correspondence. This is only a request for quotation and not an order.

**Please note that under any circumstances both delayed offer and late offers will not be considered. Hence vendors are requested to ensure that the offer is reaching physically our office before 14.00 hrs on the Date of tender opening.**

| Item | Description | Quantity |
|---|---|---|
| 10 | **Incremental Induction Pipe Bending Machine - PB 600** as per the technical specification & commercial conditions applicable (to be downloaded from web site www.bhel.com or http://tenders.gov.in) | **2 Nos**. |

**Important points to be taken care during submission of offer**

1. **Delivery required 15 months from the date of purchase order.**
2. **Grace period of 3 months beyond the above delivery period will be considered.**
3. **Checklist to be filled and enclosed along with the offer failing which, the offer will not be considered for evaluation.**

**BHEL's General guidelines / instructions (refer MM/CE/GT/001) including bank guarantee formats and list of consortium banks, commercial terms check-list can be downloaded from BHEL web site http://www.bhel.com or from the Government tender website http://tenders.gov.in (public sector units > Bharat Heavy Electricals Limited page) under Enquiry reference "2620900189".**

| | |
|---|---|
| Tenders should reach us before 14:00 hours on the due date<br>Tenders will be opened at 14:30 hours on the due date<br>Tenders would be opened in presence of the tenderers who have submitted their offers and who may like to be present | Yours faithfully,<br>For **BHARAT HEAVY ELECTRICALS LIMITED**<br><br>Manager / Capital Equipment / MM |

# PART A

## QUALIFYING CRITERIA FOR THE SUPPLY OF

## INCREMENTAL INDUCTION PIPE BENDING MACHINE [711mm OD]

## SECTION – I : COMPANY PROFILE

The BIDDER is requested to provide details listed in the table given below:

| S.No. | PARTICULARS | VENDOR's RESPONSE |
|---|---|---|
| **1.0** | Number of Years of Experience of the BIDDER / VENDOR in the field of Design, Manufacture, Supply and Commissioning of Induction Pipe Bending Machines | |
| **2.0** | Number of Induction Pipe Bending Machines supplied and installed till date with details about customers | |
| **3.0** | Details on International Standards or Codes followed in the Design | |
| **4.0** | Details of Manufacturing Facilities:<br>a) Fabrication Facilities<br>b) Heat Treatment Facilities<br>c) Heavy Machining Facilities<br>d) Assembly & Testing Facilities | |
| **5.0** | Details of Quality System (with Stages of Internal Inspection) followed for the Fabrication and Non-Destructive Testing (NDT) of Weldments | |
| **6.0** | Details on AFTER-SALES-SERVICE Set-Up in INDIA for providing timely service support to BHEL | |

## SECTION – II : QUALIFYING CRITERIA

The BIDDER has to meet the following requirements to get qualified for submitting an offer for the INCREMENTAL INDUCTION PIPE BENDING MACHINE – (suitable for a pipe outer diameter of 711mm ) :

| S.No. | REQUIREMENTS | VENDOR's RESPONSE |
|---|---|---|
| **7.0** | Only those BIDDERs (Original Equipment Manufacturers), who have supplied and commissioned at least one Induction Incremental Pipe Bending Machine for bending pipes of size 700 mm Outer Diameter or above with 60 mm or above Wall Thickness for R/D Ratios of 1.5 to 5 and the same is working satisfactorily for a period of more than one year after commissioning and acceptance (as on date of this tender opening), shall quote. However, if such machine (s) has/had been supplied to BHEL, then such machine should be presently working satisfactorily for more than six months after its commissioning and acceptance in BHEL (as on date of tender opening).<br><br>*The following information should be submitted by the vendor about the companies where similar machines have been supplied. This is required from all the vendors for qualification of their offer* | |
| **8.0** | Name of the Customer / Company where the machine is installed. | |
| **9.0** | Complete Postal Address of the Customer, using machines mentioned under **Clause No. 7.0** | |
| **10.0** | Year of Commissioning. | |
| **11.0** | Parameters of Machine(s) supplied (parameters as mentioned in **Clause 7.0** above) and application for which the machine is supplied. | |
| **12.0** | Name and Designation of the Contact Person of the Customer. | |
| **13.0** | Phone No., FAX No. and e-mail address of the Contact Person of the Customer. | |
| **14.0** | Performance Certificate from the Customers regarding satisfactory performance of machine supplied to them (Original Certificate or Through E-mail directly from the customer). The original performance certificate may be returned after verification by BHEL, if required by BIDDER. A model format for Performance Certificate is given on Page 4 / PART A. | |

| S.No. | REQUIREMENTS | VENDOR's RESPONSE |
|---|---|---|
| **15.0** | BHEL reserves the right to verify the information provided by vendor. In case the information provided by vendor is found to be false/ incorrect, the offer shall be rejected. | |

## SECTION – III : BID / OFFER FORMAT

The BIDDER has to note the following:

| S.No. | REQUIREMENTS | VENDOR's COMPLIANCE |
|---|---|---|
| **16.0** | The BIDDER shall submit the offer in TWO PARTS - Technical [**with PART A & PART B**] & Commercial and Price Bid. | |
| **17.0** | The OFFER shall contain a comparative statement of Technical Specifications given by BHEL and the Offer Details submitted by the Bidder, against each Clause. A just 'YES' or 'CONFIRMED' or 'NO-DEVIATION' or 'COMPLIES' or 'ACCEPTED' or similar words in the technical comparative statement may lead to disqualification of the Technical Offer. | |
| **18.0** | The Technical Offer shall be supported by Product Catalogue and Data Sheets in ORIGINAL and complete technical details of 'Bought-Out-Items' with copies of Product Catalogue and Selection Criteria | |
| **19.0** | The Commercial Offer (given with the Technical Offer) shall contain the Scope of Supply and the Un-Priced Part of the Price-Bid, for confirmation of the inclusion of all the accessories, tooling, attachments, auxiliary parts, spares, consumables, etc. with the main and basic equipment, to meet the technical specification requirements. | |
| **20.0** | The expected delivery period (including the time for Pre-Dispatch Inspection clearance by BHEL) for the Incremental Pipe Bending Machines (2 Nos.) is not more than FIFTEEN months from the date of issue of BHEL Purchase Order. In case the quoted delivery period extends beyond FIFTEEN months, a grace period of THREE months is permitted, but with a loading for arriving at the PRICE COMPETITIVENESS of the Offer (if the OFFER is technically acceptable on all accounts). Details are given in the commercial terms of the this tender | |

# PERFORMANCE CERTIFICATE – [SAMPLE FORMAT]

(On Customer's Letter Head with Additional Sheet – if necessary)

1. Supplier of the Equipment/Machine :

2. Make & Model of the Equipment :

3. Month & Year of Commissioning :

4. Application for which Machine is used :

5. a. Equipment Serial Number :
   b. Maximum Pipe Diameter Handled :
   c. Minimum Pipe Diameter Handled :
   d. Inductive Power in kW :
   e. Operating Frequency Range in Hz :
   f. Special Features – like Pipe Rotating Device…….:

6. Performance of the Machine : Satisfactory / Good / Average / Not Satisfactory

7. Feed- back on 'After Sales Service' by the Supplier :

8. Remarks / Reasons for Recommendations to BHEL :

Date:

Signature & Seal of the Authority
Issuing the Performance Certificate

**PART B: SPECIFICATION CUM COMPLIANCE CERTIFICATE FOR INCREMENTAL INDUCTION PIPE BENDING MACHINE - 711mm OD**

**NOTE:-**

1. **The "Offered" Column and where applicable, the "Deviations" & "Remarks" Column, of this format shall be filled in by the BIDDER and submitted along with the offer. Inadequate / incomplete, ambiguous, or unsustainable information against any of the clauses of the specifications/requirements shall be treated as non-compliance.**
2. **The offer and all documents enclosed with offer should be in English language only.**
3. **Scope of Work : Design, Manufacture, Testing, Supply, Erection & Commissioning of INCREMENTAL INDUCTION PIPE BENDING MACHINE (suitable for maximum Pipe - OD -711 mm) COMPLYING WITH SPECIFICATIONS AS BELOW**

