Bharat Heavy Electricals Limited

(High Pressure Boiler Plant**)**
Tiruchirappalli – 620014, TAMIL NADU, INDIA
An ISO 9001 Company
CAPITAL EQUIPMENT / MATERIALS MANAGEMENT

ENQUIRY	Phone: +91 431 257 79 38 Fax : +91 431 252 07 19 Email : tvenkat@bheltry.co.in Web : www.bhel.com

	Enquiry Number:	**Enquiry Date:**	**Due date for submission of quotation:**
	2620700087	**04.09.2007**	**16.10.2007**
You are requested to quote the Enquiry number date and due date in all your correspondences. This is only a request for quotation and not an order			

Item	**Description**	**Quantity**	**Delivery (Item required at BHEL on)**
10	Incremental Induction Pipe Bending Machine – 711 mm OD as per the technical specification & commercial conditions applicable (to be downloaded from web site www.bhel.com or http://tenders.gov.in)	1 No.	30.08.2008

BHEL commercial terms & conditions with Price Bid and Bank Guarantee formats along with technical specifications 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 "2620700087".

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

INCREMENTAL INDUCTION PIPE BENDING MACHINE - 711mm OD

PART A.

SECTION – I: QUALIFYING CRITERIA

The BIDDER / VENDOR has to meet the following requirements to get qualified for submitting an offer for INCREMENTAL INDUCTION PIPE BENDING MACHINE - 711mm OD:

S.No.	REQUIREMENTS	VENDOR's RESPONSE
1.0	Only those vendors (OEMs), who have supplied and commissioned at least one Induction Incremental Pipe Bending Machine for bending pipes of size 700mm OD or above and 60 mm Thick or above 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 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). 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	
2.0	Name of the Customer / Company where the machine is installed.	
3.0	Complete Postal Address of the Customer.	
4.0	Year of Commissioning.	
5.0	Parameters of Machine(s) supplied (parameters as mentioned in Clause **1.0** above) and application for which the machine is supplied.	
6.0	Name and designation of the contact person of the Customer.	
7.0	Phone No., FAX No. and e-mail address of the contact person of the Customer.	
8.0	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 vendor.	
9.0	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 – II: COMPANY PROFILE

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

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

SECTION – III: BID / OFFER FORMAT

The BIDDER / VENDOR to note the following:

S.No.	REQUIREMENTS	VENDOR's COMPLIANCE
15.0	The BIDDER shall submit the offer in TWO PARTS - Technical [with PART A & PART B] & Commercial and Price Bid.	
16.0	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.	
17.0	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	
18.0	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.	

	BHARAT HEAVY ELECTRICAL LIMITED **(A Government of India Undertaking)** **High Pressure Boiler Plant** **Tiruchirapalli-620 014** **Tamilnadu, India**	**Enquiry No. :** **Due Date :** **Supplier Qtn. No.:**	
	Contact Person: SDGM / Capital Purchase **Tel: +91(431) 2577575 Fax: +91(431) 2520719**	**Date :**	

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 Vendor 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.

NAME & ADDRESS OF THE SUPPLIER :	
CONTACT PERSON:	
TELEPHONE NOS.:	
FAX NOS.:	
E-MAIL ADDRESS :	

