



Bharat Heavy Electricals Limited

(High Pressure Boiler Plant)

Tiruchirappalli – 620014, TAMIL NADU, INDIA

CAPITAL EQUIPMENT / MATERIALS MANAGEMENT

An ISO 9001
Company

ENQUIRY	Phone: +91 431 257 79 38 Fax : +91 431 252 07 19 Email : tvenkat@bheltry.co.in Web : www.bhel.com
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	Enquiry Number: 2620700089	Enquiry Date: 24.09.2007	Due date for submission of quotation: 10.11.2007
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	System Bender for Serpentine Tube Coil Formation as per the technical specification & commercial conditions applicable (to be downloaded from web site www.bhel.com or http://tenders.gov.in)	1 No.	31.12.2008

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 “2620700089”.

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

SYSTEM BENDER FOR SERPENTINE TUBE COIL FORMATION
PART A : QUALIFYING CRITERIA

SECTION-I

S. No.	PARTICULARS	VENDOR'S RESPONSE
1.0	<p>Only those vendors, who have supplied and commissioned at least one System Bender for similar applications in the past and such machine is presently working satisfactorily for more than one year after commissioning (on the date of opening of Tender), should quote.</p> <p>However, if such machine (s) has / had been supplied to BHEL, then it should be presently working satisfactorily for more than six months after its commissioning and acceptance (on the date of opening of Tender) in BHEL .</p> <p>The following information should be submitted by the vendor about the companies where similar machines have been supplied, for qualification of their offer.</p>	
1.1	a. Name of the customer / company where similar machine is installed.	
	b. Complete postal address of the customer	
	c. Month and Year of commissioning	
	d. Application for which the machine is supplied	
	e. Name and designation of the contact person of the customer.	
	f. Phone, FAX Nos. and E-Mail address of the contact person of the customer	
	g. Performance certificate from the customers regarding satisfactory performance of Furnace supplied to them as per the enclosed format.	
2.0	Offers of only those vendors who meet the above Qualifying Criteria will be considered for further evaluation	
3.0	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

The vendors are requested to provide the following details

S. No.	PARTICULARS	VENDOR'S RESPONSE
4.0	Number of Years of Experience of the BIDDER/ VENDOR in the field of design, manufacture, supply, erection & commissioning of tube bending machines for similar application	
5.0	Number of machines supplied, installed and commissioned till date	
6.0	Number of machines supplied, installed and commissioned till date in the QUOTED MODEL	
7.0	Number of such machines supplied, installed and commissioned till date for the following category of CUSTOMERS a) Power Utility Boiler Manufacturer b) Equipment Supplier for Process Industries [Heavy Engineering Companies] c) Research Establishments	
8.0	Details on SERVICE-AFTER-SALES Set-Up in India including the Addresses of Agents / Service Centre in India and Asia	
9.0	Any Additional Data to supplement the manufacturing capability of the BIDDER for the subject machine.	

SECTION – III

The vendor has to comply with the following :

S.No.	REQUIREMENTS	VENDOR's COMPLIANCE
10.0	The BIDDER / VENDOR shall submit the offer in TWO PARTS - Technical [with PART A & PART B] & Commercial and Price Bid.	
11.0	The Offer shall contain a comparative statement of Technical Specifications given by BHEL and the Offer Details submitted by the Bidder, against each clause. Where details are required, a mere 'CONFIRMED' or 'COMPLIES' or 'YES' or 'NO-DEVIATION' or similar words in the technical comparative statement may lead to disqualification of the Technical Offer.	
12.0	The BIDDER / VENDOR shall assure a continuous support for SPARES and SERVICE for TEN Years, from the date of commissioning of the equipment at BHEL Works.	
13.0	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	
14.0	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	
15.0	BIDDER has to indicate the Country of Origin for the supply of equipment.	
16.0	The reference List of Customers shall be accompanied with the details (Phone Number /E-Mail ID) of the CONTACT PERSON for cross reference by BHEL	