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| **1.0** | **PURPOSE & WORK-PIECE MATERIAL** | | | |
| 1.1 | Purpose: The Incremental Induction Heating Pipe Bending Machine is required for progressive, formerless bending of pipes used in Utility and Industrial Boilers for conveying steam, water etc . | Vendor to Note & Confirm Suitability of Machine for the same | | |
| 1.2 | Work Piece Material: Carbon Steel pipes including SA106 Grade B, Grade C & Alloy Steel pipes, including SA 335 P11, P22, P91, P92, SA 335 P23,P36 (WB 36) specifications. | Vendor to Note & Confirm Suitability of Machine for the same | | |
| | | | | |
| **2.0** | **SPECIFICATION:** | | | |
| | | | | |
| **2.1** | **MACHINE CONFIGURATION:** | Vendor to Confirm | | |
| 2.1.1 | The machine shall have the following features: | | | |
| a) | Main Frame with Pusher | | | |
| b) | Bending Arm | | | |
| c) | Induction Heating system | | | |
| d) | Chilling Unit for Induction Heating System | | | |
| e) | Inductor Control System | | | |
| f) | Quenching System | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| g) | Temperature Measuring System | | | |
| h) | Hydraulic system | | | |
| i) | Pipe Rotation Device | | | |
| j) | Pipe Loading Device (Optional ) | | | |
| k) | Input Transformer for Induction Heating Equipment | | | |
| l) | The machine shall be suitable for<br>**Case 1 :** Counter-Clockwise bending when viewed from the pipe pusher<br>**Case 2 :** Clockwise bending when viewed from the pipe pusher<br>*[as BHEL intends to procure 2 Machines, one in each configuration ; BHEL also reserves the right to procure 2 Machines with same configuration - which will be finalised before the placement of Purchase Order by BHEL]* | | | |
| | | | | |
| **2.2** | **PIPE & BEND SPECIFICATIONS:** | | | |
| 2.2.1 | Maximum Pipe Diameter (in mm) | 711 | | |
| 2.2.2 | Minimum Pipe Diameter in mm (expected around 168mm) | Vendor to Specify | | |
| 2.2.4 | Maximum Pipe Wall Thickness in mm (expected around 100 mm) | Vendor to Specify | | |
| 2.2.5 | Minimum Pipe Wall Thickness in mm (expected around 5 mm) | Vendor to Specify | | |
| 2.2.6 | Maximum Bending Radius (approx **5D** required) | Vendor to Specify | | |
| 2.2.7 | Minimum Bending Radius (upto 90 deg bending angle) | Vendor to Specify | | |
| 2.2.8 | Minimum Bending Radius (upto 180 deg bending angle) | Vendor to Specify | | |
| 2.2.9 | Maximum **D/t** Ratio for Air Quenchable Steel *[ D - Pipe Diameter]* | Vendor to Specify | | |
| 2.2.10 | Maximum **D/t** Ratio for Water Quenchable Steel *[t-Pipe Wall Thickness]* | Vendor to Specify | | |
| 2.2.11 | R/D Ratio : 1.5 to 5 | Vendor to Confirm | | |
| 2.2.12 | Bending Angle (in degrees) | 0 to 180 | | |
| 2.2.13 | Maximum Pipe Length (in mm) (approximately) | 9000mm | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.2.14 | Bending Temperature (Extrados): (deg C)<br>Carbon Steel Pipes and Alloy Steel Pipes of Grade<br>a) P11, P12, P22<br>b) P36 (WB 36)<br>c) P23<br>d) P91, P92 | <br><br>770-780<br>750-950<br>750-1100<br>1000-1100 | | |
| 2.2.15 | Bending Temperature (Intrados): (deg C)<br>Carbon Steel Pipes and Alloy Steel Pipes of Grade<br>a) P11, P12, P22, P36 (WB 36) & P23<br><br>b) P91, P92 | <br><br>1000<br><br>1000-1100 | | |
| 2.2.16 | Bending temperature control on Intrados / Extrados : Within ± 10° C | Vendor to Confirm | | |
| 2.2.17 | **Accuracies required for bends :**<br>The bends made on the machine shall be within under-mentioned limits | | | |
| a) | Wall thinning :<br>10% to 22% (depending on thickness of pipe) for R/D = 1.5<br>Max. 10% for all pipe thickness for R/D = 3.0 | Vendor to Confirm | | |
| b) | Ovality should be limited to 20 D/R subjected to a maximum of 5 % | Vendor to Confirm | | |
| c) | Wrinkles :<br>*Pitch of Valley / Depth >/= 12<br>Depth of Valley / OD </= 3 % | Vendor to Confirm | | |
| d) | Angle of Bend : Within +/- 0.5 degrees | Vendor to Confirm | | |
| e) | Bending Radius (Tolerance on radius):<br>NB < 250 mm: ± 3 mm<br>NB 300 to 600 mm: ± 5 mm<br>NB 600 to 900 mm: ± 6 mm<br>NB > 900 mm: ± 8 mm | Vendor to Confirm | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.2.18 | **Tolerance on Pipe:**<br>Where Outside Diameter is specified, the tolerance on Outside Diameter is +/- 1% and on thickness is +/- 12.5 %. Where Inside Diameter is specified, tolerance on Inside Diameter is +0.0 / - 3.2mm and on Thickness is + 3.2 mm, - 0.0 mm. | Vendor to note | | |
| 2.2.19 | The temperature difference between the outside skin & inside skin of the pipe, both at the Intrados & extrados, for the maximum wall thickness & Outside diameter | Vendor to specify | | |
| 2.2.20 | ***Some of the Pipe Sizes proposed to be bent on the machine are furnished in Annexure I. Vendor to indicate, against each pipe size; the possibility, or otherwise, of bending the various sizes mentioned in Annexure I. Vendor shall also furnish the approx bending speed. The vendor has to indicate the likely thinning, raw material thickness considering the thinning and the ovality likely. No water quenching is allowed in P91 / P92 material .*** | Vendor to furnish | | |
| | | | | |
| **2.3** | **MAIN FRAME WITH PUSHER:** | | | |
| 2.3.1 | Pushway Length (mm) | Vendor to Specify | | |
| 2.3.2 | Remainder Length (mm) (should be as small as possible) | Vendor to Specify | | |
| 2.3.3 | Pipe pusher shall be driven by an electric motor | Vendor to Confirm | | |
| 2.3.4 | Pusher drive motor rating (in kW) | Vendor to Specify | | |
| 2.3.5 | Pusher drive mechanism (Chain / Spindle/ any other mechanism) | Vendor to Specify | | |
| 2.3.6 | Support for Pusher drive mechanism along the length to prevent sagging | Vendor to furnish details | | |
| 2.3.7 | Mechanism to maintain equal tension in the two pusher drive | Vendor to Specify | | |
| 2.3.8 | Automatic Timed Lubrication of Spindle / Chain etc should be provided | Vendor to Confirm | | |
| 2.3.9 | Bending Speed Range (minimum 0.5mm/minute or less) | Vendor to Specify | | |
| 2.3.10 | Idle Speed of Pusher (mm/min) | Vendor to Specify | | |
| 2.3.11 | Maximum force on bending roll | Vendor to Specify | | |
| 2.3.12 | Mechanism for movement / positioning of bending roll | Vendor to furnish details | | |
| 2.3.13 | Pipe Support Rolls should be provided | Vendor to Confirm | | |
| 2.3.14 | Pipe Support Roll adjustment mechanism | Vendor to Specify | | |
| 2.3.15 | Other Rolls provided on the machine and their purpose | Vendor to specify | | |
| 2.3.16 | Radius adjustment mechanism | Vendor to specify | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.3.17 | Rating of radius adjustment motor | Vendor to specify | | |
| 2.3.18 | Should be provided with an adjustable platform for mounting the matching (Medium frequency) transformer | Vendor to Confirm | | |
| 2.3.19 | Motorized adjustment of the MF Transformer should be possible in the longitudinal (pipe axis), transverse, and Up/Down directions. Detail of the arrangement should be furnished with the offer | Vendor to Confirm & furnish details | | |
| | | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| **2.4** | **MAIN BENDING ARM:** | | | |
| 2.4.1 | Maximum Diameter of pipe that can be clamped (mm) | Vendor to Specify | | |
| 2.4.2 | Minimum Diameter of pipe that can be clamped (mm) | Vendor to Specify | | |
| 2.4.3 | Maximum thickness of pipe (mm) | Vendor to Specify | | |
| 2.4.4 | Minimum thickness of pipe (mm) | Vendor to Specify | | |
| 2.4.5 | Maximum radius of bend (mm) | Vendor to Specify | | |
| 2.4.6 | Minimum radius of bend (mm) | Vendor to Specify | | |
| 2.4.7 | Maximum Clamping Length - Should be as small as possible (mm) | Vendor to Specify | | |
| 2.4.8 | It should also be possible to clamp pipes of smaller diameter and thickness with clamping arrangement that has half the above clamping length | Vendor to Confirm and Provide Details | | |
| | a) Max diameter and thickness of pipe that can be clamped with above half clamp length (mm) | Vendor to Specify | | |
| 2.4.9 | Clamping Mechanism (Electro-Hydraulic / Electro-Mechanical) Vendor to Furnish Details along with the offer | Vendor to Furnish | | |
| 2.4.10 | Provision to ensure that clamping force is not lost during bending | Vendor to Specify | | |
| 2.4.11 | Straight Start (mm) | Vendor to Specify | | |
| 2.4.12 | Maximum Pushing Force (in kN) | Vendor to Specify | | |
| 2.4.13 | Maximum Bending Moment (in kN-m) | Vendor to Specify | | |
| 2.4.14 | Capacity Graphs for Water Quenchable steels and Air Quenchable Steels shall be furnished along with offer | Vendor to Furnish | | |
| 2.4.15 | Bending Temperature at which the above graphs are valid (deg C) | Vendor to Specify | | |
| 2.4.16 | Ovality graphs (Ovality to R/D Ratio) for various D/t ranges for both air and water quenchable steels should be furnished along with offer | Vendor to Furnish | | |
| 2.4.17 | Wall Thinning graphs (Wall Thinning to R/D Ratio) for various thickness ranges should be furnished along with offer | Vendor to Furnish | | |
| 2.4.18 | Minimum R/D possible (below 1.5) with corresponding graphs for capacity, thinning and ovality | Vendor to Furnish | | |
| | | | | |
| **2.5** | **INDUCTION HEATING SYSTEM:** | | | |
| 2.5.1 | Static Frequency Converter | Vendor to Specify | | |
| 2.5.2 | Inductive Power (in kW) (minimum required 500 kW) | Vendor to Specify | | |
| 2.5.3 | Frequency (Hz) (500 to 3000 Hz) | Vendor to Specify | | |
| 2.5.4 | Medium Frequency (MF) Output Voltage | Vendor to Specify | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.5.5 | Fixed Capacitance (in kVAR) | Vendor to Specify | | |
| 2.5.6 | Switchable Capacitance (in kVAR) | Vendor to Specify | | |
| 2.5.7 | Control shall be Microprocessor based<br>*(make of Microprocessor and its Technical Details are to be furnished)* | Vendor to Confirm | | |
| 2.5.8 | Power Setting by Potentiometer on Control Desk (max power in case of auto control of temperature, actual power in case of Manual control) (Remote Operation) | Vendor to Confirm | | |
| 2.5.9 | The frequency range should be selectable by means of switchable capacitor banks. Vendor to provide details | Vendor to Furnish | | |
| 2.5.10 | Transistor Inverter or IGBT Inverter or Thyristor Inverter<br>*[BHEL prefers to have an IGBT based Power Converter with uncontrolled rectifier at the input side, considering the advantages of improved efficiency and power factor]* | Vendor to Specify | | |
| 2.5.11 | AC Unit of sufficient capacity shall be provided for the Converter panel. | Vendor to Confirm | | |
| 2.5.12 | Diagnostics feature shall be provided for trouble shooting the faults in the Induction Generator | Vendor to Confirm | | |
| 2.5.13 | Display of Output Power, Frequency, MF Output Voltage, Inverter Current, DC Link Voltage and Current shall be provided | Vendor to Confirm | | |
| 2.5.14 | Make of Induction Heating System | Vendor to Specify | | |
| 2.5.15 | MF (load matching) Transformer Rating | Vendor to Specify | | |
| 2.5.16 | Tap changing (transformer ratio) in primary of output MF transformer shall be by means of switches. Vendor shall furnish details of tap | Vendor to Furnish | | |
| 2.5.17 | Should meet Electromagnetic Compatibility (EMC) Regulations. | Vendor to Confirm | | |
| | | | | |
| **2.6** | **WATER CHILLER FOR INDUCTION HEATING SYSTEM:** | | | |
| 2.6.1 | Closed Circuit, Refrigeration type Water Chiller shall be provided for circulating chilled water through the components of the induction | Vendor to Confirm | | |
| 2.6.2 | Cooling Water Flow (in m3/min.) | Vendor to Specify | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.6.3 | The average wet-bulb temperature at BHEL works is 33 º C & the maximum wet-bulb temperature is 35 º C . The maximum dry bulb temperature is 44 º C & the minimum is 35 º C. The closed circuit cooling equipment shall be suitable for open circuit cooling water inlet temperature of 37 º C (max) | Vendor to Note | | |
| 2.6.4 | Chilled Water Temperature (deg C) | Vendor to Specify | | |
| 2.6.5 | Power Rating of Chiller in kW | Vendor to Specify | | |
| 2.6.6 | Water quality required for Chiller Unit (Closed Circuit) | Vendor to Specify | | |
| 2.6.7 | The chiller unit shall be provided with suitable water tank | Vendor to Confirm | | |
| 2.6.8 | Capacity of Tank | Vendor to Specify | | |
| 2.6.9 | Features that will prevent erosion of fittings used in Chiller unit resulting from scale formation | Vendor to Specify | | |
| 2.6.10 | BHEL prefers the BIDDER to include a Portable Water Treatment Unit, alongwith the Chiller Unit for the Closed Circuit Cooling System for a fool-proof system. The quality of treated water supplied by BHEL (as the inlet water for the Water Treatment Unit) will have the following properties : pH Value - 7.2 ; Conductivity - 990 micro.mho/cm ; Total Hardness - 260 ppm as CaCO3 ; Dissolved Solids - 477 ppm ; Resistivity - 1010 ohm.cm ; Iron content - 0.5 ppm as Fe ; Suspended | Vendor to Specify | | |
| | | | | |
| **2.7** | **INDUCTOR CONTROL SYSTEM:** | | | |
| 2.7.1 | It should be possible to move the inductor in 3 directions for gradation bending (Start / Stop Procedure), control of temperature at the intrados and extrados, control forces of deflection experienced by the machine frame etc. It may be accomplished by moving the MF transformer support platform in 3 directions | Vendor to furnish details | | |
| 2.7.2 | Inductor Stroke: | | | |
| | a) Forward / Backward Stroke (mm) | Vendor to Specify | | |
| | b) Up/down Stroke (mm) | Vendor to Specify | | |
| | c) Transverse Stroke (mm) | Vendor to Specify | | |
| 2.7.3 | Mechanism for adjustment (Vendor to furnish details)<br>Guide-ways shall preferably be LM Guides | Vendor to Specify | | |
| 2.7.4 | Auto and manual control should be possible | Vendor to confirm | | |
| 2.7.5 | Adjustment motors should be AC with frequency control | Vendor to Confirm | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| | | | | |
| **2.8** | **QUENCHING SYSTEM:** | | | |
| 2.8.1 | All required accessories for Air Quenching and Water Quenching of Pipe on either side of the heated zone should be provided | Vendor to confirm & Furnish Details | | |
| 2.8.2 | Automatic Selection of Quenching Medium should be possible through program | Vendor to confirm & Furnish Details | | |
| 2.8.3 | Quenching water flow (m3/min) | Vendor to Specify | | |
| 2.8.4 | Quenching water pressure | Vendor to Specify | | |
| 2.8.5 | Quenching air flow (in m3/min. - cubic metre per minute)<br>(Shop air pressure is available at 60 to 65 psi) | Vendor to Specify | | |
| 2.8.6 | A water manifold shall be provided at a proper location on the machine platform to enable the operator to set the amount of quench water and the amount of quench air | Vendor to Confirm & Furnish Details | | |
| 2.8.7 | Quenching arrangement shall be provided for :<br>a) Water Quenching of Intrados<br>b) Water Quenching of Extrados<br>c) Air Quenching of Intrados<br>d) Air Quenching of Extrados<br>e) Water for Inductor Ring | Vendor to confirm & Furnish Details | | |
| 2.8.8 | Suitable water flow switch should be furnished to monitor the Inductor Ring cooling water flow and switch off the heating in case of inadequate water flow | Vendor to Confirm | | |
| 2.8.9 | Inductor Ring cooling water flow (in m3/min) | Vendor to Specify | | |
| 2.8.10 | In addition a separate water nozzle shall be provided which can be moved away from the quenching ring to provide additional water quench for providing additional cooling at the extrados. | Vendor to confirm | | |
| 2.8.11 | It should be possible to adjust the position of the extrados quench ring and the quench nozzle at the extrados | Vendor to furnish details | | |
| 2.8.12 | Total water flow for quenching, inductor ring etc (i.e open circuit cooling) (in m3/min) | Vendor to Specify | | |
| 2.8.13 | Pressure of open circuit cooling water | Vendor to Specify | | |
| 2.8.14 | Temperature of open circuit cooling water | Vendor to Specify | | |
| 2.8.15 | Required pump and drive for open circuit cooling water will be provided by BHEL | Vendor to note | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.8.16 | Open Circuit cooling water shall be provided by BHEL at one point near the machine. Further distribution is in the scope of BIDDER | Vendor to Confirm | | |
| 2.8.17 | Compressed air line will be provided by BHEL at one point near the machine. Further distribution is in the scope of the vendor | Vendor to Confirm | | |
| | | | | |
| **2.9** | **TEMPERATURE MEASUREMENT SYSTEM :** | | | |
| 2.9.1 | One set of optical temperature measurement system for measuring temperature of the pipe intrados and extrados during bending shall be provided. | Vendor to Furnish details | | |
| 2.9.2 | The output of the measurement system should be fed back to the control system for display and control of the temperature | Vendor to Confirm | | |
| 2.9.3 | It should be possible to adjust the optical sensor and focus on the bending zone. If possible a laser pointer shall be provided to focus the pyrometer. Location of pyrometer should be such that it is easily accessible for adjustment | Vendor to Confirm | | |
| 2.9.4 | Once set, the optical temperature measurement sensor should move along with the movement of the inductor so that the sensor always remains focused on the heated band | Vendor to Confirm | | |
| 2.9.5 | Temperature Range (600 deg C to 1200 deg C) | Vendor to Specify | | |
| 2.9.6 | The equipment should be capable of reading the correct temperature irrespective of the emissivity of the material. No manual setting of correction factors should be required | Vendor to Confirm | | |
| 2.9.7 | Make & Model | Vendor to Specify | | |
| 2.9.8 | There shall be no difference between the temperature as indicated by the optical pyrometer and contact thermometer placed at the point focused by the optical pyrometer. Alternatively suitable compensating mechanism shall be provided. | Vendor to Confirm | | |
| 2.9.9 | Calibration certificate traceable to International Standards shall be supplied along with the equipment | Vendor to Confirm | | |
| | | | | |
| **2.10** | **HYDRAULIC SYSTEM :** | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.10.1 | The System should be centralized. Hydraulic Tank shall preferably be located at floor level | Vendor to Confirm | | |
| 2.10.2 | Make shall be necessarily of Rexroth or Vickers Sperry only. (Complete Technical Details to be submitted) | Vendor to Specify | | |
| 2.10.3 | Filtration System, Details to be submitted. | Vendor to Furnish | | |
| 2.10.4 | Failure Indication should be provided | Vendor to Confirm | | |
| 2.10.5 | Suitable refrigeration type cooling system of sufficient capacity to maintain hydraulic system at a temperature not exceeding 40 deg C irrespective of the ambient conditions should be installed. Complete details should be submitted | Vendor to Confirm | | |
| 2.10.6 | Hydraulic Pump Capacity **(flow / pressure)** | Vendor to Specify | | |
| 2.10.7 | Oil Tank Capacity | Vendor to Specify | | |
| 2.10.8 | Where more than one pump is used, each pump should have an independent motor. Tandem pumps should not be used | Vendor to Confirm | | |
| 2.10.9 | **First filling of all required Oils & Grease etc.** to be supplied by Vendor. Indigenous (Indian) source or Indian equivalent and specifications of oils/ greases are also to be provided by the Vendor, for future procurement by BHEL. | Vendor to Confirm | | |
| | | | | |
| **2.11** | **PIPE ROTATION DEVICE:** | | | |
| 2.11.1 | This device is required for clamping and rotating the pipe to carryout multi-plane bends | Vendor to Furnish details | | |
| 2.11.2 | Rotation Angle (minimum range required is 0 to 180 degrees) | Vendor to Specify | | |
| 2.11.3 | Maximum diameter and thickness of pipe that can be handled by the Pipe Rotation Device | Vendor to Specify | | |
| 2.11.4 | Pipe Rotation Device shall have suitable clamping system to hold the pipe during setting of plane of bend and distance between bends. Further the clamp should hold the pipe during return of the bending arm to start position | Vendor to Furnish details | | |
| 2.11.5 | Suitable support rolls should also be provided to support the bent pipe when the pipe clamp in the bending arm is released for return to start position | Vendor to Furnish details | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.11.6 | Suitable mechanism should be provided to prevent the pipe clamp in the bending arm from hitting against the pipe during its return to start | Vendor to Furnish details | | |
| | | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| **2.12** | **PIPE LOADING DEVICE: (OPTIONAL)** | | | |
| 2.11.1 | Suitable pipe loading mechanism should be offered for loading of pipe on the machine | Vendor to Furnish details | | |
| 2.11.2 | The device shall be suitable for the maximum length of pipe specified | Vendor to Confirm | | |
| 2.11.3 | Location and size of Pipe Loading device shall be furnished | Vendor to Furnish details | | |
| | | | | |
| **2.13** | **CONSTRUCTION:** | | | |
| 2.13.1 | Vendor to furnish broad constructional details of the machine and induction heating system including explanatory drawings / sketches, etc. | Vendor to Furnish | | |
| 2.13.2 | Video images on CD / Photographs / Literature explaining the technical features should be enclosed with the offer | Vendor to Furnish | | |
| 2.13.3 | Machine Control Main Panel, Medium Frequency (MF) Transformer, Hydraulic Power-Pack, etc. shall be mounted on the moving machine bed to minimize the complications arising out of handling MF Power Cables. | Vendor to Furnish details | | |
| 2.13.4 | Main Power Cables taken from the Electrical Sub-Station to the Machine's Main Panel shall be taken though Metallic Cable Drag Chain Arrangement, alongwith the associated control cable line, compressed air line, cooling water line, etc. | Vendor to Furnish details | | |
| 2.13.5 | It is preferred to have individual water cooled MF power cables, instead of employing a single co-axial type MF power cable (from the MF Transformer to the Inductor Ring). | Vendor to Furnish details | | |
| | | | | |
| **2.14** | **OPERATOR'S PLATFORM :** | | | |
| 2.14.1 | Machine Operator's Platform, with access ladder, should be provided on the machine. | Vendor to Confirm | | |
| 2.14.2 | Height of Platform from Shop Floor. | Vendor to Specify | | |
| | | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| **2.15** | **OPERATION AND CONTROL SYSTEM:** | | | |
| **2.15.1** | **OPERATOR'S PANEL:** | | | |
| 2.15.1.1 | Desk type Operator's Control Desk complete with HMI for data input and display shall be provided on the machine platform at a suitable location. The location should provide the operator with an unhindered view of the pipe, clamp, heating zone and inductor during loading and bending of pipe. All switches on the operator's panel should be within reach of operator for convenient, efficient & safe operation. All displays/indications should also be conveniently placed accordingly. Layout showing complete details of controls on the desk should be | Vendor to confirm | | |
| 2.15.1.2 | An Auxiliary Pendant Control Unit should be provided, if required, for efficient operation | Vendor to confirm | | |
| 2.15.1.3 | Suitable provision should be made to protect the operator and control desk from heat radiation emanating from the pipe heating zone during bending with air quenching. | Vendor to Furnish details | | |
| | | | | |
| **2.15.2** | **CONTROL SYSTEM & FEATURES :** | | | |
| 2.15.2.1 | CNC or Industrial PC / PLC with Graphics Panel (HMI) (Latest Version) | Vendor to Specify & furnish complete details | | |
| 2.15.2.2 | Make and Model | Vendor to Specify | | |
| 2.15.2.3 | It should be possible to program, edit different bending cycles and store the same for retrieval | Vendor to Confirm | | |
| 2.15.2.4 | Number of Programs that can be stored | Vendor to Specify | | |
| 2.15.2.5 | It should be possible to monitor the entire bending process on the display | Vendor to Confirm | | |
| 2.15.2.6 | Display Type (Color TFT / CRT) & Size | Vendor to Specify | | |
| 2.15.2.7 | It should be possible to Up/download PLC Programs | Vendor to Confirm | | |
| 2.15.2.8 | It should be possible to Up/download of NC/PLC Data | Vendor to Confirm | | |
| 2.15.2.9 | It should be possible to Up/download of Programs | Vendor to Confirm | | |
| 2.15.2.10 | Details of the process of up/downloading of PLC Program, NC/PLC data and Up/downloading of programs should be furnished | Vendor to Furnish | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.15.2.11 | Automatic Control of the following should be possible: | | | |
| a) | Bending Gradation - Vendor to furnish details<br>(smooth transition at start of bend and at the end of bending) | Vendor to Confirm | | |
| b) | Pipe Support Rolls | Vendor to Confirm | | |
| c) | Bending Speed | Vendor to Confirm | | |
| d) | Bending Temperature/Power | Vendor to Confirm | | |
| e) | Radius | Vendor to Confirm | | |
| f) | Inductor Position (3 directions) | Vendor to Confirm | | |
| g) | Quenching | Vendor to Confirm | | |
| h) | Auto-setting of Pipe Clamping Pressure based on pipe size and control of set pressure | Vendor to Confirm | | |
| i) | Pipe Rotation | Vendor to Specify | | |
| j) | Other parameters available on auto-control to be listed | Vendor to Specify | | |
| 2.15.2.12 | Measurement & Display of the following: | | | |
| a) | Inductive Power, Frequency, Voltage, Current | Vendor to Confirm | | |
| b) | Temperature at Pipe Intrados and Extrados | Vendor to Confirm | | |
| c) | Radius | Vendor to Confirm | | |
| d) | Bending Temperature/Power | Vendor to Confirm | | |
| e) | Radius | Vendor to Confirm | | |
| f) | Inductor Position (3 directions) | Vendor to Confirm | | |
| g) | Bending Speed | Vendor to Confirm | | |
| i) | Bending Length | Vendor to Confirm | | |
| j) | Bending Force (in kN) | Vendor to Confirm | | |
| k) | Bending Moment (in kN-m) | Vendor to Confirm | | |
| l) | Position of Pipe Supports | Vendor to Confirm | | |
| m) | Pipe Clamping Pressure | Vendor to Confirm | | |
| n) | Quenching Water Flow | Vendor to Confirm | | |
| o) | Pusher Position | Vendor to Confirm | | |
| p) | Machine / Bending Arm Position | Vendor to Confirm | | |
| q) | Pipe Rotation Angle | Vendor to Confirm | | |
| r) | Machine Up/Down Position (if machine up/down movement is provided) | Vendor to Specify | | |
| s) | Other Operating or Machine Functional Parameters | Vendor to Specify | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.15.2.13 | Apart from the display on HMI the important parameters like Bending Speed, Bending Force, Bending Moment, Bending Length, Power etc should be displayed on a large LED Display on the Control Desk | Vendor to Confirm and Furnish Details | | |
| 2.15.2.14 | Details of other Standard features of the Control System | Vendor to Specify | | |
| 2.15.2.15 | Details of other Optional Features, if any | Vendor to Specify | | |
| 2.15.2.16 | The system should have additional draw-out type Qwerty Key Board and mouse in suitable enclosure, RS232C serial interfaces, parallel interface for printer, COM port for telediagnostics, USB port, hard disk of sufficient capacity and preinstalled system software & other required softwares etc. (Details should be submitted by Vendor) | Vendor to Furnish | | |
| 2.15.2.17 | In case of an interruption in the bending cycle, it should be possible to restart the bending from the point of interruption. Details of provision in the machine for the same should be furnished | Vendor to Furnish | | |
| 2.15.2.18 | It should be possible to display, record, store and print the temperature-time profile (both extrados and intrados) for each bend made on the machine. The time for completing a bend may sometimes extend to 64 hours | Vendor to Confirm | | |
| 2.15.2.19 | Suitable printer shall be built into the control desk for this purpose. Details should be furnished with the offer | Vendor to Furnish | | |
| 2.15.2.20 | Provision for automatic safe shut down of CNC Control in case of Power Failure | Vendor to specify | | |
| 2.15.2.21 | Software for Bending should be included. The software shall facilitate calculation of bending parameters, cost, thinning, ovality etc | Vendor to Furnish Details | | |
| 2.15.2.22 | Position Encoders shall be Absolute Encoders | Vendor to Confirm | | |
| 2.15.2.23 | Manual / Auto Modes of Control should be provided | Vendor to Confirm | | |
| 2.15.2.24 | Provision shall be available to take back-up of Bending Program and other Operating Data on a Compact Disc (CD) through a DVD Writer | Vendor to Confirm | | |
| 2.15.2.25 | A fail-proof and uninterrupted power supply back-up protection to be incorporated in the Machine Electrical System, for the operating PLC to avoid memory corruption, even in case of electric power failure. | Vendor to Confirm | | |