SCOPE: SUPPLY, ERECTION & COMMISSIONING OF INCREMENTAL INDUCTION PIPE BENDING MACHINE-711 mm COMPLYING WITH SPECIFICATIONS AS BELOW					
SNO	**DESCRIPTION FOR BHEL REQUIREMENT**	**SPECIFICATION**	**OFFERED**	**DEVIATIONS**	**REMARKS**
1.0	**PURPOSE & WORKPIECE MATERIAL**				
1.1	Purpose: The Incremental Induction Heating Pipe Bending Machine is required for progressive, formerless bending of pipes used in Utility and Industrial Boilersfor 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				
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 counter-clockwise bending when viewed from the pipe pusher				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
2.2	**PIPE & BEND SPECIFICATIONS:**				
2.2.1	Max Pipe Diameter (mm)	711			
2.2.2	Min pipe diameter (around 168mm) (mm)	Vendor to Specify			
2.2.4	Max Pipe Thickness (around 100mm) (mm)	Vendor to Specify			
2.2.5	Min Pipe Thickness (around 5mm)	Vendor to Specify			
2.2.6	Max Bending Radius (approx **5D** required)	Vendor to Specify			
2.2.7	Min Bending Radius (upto 90 deg bending angle)	Vendor to Specify			
2.2.8	Min Bending Radius (upto 180 deg bending angle)	Vendor to Specify			
2.2.9	Max D/t Ratio for Air Quenchable Steel	Vendor to Specify			
2.2.10	Max D/t Ratio for Water Quenchable Steel	Vendor to Specify			
2.2.11	R/D Ratio: 1.5 to 5	Vendor to Confirm			
2.2.12	Bending Angle (deg)	0 to 180			
2.2.13	Max Pipe Length (mm) (approx)	9000mm			
2.2.14	Bending Temperature (Extrados): (deg C) Carbon Steel Pipes and Alloy Steel Pipes of Grade a) P11, P12, P22 b) P36 (WB 36) c) P23 d) P91, P92	 770-780 750-950 750-1100 1000-1100			
2.2.15	Bending Temperature (Intrados): (deg C) Carbon Steel Pipes and Alloy Steel Pipes of Grade a) P11, P12, P22, P36 (WB 36) & P23 b) P91, P92	 1000 1000-1100			
2.2.16	Bending temperature control on Intrados / Extrados : Within ± 10° C	Vendor to Confirm			
2.2.17	**Accuracies required for bends :** The bends made on the machine shall be within under-mentioned limits				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
a)	Wall thinning : 10% to 22% (depending on thickness of pipe) for R/D = 1.5 Max. 10% for all pipe thickness for R/D = 3.0	Vendor to Confirm			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
b)	Ovality should be limited to 20 D/R subjected to a maximum of 5 %	Vendor to Confirm			
c)	Wrinkles : *Pitch of Valley / Depth >/= 12 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): NB < 250 mm: ± 3 mm NB 300 to 600 mm: ± 5 mm NB 600 to 900 mm: ± 6 mm NB > 900 mm: ± 8 mm	Vendor to Confirm			
2.2.18	**Tolerence on Pipe:** Where Outside Diameter is specified, the tolerance on Outside Diameter is +/- 1% and on thickness is +/- 12.5 %. Where Inside Diameter is specfied, 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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
2.3.4	Pusher drive motor rating (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 mechanisms	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	Max 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			
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			
2.4	**MAIN BENDING ARM:**				
2.4.1	Max Diameter of pipe that can be clamped (mm)	Vendor to Specify			
2.4.2	Min Diameter of pipe that can be clamped (mm)	Vendor to Specify			
2.4.3	Max thickness of pipe (mm)	Vendor to Specify			
2.4.4	Min thickness of pipe (mm)	Vendor to Specify			
2.4.5	Max radius of bend (mm)	Vendor to Specify			
2.4.6	Min radius of bend (mm)	Vendor to Specify			
2.4.7	Max Clamping Length - Should be as small as possible (mm)	Vendor to Specify			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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	Max Pushing force (kN)	Vendor to Specify			
2.4.13	Max Bending Moment (kNm)	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 (KW) (min 500 KW)	Vendor to Specify			
2.5.3	Frequency (Hz) (500 to 3000 Hz)	Vendor to Specify			
2.5.4	MF Output Voltage	Vendor to Specify			
2.5.5	Fixed Capacitance (KVAR)	Vendor to Specify			
2.5.6	Switchable Capacitance (KVAR)	Vendor to Specify			
2.5.7	Control shall be microprocessor based	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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
2.5.10	Transistor Inverter or Thyristor Inverter	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 changing	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 generator.	Vendor to Confirm			
2.6.2	Cooling Water Flow (m3/min)	Vendor to Specify			
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	KW rating of Chiller	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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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) 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			
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 (m3/min) (Shop air pressure is available at 60 to 65 psi)	Vendor to Specify			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
2.8.6	A water manifold shall be provided at a proer 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 : a) Water Quenching of Intrados b) Water Quenching of Extrados c) Air Quenching of Intrados d) Air Quenching of Extrados 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 (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) (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			
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 vendor	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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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 focussed 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 focussed 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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
2.10	**HYDRAULIC SYSTEM :**				