PART B**TECHNICAL SPECIFICATION FOR SYSTEM BENDER FOR SERPENTINE TUBE COIL FORMATION**

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
1.0	PURPOSE & JOB DETAILS:		
1.1	Purpose:		
1.1.1	The machine is meant for the cold and hot bending (if required) of seamless steel tubes to form serpentine coils for Economizer, Re-heater and Super-heater coils of large Power and Industrial Boilers	A few indicative drawings are enclosed	
1.2	Job Details:		
1.2.1	Range of diameter, thickness of tube and radii of bends	Annexure I	
1.2.2	Tube Outside Diameter (OD):	31.8 mm to 63.5 mm	
1.2.3	Wall thickness:	3.2 mm to 12.5 mm	
1.2.4	Tube length:	10000 mm to 72000 mm	
1.2.5	Required Minimum R/d Ratio	R/d = 1.1 (Cold bending)	
1.2.6	Bending radii	38 mm to 320 mm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
1.2.7	Bending Direction	Left and Right bending	
1.2.8	The bends will be serpentine, forming coils having TWO radii	Vendor to confirm	
1.2.9	Maximum length of coil	18 metres	
1.2.10	Maximum width of coils	4 metres	
1.2.11	Maximum weight of finished coil	Approx. 1500 kg	
1.3	Tube Material:	a. Carbon Steel: SA192, SA210A1, SA210C b. Alloy Steel: SA209T1, SA213T11, SA213T22, SA213T91, T-23, T-93 c. Stainless Steel SA 213 TP304H, SA 213 TP321H, SA 213 TP347H	
1.4	TOLERANCES FOR BENDS		
1.4.1	Visual Defects: It shall be free from harmful surface visual defects, such as scoring marks, wrinkles, tool marks and depressions.	Vendor to Confirm	
1.4.2	Percentage Ovality: $\% \text{ Ovality} = \{(\text{Max.OD}-\text{Min.OD}) / \text{Nominal OD}\} \times 100$	To be Less than 10%. Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
1.4.3	Percentage Thinning: $\% \text{ Thinning} = \{(t_{\text{nom}} - t_{\text{min}}) / t_{\text{nom}}\} \times 100$ Where, t_{nom} – is the nominal thickness before bending t_{min} – min wall thickness after bending	Maximum allowed Thinning is 10%. Vendor to confirm	
1.4.4	Tolerance on Bending angle	$\pm 0.5^\circ$	
1.4.5	Tolerance on Bend Radius:		
1.4.6	a) For Radius < 250 mm	$\pm 3 \text{ mm}$	
1.4.7	b) For Radius 300 to 600 mm	$\pm 6 \text{ mm}$	
2.0	MACHINE SPECIFICATION:		
2.1	CONFIGURATION:		
2.1.1	The bending system shall be Draw-Bending type by All Electric or Electro-Hydraulic means and with CNC mode of operation.	Vendor to confirm	
2.1.2	The machine will have ONE (Left & Right) <u>OR</u> TWO (One Left and One Right bender) main benders with induction heating facility (if required)	Vendor to confirm	
2.1.3	The System benders shall have provision for bending the coils with two different radii. Both shall be split dies. The arrangement of mounting bend dies shall be explained in the offer.	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.1.4	Booster Bending System shall be provided	Vendor to specify the type of boosting.	
2.1.5	The machine shall be provided with the Detailed Manufacturing Drawings for manufacture at BHEL for the following: a) Loading Stand b) Kick-off arrangement c) Tube In-feed Roller Conveyor d) Machine Platform for coil formation		
2.2	OPERATING PARAMETERS:		
2.2.1	Tube Outside Diameter (OD) Range:	31.8mm to 63.5mm (refer Annexure I)	
2.2.2	Tube Wall Thickness Range	Minimum 10% of Tube OD (refer Annexure I)	
2.2.3	Straight Tube length	Minimum: 10000mm Maximum: 72000mm	
2.2.4	Bending Radius	Minimum: 38 mm Maximum: 320mm	
2.2.5	Bending Capacity of the bender in terms of Section Modulus expressed in cm ³ (with tube of T91 / 347H Stainless Steel Material)	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.2.6	Max D/t at R/D of 1.1	Vendor to Specify	
2.2.7	Max D/t at R/D of 5	Vendor to Specify	
2.2.8	Bending Angle in Job	0° to 190°	
2.2.9	Bending Direction	Clockwise and Anti Clockwise	
2.2.10	Tube Working Height	Vendor to Specify	
2.2.11	Max length of coil	18000mm	
2.2.12	Max Width of coil	4000mm	
2.2.13	Minimum End Limb Length	150mm	
2.2.14	Max Number of Bending Programs that can be stored and recalled	Vendor to Specify	
2.2.15	Min. speed of bending	Vendor to specify	
2.2.16	Max. Speed of bending	Vendor to specify	
2.2.17	Return Speed	Vendor to specify	
2.2.18	Maximum Bending Torque	Vendor to specify	
2.2.19	Clamp & Pressure Slide Stroke	Vendor to specify	
2.2.20	Follower Slide Stroke	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.3	LOADING STAND:	Loading stands shall be fabricated by BHEL. Vendor has to provide the detailed manufacturing drawings in case of an order. Vendor to confirm	
2.3.1	Stand shall be designed for loading 30 tubes of length 72 meters to feed the kick off stand for ensuring continuous bending operation on the machine	Vendor to confirm	
2.3.2	The stand should have provision for keeping the tubes as bundles and as loose tubes for stock and instant feeding.	Vendor to Confirm	
2.3.3	The tube loading stands should be lined with non-metallic lining like Nylon / Teflon or equivalent to absorb the hammering noise of tubes.	Vendor to Specify	
2.3.4	The structural design should be rigid enough to withstand impact loading of tubes	Vendor to Confirm	
2.3.5	The arrangement of tube loading stand to be shown in a GA drawing.	Vendor to provide general arrangement drawing along with the offer.	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.4	KICK-OFF STAND:	Kick off stand shall be fabricated by BHEL. Vendor has to provide the detailed manufacturing drawings in case of an order.	
2.4.1	This stand shall be designed for picking and placing the above tubes for bends one by one on to the tube in-feed roller stand as per the requirement of the machine.	Vendor to Specify	
2.4.2	Operation shall be pneumatic	Vendor to Confirm	
2.4.3	Span between the kick-off arms (approx 2000mm).	Vendor to Specify	
2.5	TUBE INFEED ROLLER CONVEYOR:	Infeed roller conveyor shall be fabricated by BHEL. Vendor has to provide the detailed manufacturing drawings in case of an order.	