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|---|---|---|---|---|
| 2.15.2.26 | An IBM make LAP-TOP Computer / NOTE BOOK PC (Latest Version at the time of Machine Delivery) with all cables , accessories and battery charging unit for the transfer (uploading and down-loading) of Machine Operating Programmes between the Machine and the Lap-Top Computer, shall form part of the supply. | Vendor to Confirm | | |
| | | | | |
| **2.16** | **AIR CONDITIONERS:** | | | |
| 2.16 .1 | Air Conditioners with Dehumidifiers of suitable / sufficient capacity to be provided for all Electrical / Electronic Panels / Cabinets including Operator's Panel considering specified ambient conditions. Detailed specifications of the same are to be submitted. | Vendor to Confirm | | |
| | | | | |
| **2.17** | **ELECTRICAL SYSTEM :** | | | |
| 2.17.1 | 415V (max likely fluctuation in Voltage is + 10% to -10%), 50Hz (max likely fluctuation +/-3 %) , 3 Phase AC (3 wire system with out neutral) Power Supply Source will be provided by BHEL at a single point near the machine, as per layout recommended by Vendor. All cables, connections, circuit breakers etc. required for connecting BHEL's power supply point to different parts of the machine/control cabinets, shall be the responsibility of vendor. Requirement of grounding/earthing with required material details is to be informed by vendor well in advance so that same could be incorporated during construction of foundation. | Vendor to Confirm | | |
| 2.17.2 | For induction heater 11 kV supply will be provided by BHEL. Required Step-Down Transformer for the operating voltage of the Induction Heater shall be supplied by Vendor. Vendor to furnish details of the Step - Down Transformer. Similarly VENDOR has to include the supply of suitable rating Power Cable for connecting the 11 kV Induction Heater Transformer to the Induction Hating Control Panel. Otherwise, per metre length PRICE has to be given, including the required End-Connectors. | Vendor to Confirm & to Furnish the Details | | |
| 2.17.3 | **Tropicalisation:** All electrical / electronic equipment shall be | Vendor to Confirm | | |
| 2.17.4 | All electrical & electronic control cabinets & panels should be dust and vermin proof | Vendor to Confirm | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 2.17.5 | All electrical components in the cabinets should be mounted on DIN Rail | Vendor to Confirm | | |
| 2.17.6 | All electrical and electronic panels including operator's panel should be provided with fluorescent lamps for sufficient illumination and power receptacles of 220Volts, 5/15 Amp AC. All adapters/receptacles should have compatibility with Indian equivalents. | Vendor to Confirm | | |
| 2.17.7 | Motors shall conform to IEC or Indian Standards | Vendor to Confirm | | |
| 2.17.8 | All cables moving with traversing axes should be installed in Caterpillar/ Drag chain. Additionally, all the cable trays required for laying of cables should be included in the OFFER. | Vendor to Confirm | | |
| 2.17.9 | Vendor shall ensure the proper earthing for the machine and its | Vendor to Confirm | | |
| 2.17.10 | In-cycle hour counter with reset facility is to be included in the offer. | Vendor to Confirm | | |
| | | | | |
| **2.18** | **SAFETY ARRANGEMENTS:** | | | |
| | Following safety features in addition to other standard safety features should be provided on the machine: | | | |
| | 1. Machine should have adequate and reliable safety interlocks / devices to avoid damage to the machine, work-piece and the operator due to the malfunctioning or mistakes. Machine functions shall be monitored continuously & alarm /warning indications through lights/alarm | Vendor to Confirm | | |
| | 2. A detailed list of all alarms / indications provided on machine should be | Vendor to Confirm | | |
| | 3. All the pipes, cables etc. on the machine should be well supported and | Vendor to Confirm | | |
| | 4. Emergency Switches at suitable locations as per International Safety Norms are to be provided. | Vendor to Confirm | | |
| | 5. Oil & water pipe lines should not run with electrical cable in the same | Vendor to Confirm | | |
| | 6. There should be no malfunction of the machine and the induction heater in the event of power failure. The machine should shut down safely | Vendor to Confirm | | |
| | | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| **2.19** | **ENVIRONMENTAL PERFORMANCE OF THE MACHINE :** | | | |
| | The Machine shall conform to following factors related to environment : | | | |
| | (a) Maximum noise level from machine operation (other than noise due to induction frequency) shall be 85 dB(A) at normal load condition, 1 metre away from the machine with correction factor for back ground noise, if necessary. This will be measured as per International Standards like DIN 45635-16.<br>Supplier to demonstrate compliance to noise level, if so required. | Vendor to Confirm | | |
| | (b) If any safety / environmental protection enclosure is required it should be built in the machine by the vendor. | Vendor to Confirm | | |
| | | | | |
| **3.0** | **TOOLINGS : [IMPORTANT SUPPLY]** | | | |
| 3.1 | Set of Inductors, Air and Water Quenching Rings with Nozzles, and Clamping Inserts for Bending Arm, Clamping Inserts for Pipe Rotation Device, etc. shall be OFFERED / QUOTED unit-wise for all the types of Pipe Sizes given under **ANNEXURE-1.** | Vendor to Confirm | | |
| 3.2 | Broad Details of the Inductor, Quenching Rings, Clamping Inserts shall be furnished with the OFFER / QUOTATION . | Vendor to furnish | | |
| 3.3 | Inductor Ring should preferably be SPLIT-TYPE<br>(Split into top and bottom halves) | Vendor to Specify | | |
| 3.4 | 300 Nos.of Spare Insulating Washers , Ceramic Rings, etc., used as the consumables in the Inductor are to be QUOTED along with Inductor. | Vendor to Confirm | | |
| | | | | |
| **4.0** | **DIAGNOSTIC SYSTEM:** | | | |
| **4.1** | **TELE-DIAGNOSTIC SERVICE :** | | | |
| 4.1.1 | Tele-Diagnostic Service should be provided through International Telephone Lines along with required Hardware / Software Package for Remote Diagnosis and correction of the problems in both CNC System / PLC System and the Induction Heating Equipment of the machine. This should be provided free of charge for the Guarantee Period. Terms and conditions for the Tele-Diagnostic Service after Guarantee Period shall be furnished by Vendor. [BIDDER to confirm that the offered Remote Diagnosis Service covers all the functions of the Incremental Bender, including the MF Power System and shall form part of the Machine Performance Prove-Out]. | Vendor to Furnish Details | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 4.1.2 | A built-in MODEM is to be included for Telediagnostics. An Ethernet or any other compatible port is to be included for remote connection of the Machine Controller through Net Working. All pre-installed software are to be of licensed versions. The MODEM supplied shall be compatible to the Landline Connection, not through a SIM Card. | Vendor to Furnish Details | | |
| **4.2** | **FAULT DIAGNOSTIC SYSTEM:** | | | |
| 4.2.1 | Supplier's Own Diagnostic System with required Hardware and Software should be supplied and installed. This should include customized Auto-Diagnostic System with supporting hardware and software which shows detailed cause and remedy for the fault on the display for Mechanical, Electrical / Electronic and Hydraulic Faults. | Vendor to Furnish Details | | |
| **4.3** | Help Guide should be provided to use both Diagnostic Systems | Vendor to Confirm | | |
| | | | | |
| **5.0** | **LEVELING & ANCHORING SYSTEM** | | | |
| 5.1 | Complete Anchoring System including Foundation Bolts, Slew Rings, Rails / Traversing Bases, Leveling Shoes, etc. shall be QUOTED / OFFERED, as these items are to be supplied for the Machine and | Vendor to Confirm | | |
| | | | | |
| **6.0** | **TOOLS FOR ERECTION, OPERATION & MAINTENANCE :** | | | |
| 6.1 | Special Tools and Equipment required for erection of the machine shall be brought by the Vendor. Necessary/Common Tools like Torque Wrench, Spanners, Keys, Grease Guns, etc..for Operation and Maintenance of the machine shall be supplied, with the MAIN MACHINE & ACCESSORIES. List of such tools shall be submitted | Vendor to furnish | | |
| | | | | |
| **7.0** | **SPARES:** | | | |
| 7.1 | Itemized break-up of Mechanical, Hydraulic, Electrical and Electronic Spares used on the machine in sufficient quantity as per recommendation of Vendor for 2 years of trouble free operation on three shifts continuous running basis, shall be OFFERED by the BIDDER.<br>The list to include following, in addition to other recommended spares: **(Unit Price of each item of spare shall be offered)** | Vendor to Furnish | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| | **a) Mechanical & Hydraulic Spares:** All types of Pumps, Valves, Pressure Switches / Transducers. All types of Filters, All types of Seals, etc. are to be offered. | Vendor to Furnish | | |
| | **b) Electrical / Electronic / CNC Spares:** All types of Relays, Contactors, Proximity Switches, Push Buttons, Indicating Lamps, Semiconductor Fuses, Special Fuses, Circuit Breakers, Main Power Switch, Encoders, MMC module, NCU module, Operator's Panel with Display Unit, Control Card & I/O Cards for PLC, Servo Motors for Feed Drives, Power Module & Control Cards for Main Drive as well as Feed Drives etc. | Vendor to Furnish | | |
| 7.2 | Spares for Machine and Accessories should be available for atleast TEN years after supply of the machine. If the above item(s) is likely to become obsolete in this period, the vendor should inform BHEL sufficiently in advance and provide drawings of parts / details of spares & suppliers to enable BHEL to procure these in advance, if required . | Vendor to Confirm | | |
| 7.3 | In case, any system or drives shall become obsolete within TEN years, the Vendor should give guidance to BHEL for the installation of the up-graded version and machine re-commissioning through tele-diagnostic system or by deputing a service engineer (at free of cost) to BHEL Works. The required upgraded version of spares will be procured by BHEL. | Vendor to Confirm | | |
| 7.4 | Vendor to confirm that complete list of spares for machine and accessories, along with specification / type / model, and name & address of the spare supplier shall be furnished along with documentation to be supplied with the machine | Vendor to Confirm | | |
| | | | | |
| **8.0** | **DOCUMENTATION :** Five sets of following documents (Hard copies) in English language should be supplied along with the machine | Vendor to confirm | | |
| 8.1 | Operation & Maintenance Manuals of Machine, Induction Heater & Control System | | | |
| 8.2 | Programming Manuals of Machine | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 8.3 | Detailed Maintenance Manual of Machine with all Drawings of Machine Assemblies / Sub-assemblies / Parts including Electrical / Pneumatic/ Hydraulic Circuit Diagrams. All Assembly/ Sub Assembly Drawings shall be supplied with the part list also. | | | |
| 8.4 | Interface & Commissioning Manuals for Control System and Induction Heater. | | | |
| 8.5 | Manufacturing Drawings for all supplied Inductors and Quenching | | | |
| 8.6 | Catalogues, O&M Manuals of all Bought-Out Items including Drawings, wherever applicable. | | | |
| 8.7 | Detailed Specifications of all Rubber Items and Hydraulic / Lube Fittings | | | |
| 8.8 | Operating Manuals, Maintenance Manuals & Catalogues for Chiller, Hydraulic System etc | | | |
| 8.9 | PLC Program Print-outs with comments in English. | | | |
| 8.10 | PLC program on CD, and backup of NC data & PLC data on suitable media | | | |
| 8.11 | Complete back-up of hard disk with clear written Instructions (3 copies) for taking back-up and reloading of a new hard disk. | | | |
| 8.12 | Complete Master List of parts used in the machine shall be submitted by the Vendor. | | | |
| 8.13 | List of Bearings used on the machine complete with specification | | | |
| 8.14 | One additional set of all the above documentation on CD ROM, wherever possible. | | | |
| | | | | |
| **9.0** | **TRAINING:** | | | |
| 9.1 | BHEL personnel should be trained at Supplier's Works for a period of 10 Working Days in the following areas:<br>a) Operation of the Machine and Programming of Bends<br>b) Electrical, Electronic & Control system maintenance for Machine & other supplied equipment like Induction Heater<br>(c) Mechanical & Hydraulic Maintenance of the Machine & other Supplied Equipment/Accessories | Vendor to confirm | | |
| 9.2 | Air-fare, boarding & lodging for the trainees shall be borne by BHEL. | Vendor to note | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 9.3 | Competent, English speaking experts shall be arranged by the vendor | Vendor to confirm | | |
| 9.4 | Vendor to quote for Training on man- day basis | Vendor to furnish | | |
| | | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| **10.0** | **FOUNDATION:** | | | |
| 10.1 | Vendor shall submit the preliminary layout drawing for getting BHEL's approval within one month from the date of Letter of Intent. The Layout should consist of all requirements pertaining to complete machine and all accessories, including space requirement for input Transformer, chiller, hydraulic system & any other accessory. Details, like Static/ Dynamic load, special requirements of the foundation etc. and final Layout Drawings shall be submitted by the supplier within three months after getting BHEL's approval of the preliminary layout drawing. BHEL will construct complete foundation for the machine under supervision of supplier and at supplier's responsibility. The vendor shall also indicate detailed specifications of grouting compound and grouting procedure etc. for foundation bolts of the machine. | Vendor to Confirm | | |
| | | | | |
| **11.0** | **ERECTION & COMMISSIONING** | | | |
| 11.1 | Supplier shall supervise the Erection. Start-up, Testing of Machine & it's Control System, Commissioning and Job Prove-Out is the responsibility of the Vendor.<br>Service requirement like Electric Power, Air & Water shall be provided by BHEL at only one point to be indicated by Supplier in their Machine Foundation / Layout Drawings. Other requirements like crane and helping personnel shall also be provided by BHEL. Details of these requirements should be informed by vendor in advance. | Vendor to confirm | | |
| 11.2 | Successful prove-out of BHEL components by the supplier shall be considered as part of commissioning. All tests, as mentioned under specification C**lause S.No. 14** (Machine Acceptance) shall form part of the commissioning activity. | Vendor to confirm | | |
| 11.3 | Spares required during commissioning should be supplied free of cost | Vendor to confirm | | |
| 11.4 | Portion, if any, of the machine, accessories and other supplied items where paint has rubbed off or peeled during transit or erection should be repainted and merged with the original surrounding paint by the vendor. For this purpose, the vendor should supply sufficient quantity of touch-up paint of various colours of paint used. | Vendor to confirm | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| 11.5 | Approximate duration for Erection & Commissioning should be indicated in the OFFER. Schedule of Erection and Commissioning shall be submitted after placement of BHEL Purchase Order | Vendor to confirm | | |
| 11.6 | Charges, duration, terms & conditions for Erection & Commissioning should be furnished in detail separately by vendor along with OFFER. (E & C charges shall be furnished only in the sealed price bid) | Vendor to furnish | | |
| | | | | |
| **12.0** | **OPERATING CONDITIONS:** | | | |
| 12.1 | The Machine, Induction Heating System and other Accessories and Control Systems should work trouble free and efficiently under following operating conditions :<br>Voltage : 415 V (likely fluctuation: - 10%, +10%)<br>Frequency : 50 Hz (likely fluctuation: +3%, - 3%)<br>No. of Phases : 3 (3 Wire and Protective Earthing, No Neutral)<br>Ambient Temperature : 5 to 45 degree Celsius<br>Relative Humidity : 95 % maximum. | Vendor to Confirm | | |
| 12.2 | Weather conditions are Tropical, Atmosphere may be dust laden during some part of the year. Machine shall be kept in the normal shop floor condition. Maximum temperature variation is up to 25 deg Celsius in 24 hours. (Vendor to confirm that machine is suitable for above) . | Vendor to Confirm | | |
| 12.4 | The Machine, including Attachments and Accessories, should be suitable for 24 hrs. continuous operation to its full capacity for 24 hour a day and 7 days a week throughout. Vendor to ensure and confirm the same. | Vendor to Confirm | | |
| | | | | |
| **13.0** | **PROVE-OUT OF BHEL COMPONENTS :** | | | |
| 13.1 | For prove-out of Machine at BHEL Works, Vendor shall carry-out a maximum of EIGHT Guarantee Bends of material and size that will be furnished during technical discussions. Material for the prove-out components shall be provided by BHEL. Clarifications, if any required by Vendor, regarding accuracy requirements of the prove-out components, whether specified or not, should be discussed and cleared by Vendor during initial technical discussions. | Vendor to Confirm | | |
| | | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| **14.0** | **MACHINE ACCEPTANCE:**<br>**(Tests/Activities to be Performed by Vendor)** | | | |
| **14.1** | **Tests/Activities to be carried out at supplier's works on the machine in the presence of BHEL engineers before dispatch :** | | | |
| 14.1.1 | No-load Operation of the Machine | Vendor to Confirm | | |
| 14.1.2 | Operation of Induction Heater (Test load to be arranged by Vendor) | Vendor to Confirm | | |
| **14.2** | **Test / Activities to be carried out at BHEL Works / Trichy / INDIA, while commissioning the machine :** | | | |
| 14.2.1 | Full load test to demonstrate the maximum power & bending capacity. | Vendor to Confirm | | |
| 14.2.2 | Demonstration of all Features of the Machine, Controls, & Accessories to the satisfaction of BHEL for their efficient and effective use. | Vendor to Confirm | | |
| 14.2.3 | Job Prove-out. | Vendor to Confirm | | |
| 14.2.4 | Two weeks supervision of independent operation of Machine by BHEL after job prove-out. | Vendor to Confirm | | |
| 14.2.5 | Training of BHEL Machine Operators in Operation of Complete Machine & Accessories, etc. by the Supplier's Experts / Engineers during their stay at BHEL Works / TRICHY / INDIA | Vendor to Confirm | | |
| | | | | |
| **15.0** | **PACKING:** | | | |
| 15.1 | Sea-worthy & Rigid Packing for all items of Complete Machine, CNC System, all Accessories and other supplied items to avoid any damage/loss in transit. When machine is dispatched in containers, all small loose items shall be suitably packed in boxes | Vendor to Confirm | | |
| | | | | |
| **16.0** | **GUARANTEE :** | | | |
| 16.1 | a. TWELVE months from the date of acceptance of the machine at BHEL Works, after machine performance prove-out.<br>b. Additional Cost, if the Guarantee is to be for TWENTY-FOUR Months, after machine performance prove-out at BHEL Works. | Vendor to confirm | | |
| | | | | |