2.10.1	The System should be centralised. Hydraulic Tank shall preferably be located at floor level	Vendor to Confirm			
2.10.2	Make Rexroth / Vickers Sperry or equivalent from a reputed manufacturer. (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 br 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.	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 (min 0-180 deg)	Vendor to Specify			
2.11.3	Max dia and thickness of pipe that can be handled by rotation device	Vendor to Specify			
2.11.4	Rotaion device shall have suitable clamping system to hold the pipe during setting of plabe 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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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 position	Vendor to Furnish details			
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 / Photograhps / Literature explaining the technical features should be enclosed with the offer	Vendor to Furnish			
2.14	**OPERATOR'S PLATFORM:**				
2.14.1	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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
2.15	**OPERATION AND CONTROL SYSTEM:**				
2.15.1	**OPERATOR'S PANEL:**				
2.15.1.1	Deak 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 dsek should be submitted.	Vendor to confirm			
2.15.1.2	An auxiliary pendant control 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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
2.15.2.11	Automatic Contol of the following should be possible:				
a)	Bending gradation (smooth transition at start of bend and at the end of bending)- Vendor to furnish details	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 on auto control	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 (kN)	Vendor to Confirm			
k)	Bending Moment (kNm	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 parameters	Vendor to Specify			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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	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 Querty 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 iterruption in the bending cycle, it should be possible to restart the bending from the point of interuption. 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 inluded. The software shall facilitate calculation of bending paameters, 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			
2.16	**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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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 resposibility 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 11kV 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 transformer	Vendor to Confirm			
2.17.3	**Tropicalisation:** All electrical / electronic equipment shall be tropicalized	Vendor to Confirm			
2.17.4	All electrical & electronic control cabinets & panels should be dust and vermin proof	Vendor to Confirm			
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 should ensure the proper earthing for the machine and its peripherals.	Vendor to Confirm			
2.17.10	In-cycle hour counter with reset facility is to be included in the offer.	Vendor to Confirm			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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, workpiece and the operator due to the malfunctioning or mistakes. Machine functions should be continuously monitored and alarm / warning indications through lights/ alarm number with messages (on PC/CNC display and panels) should be available.	Vendor to Confirm			
	2. A detailed list of all alarms / indications provided on machine should be submitted by the supplier.	Vendor to Confirm			
	3. All the pipes, cables etc. on the machine should be well supported and protected.	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 tray / trench.	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			
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 M 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. Supplier to demonstrate compliance to noise level, if so required.	Vendor to Confirm			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
	(b) If any safety / environmental protection enclosure is required it should be built in the machine by the vendor.	Vendor to Confirm			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
3.0	**TOOLINGS:**				
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 supplied for 8 pipe sizes (Pipe sizes shall be furnished by BHEL during technical discussions)	Vendor to Confirm			
3.2	Broad details of the inductor, quenching rings, clamping inserts shall be furnished wth the offer	Vendor to furnish			
3.3	Inductor ring should preferably be split type (Split into top and bottom halves)	Vendor to Specify			
3.4	300 Nos.of spare insulatuing washers , ceramic rings etc used in the inductor are to be supplied 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 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 service after guarantee period should be informed by vendor.	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 customised 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				
5.0	**LEVELING & ANCHORING SYSTEM**				
5.1	Complete anchoring system including foundation bolts, leveling shoes etc shall be supplied for the Machine and accessories	Vendor to Confirm			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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 tools like Torque Wrench, Spanners, Keys, grease guns etc.for operation and maintenance of the machine should be supplied. List of such tools should be submitted with offer	Vendor to furnish			
7.0	**SPARES:**				
7.1	Itemised breakup 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 should be offered by vendor. The list to include following, in addition to other recommended spares: **(Unit Price of each item of spare should be offered)**	Vendor to Furnish			