2.5.1	The kick off arrangement shall be designed to place the tube onto the Tube In-feed roller stand. The tube is then transported by means of the Pinch rollers OR Drive rollers, feed the tube to the tube stopper automatically.	Vendor to confirm. In case of Pinch roller arrangement, vendor to specify the number of pinch roller drives.	
2.5.2	Length of the tube in-feed conveyor	Vendor to Specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.6	TUBE STOPPER:	To be supplied by the Supplier. Vendor to confirm	
2.6.1	The tube stop assembly is to enable the tube fed by pinch rollers to stop at a reference position.	Vendor to confirm	
2.6.2	Accuracy of positioning	Vendor to specify	
2.6.3	Position feedback	Electronic	
2.6.4	Tube stopper should be of robust design	Vendor to Confirm	
2.7	CARRIAGE DRIVE UNIT FOR TUBE FEEDING:	To be supplied by the Supplier. Vendor to confirm	
2.7.1	The tube carriage should serve to take the tube to the bender by a measured accurate length and positioning at the bender die for bending operation.	Vendor to Confirm	
2.7.2	Carriage to be provided with a Tube Gripping Device (Hydraulic collet type preferable) for feeding Tubes into the machine	Vendor to Confirm	
2.7.3	The Tube gripping device / Tube Collet should be capable of allowing weld reinforcement of max 8mm to 10mm on the tube diameter at the tube-to-tube joints	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.7.5	Vendor to give details of the different gripper / collet ranges that will be used for various diameters specified	Vendor to Specify	
2.7.6	Carriage Drive - AC Servo Motor	Vendor to Specify - Details to be furnished (make, rating etc shall be specified)	
2.7.7	Drive arrangement	Vendor to Specify - Details to be furnished	
2.7.8	Method of Backlash elimination in carriage drive	Vendor to Specify	
2.7.9	Traveling Speed of Carriage (Not less than 30m / min)	Vendor to Specify	
2.7.10	Final positioning speed	Vendor to Specify	
2.7.11	Accuracy of tube positioning	Vendor to Specify	
2.7.12	Carriage Bed length	Vendor to Specify	
2.7.13	Max Carriage Feed Stroke - 15 metres	Vendor to Confirm	
2.7.14	Tube Rotation (Twisting) - 360 Degrees (Required only after the first bend and not for subsequent bends)	Vendor to Confirm	
2.7.15	Tube Rotation drive - AC Servo Motor	Vendor to Specify - Details to be furnished (make, rating etc shall be specified)	
2.7.16	Rotation speed	Vendor to Specify	
2.7.17	Rotation Torque	Vendor to Specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.7.18	Carriage shall be of rigid construction with capability of handling the entire range of Tubes mentioned and with anti-slip gripping of Tubes during bending operations.	Vendor to Confirm	
2.7.20	Carriage drive motor power rating	Vendor to Specify	
2.7.21	Tube rotation drive motor rating	Vendor to Specify	
2.7.22	Supports to prevent sagging of tube during tube feeding	Vendor to Specify with details of how this is achieved in their machine.	
2.8	TUBE BENDERS:		
2.8.1	Bender operation Electro - Hydraulic OR All Electric (AC Servo Motor)	Vendor to specify	
2.8.2	Number of Benders	ONE (Left & Right) <u>OR</u> TWO (One Left and One Right bender). Vendor to specify	
2.8.3	Bending Torque	Vendor to Specify	
2.8.4	Capacity of the machine: The maximum Section Modulus for which the machine is designed, for.	Vendor to Specify in cm ³	
2.8.5	Movement of the benders in the vertical and / or horizontal direction shall be through suitable drive arrangement and properly guided without any slackness in robust guide ways (Complete details should be furnished with the offer)	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.8.6	The selection of bender should be automatically done from the program.	Vendor to Confirm	
2.8.7	Bending dies for Two Radii as per Annexure - 1	Vendor to Confirm	
2.8.8	Type of Bending Die - Both Split Dies	Vendor to Confirm	
2.8.9	Die clamping shall be hydraulic. The upper and lower die should be hydraulically clamped together during bending. (Detailed description should be furnished with the offer)	Vendor to Confirm	
2.8.10	The tube clamping arrangement (Vendor to furnish complete description of the clamping arrangement in the offer)	Vendor to Specify	
2.8.11	Tube Clamping Length	Max 100mm	
2.8.12	Upper and lower die shall be easily removable and mountable with least effort by the operator.	Vendor to Confirm	
2.8.13	Independent upper and lower die for each diameter shall be quoted, for all diameters as given in the specification. There shall NOT be any pads to change over diameters.	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.8.14	Programmable spring back compensation should be provided.	Vendor to Confirm	
2.8.15	The bending angle encoder shall be suitably placed for easy accessibility for maintenance	Vendor to Confirm	
2.9	PRESSURE DIE:		
2.9.1	The pressure die shall be suitable for diameters and radius range specified	Vendor to confirm	
2.9.2	Length of pressure die	Vendor to Specify	
2.9.3	Pressure Die Hydraulic Pressure	Vendor to Specify	
2.9.4	Pressure Die force	Vendor to Specify	
2.9.5	Individual pressure dies shall be offered for each tube diameter. There shall NOT be any pads to change over diameters.	Vendor to Confirm	
2.10	BOOSTER UNIT:	(Complete description of boosting arrangement should be furnished with the offer)	
2.10.1	Type of Boosting	Back boosting / Clamp boosting / Pressure die assist boosting.	
2.10.2	Maximum Booster force	Vendor to specify	
2.10.3	Boosting shall be programmable It should be possible to set the required boosting power in the CNC control.	Vendor to Confirm - Details to be furnished	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.11	INDUCTION HEATING UNIT:	(If vendor is confident of achieving the bend quality requirements without the use of Induction Heating unit, sufficient proof by way of results from already supplied Machines of this capacity should be furnished to establish that bends of required quality could be achieved.)	
2.11.1	The induction heating system is used to heat a band of tube to increase the ductility of the metal when a bend is to be made on a tight centerline radius	Vendor to confirm (Complete details of the induction heating system shall be furnished with the offer)	