| S. No. | DESCRIPTION FOR BHEL REQUIREMENT | SPECIFICATION | OFFERED | DEVIATIONS |
|---|---|---|---|---|
| **17.0** | **GENERAL : The vendor should submit the following information:** | | | |
| 17.1 | Machine Model | Vendor to Furnish | | |
| 17.2 | Total Connected Load (in kVA): | Vendor to Furnish | | |
| 17.3 | Floor area required (Length, Width, Height) for Complete Machine & Accessories | Vendor to Furnish | | |
| 17.4 | Painting of Machine/ Electrical Panels: RAL 6019 Pastel Green (Synthetic Enamel Paint) | Vendor to Furnish | | |
| 17.5 | Total Weight of the Machine | Vendor to Furnish | | |
| 17.6 | Weight of Heaviest Part of Machine | Vendor to Furnish | | |
| 17.7 | Weight of the Heaviest Assembly/ Sub-assembly of the Machine | Vendor to Furnish | | |
| 17.8 | Dimensions of Largest Part/ Sub-assembly/ Assembly of the Machine | Vendor to Furnish | | |
| 17.9 | Vendor to submit, along with offer, the reference list of customers where similar machines have been supplied mentioning the customer, Machine Model, major specifications of the supplied machine, Control System, Year of Supply, etc.<br>***PLEASE REFER to PART A of THIS TENDER for DETAILS*** | Vendor to Furnish | | |
| 17.10 | Detailed Catalogues , Sketch / Photographs of the Main Machine and Accessories / Attachments should be submitted with the OFFER. | Vendor to Furnish | | |
| 17.11 | Hydraulic, Pneumatic & Oil - Pipings should be preferably of metallic except places where flexible pipings are essential. All the pipes required for the same shall be included in the standard scope of the machine. | Vendor to Confirm | | |
| | | | | |