	a) Mechanical & Hydraulic Spares: All types of pumps, All types of Valves, All types of pressure switches / transducers, All types of filters, All types of seals	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 machine or control 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	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			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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				
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 rings				
8.6	Catalogues, O&M Manuals of all bought out items including drawings,wherever applicable.				
8.7	Detailed specification 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.				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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: a) Operation of the Machine and Programming of Bends b) Electrical, Electronic & Control system maintenance for machine & other supplied equipment like Induction Heater (c) Mechanical & Hydraulic maintenance of the machine & other supplied equipments	Vendor to confirm			
9.2	Air-fare, boarding & lodging for the trainees shall be borne by BHEL.	Vendor to note			
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			
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 ofthe machine.	Vendor to Confirm			
11.0	**ERECTION & COMMISSIONING**				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
11.1	Supplier shall supervise the erection. Start up, testing of machine & it's control system, commissioning and job proveout is the responsibility of the vendor Service requirement like power, air & water shall be provided by BHEL at only one point to be indicated by supplier in their 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 proving of BHEL components by the supplier shall be considered as part of commissioning. All tests, as mentioned at **clause 14** (Machine Acceptance) shall form part of the commissioning activity.	Vendor to confirm			
11.3	Spares requied 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			
11.5	Approximate duration for Erection & Commissioning should be indicated in the offer. Schedule of Erection and Commissioning shall be submitted after placement of purchase order	Vendor to confirm			
11.6	Charges, duration, terms & conditions for E&C 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:**				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
12.1	The machine, induction heating system and other accessories and control systems should work trouble free and efficiently under following operating conditions: Voltage: 415 V (likely fluctuation: - 10%, +10%) Frequency: 50 Hz (likely fluctuation: +3%, - 3%) No. of phases = 3 (3 Wire and PE, no neutral) Ambient Temperature = 5 to 45 degree celsius Relative Humidity = 95% max.	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. Max. temperature variation is up to 25 deg Celsius in 24 hours. (Vendor to confirm that machine is suitable for above)	Vendor to Confirm			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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	**PROVEOUT OF BHEL COMPONENTS :**				
13.1	For proveout of machine at BHEL works, vendor shall carryout a maximum of 8 guarantee bends of material and size that will be furnished during technical discussions. Material for the proveout components shall be provided by BHEL. Clarifications, if any required by vendor, regarding accuracy requirements of the proveout components, whether specified or not, should be discussed and cleared by vendor during initial technical discussions.	Vendor to Confirm			
14.0	**MACHINE ACCEPTANCE: (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 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 proveout.	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	Vendor to Confirm			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFICATION	OFFERED	DEVIATIONS	REMARKS
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 despatched in containers, all small loose items shall be suitably packed in boxes	Vendor to Confirm			
16.0	**GUARANTEE :**				
16.1	24 months from the date of acceptance of the machine.	Vendor to confirm			
17.0	**GENERAL : The vendor should submit the following information:**				
17.1	Machine Model	Vendor to Furnish			
17.2	Total connected load (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 6011 Apple 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/ subassembly of the Machine	Vendor to Furnish			
17.8	Dimensions of largest part/ subassembly/ 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	Vendor to Furnish			
17.10	Detailed catalogues , sketch/ photographs of the m/c and accessories/ attachments should be submitted with the offer.	Vendor to Furnish			
17.11	Hydraulic, Pneumatic & oil pipings should be preferably 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		P22	36.00	As high as possible	770-780	Air / Water							45								

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		
63	219	25	P91	28.57	1000-1100	1000-1100	Air															
64	219	28	P91	32.00	1000-1100	1000-1100	Air															
65	324	31	P91	35.43	1000-1100	1000-1100	Air															
66	324	35	P91	40.00	1000-1100	1000-1100	Air															
67	324	42	P91	48.00	1000-1100	1000-1100	Air															
68	406	11.5	P91	13.14	1000-1100	1000-1100	Air															
69	406	42	P91	48.00	1000-1100	1000-1100	Air															
70	457	42	P91	48.00	1000-1100	1000-1100	Air															
71	564		P91	58.00	1000-1100	1000-1100	Air							--	--	64						

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/min		
1	253.6	47	P22	50.20	As high as possible	770-780	Air															
2	260	51	P22	53.20	As high as possible	770-780	Air															