2.11.2	Location of the Inductor with respect to the bender	Vendor to indicate in the GA drawing.	
2.11.3	The induction heating system shall consist of a thyristor based inverter unit, control unit, HF Transformer, cables and inductor arrangement	Vendor to Confirm	
2.11.4	The inductor unit shall be suitable for strip (band) heating of the entire range of tube diameters and radii	Vendor to Confirm	
2.11.5	Tube Heating Temperature Range Up to 850 degrees C	Vendor to Confirm	
2.11.6	Time setting for the tube to reach the required temperature (in seconds) shall be preferably through the main CNC control.	Vendor to Specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.11.7	Tube heating unit raising / lowering arrangement	Vendor to Specify	
2.11.8	Display of Power, Frequency and Current of induction heating unit	Vendor to Specify	
2.11.9	Cooling of inductor shall be through a closed-circuit chilled water cooling system with suitable capacity refrigerated water chilling unit.	Vendor to Confirm (Complete description of chilling unit shall be submitted with the offer)	
2.12	GUIDE DURING TUBE FEEDING		
2.12.1	The tube has to be guided while the carriage feeds the tube. Guides such as radial gripper are preferable. Vendor to provide details of the type of arrangement for guiding of tubes during tube feeding.	Vendor to Specify	
2.12.2	In case of providing the radial grippers, the radial grippers are to be located beyond the bender. It should remain below the tube level when not in operation and come up by scissor action to guide the tube	Vendor to confirm	
2.12.3	Operation should be automatic through program control	Vendor to confirm	
2.12.4	Operation	Hydraulic	
2.12.5	Alternate arrangement for the above can also be offered	Vendor to Specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.13	MACHINE PLATFORM	Machine Platform shall be fabricated by BHEL. Vendor has to provide the detailed manufacturing drawings in case of an order.	
2.13.1	During and after bending the coil has to be supported on a platform. (Complete description of the machine platform has to be submitted with the offer)	Vendor to Confirm	
2.13.2	Width of platform (Sufficient enough to support the coil without sag)	Vendor to Specify	
2.13.3	The platform top shall be designed to have mild steel plate of suitable thickness	Vendor to Specify	
2.13.4	Vendor to explain how the finished coil is transported out of the platform after the bending is completed.	Vendor to provide details.	
2.13.5	Suitable mechanical stoppers shall be designed to ensure that the bends of the coil do not foul with the carriage during bending	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.14	OPERATOR'S PLATFORM:	To be supplied by the Supplier.	
2.14.1	Suitable operator's station shall be provided to give unhindered view of bending operation. The platform should have sufficient space for movement without any obstruction for convenient and safe operation. A 15 Amp. Plug Point with ON/ OFF switch is also to be provided on the Platform.	Vendor to specify	
2.15	OPERATOR'S PANEL:		
2.20.1.1	Operator's panel having complete CNC / PC based controller and machine control system with display of required configuration shall be provided for convenient and efficient operation. All switches should be within reach of operator. All displays/indications should also be conveniently placed (Layout showing complete details should be submitted with the offer)	Vendor to Confirm	
2.16	CNC SYSTEM & FEATURES:		
2.16.1	Make of CNC system / Industrial PC Based System.	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.16.2	Type: PC based latest version	Vendor to specify	
2.16.3	Model (Suitable and Latest version, as available at the time of ordering, should be supplied).	Vendor to specify	
2.16.4	The system should have full alphanumeric keyboard, TFT colour display (10.4" or more), additional draw-out type QWERTY Key Board and optical mouse, in suitable dust-proof enclosure, RS232C serial interfaces, parallel interface for printer, COM port for on-line tele diagnostics, USB Port, compact disc R/W drive unit for data input/output, hard disk of sufficient capacity - 80GB, graphic simulation and preinstalled system software & other required soft wares etc (Details should be furnished by the Vendor in the offer)	Vendor to Confirm	
2.16.5	Details of Standard features	Vendor to specify	
2.16.6	Details of optional features, recommended by vendor.	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.16.7	Number of axes and axes description	Vendor to specify	
2.16.8	XYZ and YBC Programming	Vendor to Confirm	
2.16.9	Operating Modes: Automatic, Semi-automatic, and Manual (Brief description of operation in these modes should be furnished with the offer)	Vendor to Confirm	
2.16.10	Auto calculation of co-ordinate conversion from Cartesian co-ordinates into bending machine co-ordinates and vice-versa	Vendor to Confirm	
2.16.11	Pre-programming and storage of number of different bending tool-data.	Vendor to Confirm	
2.16.12	Storing and retrieval of all machine operating parameters including spring back applied, stretch compensation applied, bending speed, boosting parameters, tooling data etc with Program search facility sorted on various criteria of bending.	Vendor to Confirm	
2.16.13	No. of bends produced counter - data logging of no. of bends per shift produced.	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.16.14	Spring back and Stretch compensation facility (Vendor to provide details of how the stretch compensation is done and the intermediate distance between bends is controlled)	Vendor to Confirm	
2.16.15	Automatic diagnostic alarm feature with error display.	Vendor to Confirm	
2.17	HAND HELD UNIT:		
2.17.1	Hand Held unit, Type B-MPI of Siemens make or equivalent along with sufficient length of interfacing cable for job setting and similar other purposes, is to be offered with complete details.	Vendor to specify	