| LIST OF OD & ID CONTROLLED PIPE SIZES - 711mm OD INCREMENTAL INDUCTION PIPE BENDING M/C | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL No | Pipe Size / Spec | | | Pipe Thickness Considering tolerance (mm) | Bending temperature | | Quenching medium | Wall Thinning | | | Bend Ovality | | | Raw Material Thickness Considering thinning [Column E / (1-percentage thinning)] | | | Possibility of Bending on Offered m/c | | | Bending Speed | | |
| | | | | | | | | R/D | | | R/D | | | R/D | | | R/D | | | R/D | | |
| | | | | | | | | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 |
| | **OD** mm | **Nom Thk** mm | Matl Spec | | Intrados | Extrados | | % | % | % | % | % | % | mm | mm | mm | | | | mm/min | | |
| 1 | 168 | 7.11 | Gr B | 8.13 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 2 | 219 | 6.35 | Gr B | 7.26 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 3 | 219 | 22.23 | Gr B | 25.41 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 4 | 273 | 6.35 | Gr B | 7.26 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 5 | 273 | 9.27 | Gr B | 10.59 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 6 | 324 | 6.35 | Gr B | 7.26 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 7 | 324 | 9.53 | Gr B | 10.89 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 8 | 406 | 6.35 | Gr B | 7.26 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 9 | 406 | 9.53 | Gr B | 10.89 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 10 | 508 | 9.53 | Gr B | 10.89 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 11 | 508 | 12.7 | Gr B | 14.51 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 12 | 508 | 14.27 | Gr B | 16.31 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 13 | 508 | 15.09 | Gr B | 17.25 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 14 | 508 | 20 | Gr B | 22.86 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 15 | 559 | 12.7 | Gr B | 14.51 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 16 | 559 | 14.2 | Gr B | 16.23 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 17 | 609 | 12.7 | Gr B | 14.51 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 18 | 660 | 12.7 | Gr B | 14.51 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 19 | 660 | 14.2 | Gr B | 16.23 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 20 | 219 | 25 | Gr C | 28.57 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 21 | 219 | 28 | Gr C | 32.00 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 22 | 273 | 32 | Gr C | 36.57 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 23 | 273 | 36 | Gr C | 41.14 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |

| SL No | Pipe Size / Spec | | | Pipe Thickness Considering tolerance (mm) | Bending temperature | | Quenching medium | Wall Thinning | | | Bend Ovality | | | Raw Material Thickness Considering thinning [Column E / (1-percentage thinning)] | | | Possibility of Bending on Offered m/c | | | Bending Speed | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | R/D | | | R/D | | | R/D | | | R/D | | | R/D | | |
| | | | | | | | | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 |
| | **OD** mm | **Nom Thk** mm | Matl Spec | | Intrados | Extrados | | % | % | % | % | % | % | mm | mm | mm | | | | mm/min | | |
| 24 | 324 | 36 | Gr C | 41.14 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 25 | 324 | 40 | Gr C | 45.71 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 26 | 355 | 50 | Gr C | 57.14 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 27 | 368 | 40 | Gr C | 45.71 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 28 | 368 | 48 | Gr C | 54.86 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 29 | 406 | 32 | Gr C | 36.57 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 30 | 406 | 36 | Gr C | 41.14 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 31 | 406 | 40 | Gr C | 45.71 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 32 | 457 | 12.7 | Gr C | 14.51 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 33 | 457 | 14.2 | Gr C | 16.23 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 34 | 457 | 40 | Gr C | 45.71 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 35 | 610 | 17.48 | Gr C | 19.98 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 36 | 660 | 20 | Gr C | 22.86 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 37 | 660 | 22 | Gr C | 25.14 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 38 | 660 | 24 | Gr C | 27.43 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| 39 | 711 | 20 | Gr C | 22.86 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 40 | 457 | 20 | P11 | 22.86 | As high as possible | 770-780 | Water | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 41 | 219 | 25 | P12 | 28.57 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 42 | 368 | 36 | P12 | 41.14 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 43 | 368 | 40 | P12 | 45.71 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 44 | 244 | 36 | P22 | P22 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 45 | 273 | 6.35 | P22 | 7.26 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |

| SL No | Pipe Size / Spec | | | Pipe Thickness Considering tolerance (mm) | Bending temperature | | Quenching medium | Wall Thinning | | | Bend Ovality | | | Raw Material Thickness Considering thinning [Column E / (1-percentage thinning)] | | | Possibility of Bending on Offered m/c | | | Bending Speed | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | R/D | | | R/D | | | R/D | | | R/D | | | R/D | | |
| | | | | | | | | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 |
| | **OD** mm | **Nom Thk** mm | Matl Spec | | Intrados | Extrados | | % | % | % | % | % | % | mm | mm | mm | | | | mm/min | | |
| 46 | 273 | 14.2 | P22 | 16.23 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 47 | 273 | 45 | P22 | 51.43 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 48 | 273 | 50 | P22 | 57.14 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 49 | 406 | 16 | P22 | 18.29 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 50 | 406 | 22.2 | P22 | 25.37 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 51 | 457 | 22.2 | P22 | 25.37 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 52 | 406 | 65 | P22 | 74.29 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 53 | 406 | 70 | P22 | 80.00 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 54 | 457 | 25 | P22 | 28.57 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 55 | 508 | 25 | P22 | 28.57 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 56 | 508 | 28 | P22 | 32.00 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 57 | 508 | 30 | P22 | 34.29 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 58 | 559 | 28 | P22 | 32.00 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 59 | 559 | 32 | P22 | 36.57 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 60 | 610 | 22.2 | P22 | 25.37 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 61 | 610 | 30 | P22 | 34.29 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 62 | 660 | 32 | P22 | 36.00 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |
| 63 | 711 | 45 | P22 | 52.00 | As high as possible | 770-780 | Air / Water | | | | | | | | | | | | | | | |