2.18	UPS FOR CNC SYSTEM:		
2.18.1	UPS of 30 minutes for CNC system-	Vendor to Specify	
2.19	PLC PROGRAMMING TOOL:		
2.19.1	If PLC is used, a PLC Programming Tool with complete software should be supplied for on-line trouble shooting, software modification, upload and download of programs	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.20	AIR CONDITIONERS:		
2.20.1	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 submit	
2.21	HYDRAULICS		
2.21.1	Hydraulic system should be centralized and separate from the machine. Hydraulic Tank shall preferably be located at floor level All hydraulic pipelines to be neatly laid out (Details should be furnished in the offer)	Vendor to Confirm	
2.21.2	Make Bosch Rexroth / Vickers Sperry / Denison / Parker Hannfin (Details to be submitted)	Vendor to specify	
2.21.3	Hydraulic hose end fittings shall be of suitable material. Hoses shall preferably be of GATES make	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.21.4	Hydraulic circuits shall be designed with minimum number of control valves and to suit oil of ISO VG 46 or 68 only. Also minimum number of check-points to be provided wherever pressure is required to be read for setting and trouble shooting. MINIMESS Pressure Gauge - 1 No with Connecting Hose to be provided.	Vendor to confirm	
2.21.5	The control voltage for all solenoid operated valves. Solenoids shall be provided with indication lamp / LED	24 V DC	
2.21.6	Filtration System, Details should be submitted.	Vendor to specify	
2.21.7	Hydraulic Failure indication	Vendor to specify	
2.21.8	Automatic shut off provision. Details should be submitted.	Vendor to specify	
2.21.9	Refrigerated type cooling system of sufficient capacity to maintain Hydraulic oil at a temperature not exceeding 40 deg C irrespective of the ambient conditions. Complete details should be submitted with the offer	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.21.10	Hydraulic pump capacity (flow / pressure)	Vendor to Specify	
2.21.11	Type of Pump - Constant Pressure / Variable Flow	Vendor to Confirm	
2.21.12	Pump Motor Power in kW	Vendor to Specify	
2.21.13	Hydraulic Tank Capacity	Vendor to Specify	
2.21.14	Each pump should have an independent motor. Tandem pumps should not be used	Vendor to Confirm	
2.21.15	<u>First filling of Grease</u> should be supplied by vendor. Indian equivalent shall be mentioned.	Vendor to specify	
2.21.16	All hydraulic pumps for the power pack should be loaded only during requirement and should run unloaded during idle running of the machine.	Vendor to Confirm	
2.21.17	Hydraulic oil level indicator and temperature indicator shall be provided in the Hydraulic power pack	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.22	ELECTRICAL:		
2.22.1	415V with voltage fluctuation of +10% / -10%, 50Hz with a fluctuation of +/-3 Hz, 3 Phase AC (3 wire system without neutral) power supply 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 should be informed by vendor well in advance so that it could be incorporated during construction of foundation.	Vendor to confirm	
2.22.2	Tropicalization: All electrical / electronic equipment shall be tropicalized.	Vendor to confirm	
2.22.3	All electrical & electronic control cabinets & panels should be dust and vermin proof	Vendor to confirm	
2.22.4	All electrical components in the cabinets should be mounted on DIN Rail	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.22.5	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	OK
2.22.6	Motors & other electrical components shall conform to IEC or Indian Standards	Vendor to confirm	
2.22.7	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	
2.22.8	Vendor should ensure the proper earthing for the machine and its peripherals.	Vendor to confirm	
2.22.9	In-cycle hour counter with reset facility should be provided.	Vendor to confirm	
2.22.10	All Electric enclosures shall have IP 54 protection	Vendor to confirm	
2.22.11	Motors and drives shall be of Fanuc / Siemens / Allen Bradley / ABB / Indramat / SEW or such reputed makes only conforming to IS / IEC Standards (Vendor should indicate make and type in the offer)	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.23	SAFETY ARRANGEMENTS:		
2.23.1	Following safety features in addition to other standard safety features should be provided on the machine:	Vendor to specify	
2.23.2	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 should be continuously monitored and alarm / warning indications through lights/ alarm number with messages (on CNC display and panels) should be available.	Vendor to specify	
2.23.3	A detailed list of all alarms / indications provided on machine should be submitted by the Vendor.	Vendor to specify	
2.23.4	All the pipes, cables etc. on the machine should be well supported and protected. These should not create any hindrance to machine operator's movement for effective use of machine.	Vendor to Confirm	
2.23.5	All the rotating parts used on machine should be statically & dynamically balanced to avoid undue vibrations and suitably guarded.	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.23.6	Emergency Switches at suitable locations as per International Norms should be provided.	Vendor to Confirm	
2.23.7	All lubricated parts like Bed, guide ways shall have provision for collecting the used Lubrication oil from machine guide ways and preventing them from spilling over on to the ground.	Vendor to Confirm	
2.23.8	Cable and hoses of the traveling axes should be well supported on suitable cable drag chains / cable carriers	Vendor to Confirm	
2.23.9	Excess pressure safety relief valve in hydraulic circuit	Vendor to Confirm	
2.23.10	Oil high temperature and oil low level alarm and safety interlock	Vendor to Confirm	
2.24	ENVIRONMENTAL PERFORMANCE OF THE MACHINE: The Machine should conform to following factors related to environment:		

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
2.24.1	Maximum noise level shall be 85 dB(A) at normal load condition, 1 meter away from the machine with correction factor for back ground noise. This will be measured as per international standards like DIN 45635-16. Supplier to demonstrate compliance to noise level, if asked for.	Vendor to Confirm	
2.24.2	If any safety / environmental protection enclosure is required it should be built in the machine by the vendor.	Vendor to confirm	
3.0	SERVO VOLATGE STABILIZER:	Vendor to specify the required Rating. BHEL shall procure separately	
4.0	ULTRA ISOLATION TRANSFORMER	Vendor to specify the required Rating. BHEL shall procure separately	
5.0	PNEUMATIC SYSTEM:		
5.1	The pneumatic operated elements of the machine shall work efficiently with BHEL compressed air supply at a pressure of 4 kg/cm²	Vendor to confirm	
5.2	BHEL will provide compressed air at only one point near / on the machine. Vendor shall provide suitable filter-regulator-lubrication (FRL) unit at this point	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
6.0	TOOLING:		
6.1	List of tooling (Clamp jaws, Bending formers, Follower jaw, etc) for the tube sizes and radii mentioned in specification and any other optional tooling should be listed and quoted item wise separately.	Vendor to Specify	
7.0	FAULT DIAGNOSTIC SYSTEM:		
7.1	Vendor's own diagnostic system with required hardware and software should be supplied and installed on the CNC system. 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 faults related to mechanical and electrical maintenance.	Vendor to confirm	
7.2	Help guide should be provided to use both diagnostic systems	Vendor to confirm	
8.0	LEVELING & ANCHORING SYSTEM		
8.1	Complete anchoring system including foundation bolts, anchoring materials, fixators, leveling shoes etc should be supplied	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
9.0	TOOLS FOR ERECTION, OPERATION & MAINTENANCE:		
9.1	The Vendor shall bring special tools and equipment required for erection of the machine. 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 confirm	
9.2	Any Test mandrel required for checking & alignment of the machine components etc. should be supplied.	Vendor to confirm.	
9.3	Laser equipment, if required, for aligning and checking positioning and repeatability should be arranged for by the vendor at his own cost	Vendor to Specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
10.0	SPARES:		
10.1	Itemized 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 confirm	
10.2	a) 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, optical sensors, spares for CNC, PLC spares (I/O card, digital to analogue card, CPU card, power supply board etc.), display unit, HMI, Servo Motors for Feed Drives, Power Module & Control Cards for Main Drive as well as Feed Drives etc.	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
10.3	b) Mechanical & Hydraulic Spares: All types of Pumps, Valves, Pressure Switches, Transducers, Flow Switches, Filters, Seals, O-rings, Hydraulic Hoses etc.	Vendor to confirm	.
10.4	All types of spares for total machine and accessories should be available for at least 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	
10.5	Vendor to confirm that complete list of spares for machine and accessories, along with item part no / 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	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
11.0	DOCUMENTATION: Three sets of following documents (3 Hard copies) in English language should be supplied along with the machine		
11.1	Operating manuals of Machine & CNC system	Vendor to confirm	
11.2	Programming Manuals of Machine & CNC system	Vendor to confirm	
11.3	Detailed Manufacturing drawings for all the components that are to be manufactured by BHEL as given 2.1.5	Vendor to confirm	
11.4	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	Vendor to confirm	
11.5	Maintenance, Interface & commissioning manuals for CNC system & feed drives.	Vendor to confirm	
11.6	Catalogues, O&M Manuals of all bought out items including drawings, wherever applicable.	Vendor to confirm	
11.7	Detailed specification of all rubber items and hydraulic/lube fittings	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
11.8	Operating Manuals, Maintenance Manuals & Catalogues for supplied Voltage Stabilizer, Isolation Transformer, and all supplied Accessories.	Vendor to confirm	OK
11.9	PLC program printouts with comments in English.	Vendor to confirm	OK
11.10	PLC program on CD, NC data & PLC data on CD / Flash Memory card	Vendor to confirm	OK
11.11	Complete back up of hard disk on GHOST CD and clear written Instructions (3 copies) to take back up and reloading of a new hard disk.	Vendor to confirm	OK
11.12	The vendor shall submit complete Master List of parts used in the machine.	Vendor to confirm	OK
11.13	One additional set of all the above documentation on CD	Vendor to confirm	OK
11.14	GA Drawing – 3 Copies	Vendor to confirm	OK
11.15	3 Sets of Manufacturing drawings for all toolings, ordered along with the machine, including Bend dies, Clamp jaws, Pressure dies, Collet jaws etc.	Vendor to Confirm	OK