| SL No | Pipe Size / Spec | | | Pipe Thickness Considering tolerance (mm) | Bending temperature | | Quenching medium | Wall Thinning | | | Bend Ovality | | | Raw Material Thickness Considering thinning [Column E / (1-percentage thinning)] | | | Possibility of Bending on Offered m/c | | | Bending Speed | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | R/D | | | R/D | | | R/D | | | R/D | | | R/D | | |
| | | | | | | | | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 |
| | **OD** mm | **Nom Thk** mm | Matl Spec | | Intrados | Extrados | | % | % | % | % | % | % | mm | mm | mm | | | | mm/min | | |
| 64 | 219 | 25 | P91 | 28.57 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 65 | 219 | 28 | P91 | 32.00 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 66 | 324 | 31 | P91 | 35.43 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 67 | 324 | 35 | P91 | 40.00 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 68 | 324 | 42 | P91 | 48.00 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 69 | 406 | 11.5 | P91 | 13.14 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 70 | 406.4 | 38 | P91 | 43.43 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 71 | 406 | 42 | P91 | 48.00 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 72 | 457 | 42 | P91 | 48.00 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 73 | 559 | 54 | P91 | 61.71 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 74 | 564 | 51 | P91 | 58.00 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 75 | 610 | 25 | P91 | 28.58 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 76 | 711 | 20 | P91 | 22.86 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 77 | 711 | 25 | P91 | 28.58 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 78 | 460 | 85 | P91 | 88.20 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 79 | 350 | 60 | P91 | 63.20 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |
| 80 | 711 | 42 | P91 | 48.00 | 1000-1100 | 1000-1100 | Air | | | | | | | | | | | | | | | |

| SL No | Pipe Size / Spec | | | Pipe Thickness Considering tolerance (mm) | Bending temperature | | Quenching medium | Wall Thinning | | | Bend Ovality | | | Raw Material Thickness Considering thinning [Column E / (1-percentage thinning)] | | | Possibility of Bending on Offered m/c | | | Bending Speed | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | R/D | | | R/D | | | R/D | | | R/D | | | R/D | | |
| | | | | | | | | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 | 1.5 | 3 | 5 |
| | **ID** mm | **Nom Thk** mm | Matl Spec | | Intrados | Extrados | | % | % | % | % | % | % | mm | mm | mm | | | | mm/min | | |
| 1 | 253.6 | 47 | P22 | 50.20 | As high as possible | 770-780 | Air | | | | | | | | | | | | | | | |
| 2 | 260 | 51 | P22 | 54.20 | As high as possible | 770-780 | Air | | | | | | | | | | | | | | | |