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
12.0	TRAINING:		
12.1	The Vendor shall train Four BHEL's Engineers in Operation and Maintenance (Mechanical, Electrical/ Electronics and CNC System) of the Machine at Vendor's works for a period not less than 10 working days.	Vendor to confirm	
12.2	The Vendor shall impart training to BHEL's Machine Operators and Maintenance crew in Operation and Maintenance (Mechanical, Electrical/ Electronics and CNC System) after the commissioning of the Machine at BHEL works for not less than 10 working days.	Vendor to confirm	
12.3	The training shall include specialized coaching in i) Safety ii) Operation of the machine iii) CNC System Operation, iv) Trouble-Shooting, v) Software Application vi) All special features of the machine vii) Electrical / Mechanical / Electronics systems	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
12.4	Airfare, boarding & lodging for the trainees shall be borne by BHEL.	Vendor to Confirm	
12.5	Competent, English speaking experts shall be arranged by the vendor during training for satisfactory & effective training of BHEL personnel	Vendor to Confirm	
12.6	Vendor to quote for training on per man per week basis	Vendor to Specify	
13.0	FOUNDATION:		
13.1	Vendor shall submit the preliminary layout drawing for getting BHEL's approval within one month from the date of Letter of Intent (LOI) Foundation details viz. static / dynamic load details etc. and Final Layout drawings shall be submitted by the Vendor within three months after getting BHEL's approval. The layout should consist of all requirements pertaining to complete machine including space requirement for & any other accessories. BHEL shall design and construct complete foundation for the machine as per the Vendor's recommendation The Vendor shall also indicate detailed specifications of grouting compound and Grouting procedure etc. for foundation bolts of the machine	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
14.0	ERECTION & COMMISSIONING		
14.1	Vendor to take full responsibility for Supervision of the erection and for start up, testing and commissioning of machine, its control & all types of other supplied equipment. Service requirement like power, air & water shall be provided by BHEL at only one point to be indicated by Vendor in their foundation/layout drawings. Other requirements like crane and helping personnel shall also be provided by BHEL.	Vendor to Confirm	
14.2	Successful proving of BHEL components by the Vendor shall be considered as part of commissioning. All tests, as mentioned (Machine Acceptance) shall form part of the commissioning activity.	Vendor to Confirm	
14.3	Tools, Test Mandrels, instruments and other necessary equipment including Laser equipment required to carry out all above activities should be brought by the Vendor.	Vendor to Confirm	
14.4	Commissioning spares, required for commissioning of the machine shall be supplied free of cost	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
14.5	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	
14.6	Schedule of Erection and Commissioning shall be submitted with the offer.	Vendor to Confirm	
14.7	Charges, duration, terms & conditions for E&C should be furnished in detail separately by Vendor along with offer.	Vendor to Confirm	
15.0	GEOMETRICAL ACCURACY		
15.1	Geometrical Accuracy Tests shall be in accordance with applicable standard recommended by the Vendor. Detailed Test Charts for the same, clearly showing the accuracies to be achieved on the machine, shall be submitted with the offer.	Vendor to Confirm	
15.2	All other accuracies shall confirm to Vendors Test chart.	Vendor to Confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
15.3	All the above accuracies should be demonstrated to BHEL engineers during pre-acceptance at Vendors works and during Erection & Commissioning at BHEL Works.	Vendor to Confirm	
16.0	RESOLUTION & REPEATABILITY:		
16.1	REPEATABILITY:		
16.1.1	Tube Feed/Transport	± 0.10 mm	
16.1.2	Tube Bending Bender-I	± 0.1 deg	
16.1.3	Tube Bending Bender-II	± 0.1 deg	
16.1.4	Tube Rotation for Orientation.	± 0.1 deg	
16.1.5	Booster	Vendor to Specify	
16.2	RESOLUTION:		
16.2.1	Tube Feed/Transport	Vendor to Specify	
16.2.2	Tube Bending Bender-I	Vendor to Specify	
16.2.3	Tube Bending Bender-II	Vendor to Specify	
16.2.4	Tube Rotation for Orientation.	Vendor to Specify	
16.2.5	Booster	Vendor to Specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
17.0	AMBIENT CONDITIONS & THERMAL STABILITY:		
17.1	Total machine including CNC system and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies. Power Supply: Voltage: 415 V with voltage fluctuation of -10% / +10% Frequency: 50 Hz with fluctuation of -3Hz / +3Hz No. of phases = 3 The machine shall be suitable for an ambient temperature of +45 deg C and relative humidity of 90 % respectively, but both do not occur simultaneously	Vendor to confirm	
17.2	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.	Vendor to confirm	
17.3	Thermal Stability of the complete machine keeping in view specified Ambient Conditions and accuracy requirements of BHEL components and vendor should ensure trouble free operation of the machine.	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
17.4	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 the year.	Vendor to Confirm	
18.0	PROVEOUT OF BHEL COMPONENTS:		
18.1	The prove-out trials shall be for the tube sizes, bend pattern that will be given by BHEL during the technical discussions / at the time of release of Purchase Order. The bends have to meet the quality requirements of all parameters (like ovality, thinning, flow area, angle of bend, distance between bends etc) as mentioned in the specification	Vendor to confirm	
18.2	Productivity: Vendor shall establish an output of minimum 300 bends / shift in OD 47.63 x 6.3 mm tube with two radii one of which will be close radius	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
19.0	MACHINE ACCEPTANCE: (Tests/Activities to be Performed by Vendor)		
19.1	Tests/Activities to be carried out on the machine at Vendor's works in the presence of BHEL engineers before dispatch:		
19.1.1	Geometrical accuracies as per applicable standard test chart recommended by the Vendor	Vendor to Confirm	
19.1.2	Resolution and Repeatability as per specification	Vendor to Confirm	
19.1.3	Full load test to demonstrate the maximum capacity of the machine.	Vendor to Confirm	
19.1.4	Demonstration of all features of the machine, control system & accessories	Vendor to Confirm	
19.2	Tests / Activities to be carried out at BHEL works while commissioning the machine:		
19.2.1	Geometrical accuracies as per applicable standard test chart recommended by the Vendor	Vendor to confirm	
19.2.2	Resolution and Repeatability as per specification	Vendor to confirm	
19.2.3	Full load test to demonstrate the maximum capacity of the machine.	Vendor to confirm	
19.2.4	Demonstration of all features of the machine, control system & accessories to the satisfaction of BHEL for efficient and effective use of the machine	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
19.2.5	Demonstration by actual use of all supplied attachments and accessories to their full capacity.	Vendor to confirm	
19.2.6	The prove-out trials as per Clause 18.0	Vendor to confirm	
19.2.7	One week supervision by vendor of independent operation of machine by BHEL after job prove out (to run concurrently with training at BHEL)	Vendor to confirm	
20.0	PACKING:		
20.1	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	
21.0	GUARANTEE:		
21.1	24 months from the date of acceptance of the machine at BHEL Works.	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
22.0	GENERAL:		
22.1	Machine Model No.	Vendor to specify	
22.2	Total connected load (KVA):	Vendor to specify	
22.3	Floor area required (Length, Width, Height) for complete machine & accessories	Vendor to specify	
22.4	Machine lubrication	Automatic centralized lubrication system.	
22.5	Painting of Machine / Electrical Panels:	RAL 6011 Apple Green (Polyurethane Paint)	
22.6	Total weight of the machine	Vendor to specify	
22.7	Weight of heaviest part of machine	Vendor to specify	
22.8	Weight of the heaviest assembly / sub-assembly of the Machine	Vendor to specify	
22.9	Dimensions of largest part/ sub-assembly/ assembly of the machine	Vendor to specify	
22.10	Vendor to submit, along with offer, reference list of customers where similar machines have been supplied mentioning broad specifications of the supplied machine	Vendor to confirm	
22.11	Detailed catalogues, sketch/ photographs of the m/c and accessories/ attachments should be submitted with the offer.	Vendor to confirm	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
22.12	Hydraulic, Pneumatic & oil piping should be preferably metallic except places where flexible piping is essential. All the pipes required for the same shall be included in the standard scope of the machine.	Vendor to confirm	
22.13	All feedback systems & field sensors, limit switches, proximity switches, pressure switches, temperature controllers, should be for heavy duty application and wired up with flexible PVC insulated screened cables. All field elements shall have easy accessibility for maintenance.	Vendor to confirm	
22.14	The general arrangement drawing showing the machine & associated systems with salient dimensions shall be submitted along with the offer. The drawing should be clear and legible	Vendor to Confirm	
22.15	The supplier should describe in the offer any additional optional accessories that are likely to enhance the productivity of the machine.	Vendor to Specify	

ANNEXURE I

TUBE OUTER DIAMETER AND THICKNESS:

All are OD (Outer Diameter) controlled tubes with thickness tolerance of Max +18%

S.No	Tube OD (mm)	THICKNESS (mm)
1	31.8	3.2 / 3.6 / 4.0 / 5.0
2	38.1	3.2 / 4.0 / 5.0 / 6.3
3	44.5	4.5 / 5.0 / 6.3 / 8 / 9 / 10
4	47.63	5.0 / 6.3 / 8 / 10
5	51.0	5.1 / 6.3 / 8 / 10 / 12
6	54.0	6.3 / 8 / 10 / 12
7	57.0	6.3 / 8 / 10
8	60.3	6.3 / 8 / 10 / 12.5
9	63.5	6.3 / 10 / 12.5

RADIUS OF BENDS:

S.No	TUBE OD (mm)	RADIUS OF BEND (mm)
1	31.8	R 40, 48
2	38.1	R 48, 51, 65
3	44.5	R 48, 51, R 65, 143
4	47.63	R 51, 114, 152
5	51.0	R 76.5, 151
6	54.0	R 76.5, 165
7	57.0	R 100
8	60.3	R 200
9	63.5	R 100, 160, 200, 320

PERFORMANCE CERTIFICATE

(On Customer's Letter Head)

1. Supplier of the machine :
2. Make & Model of the Equipment :
3. Month & Year of Commissioning :
4. Application :
5. Sizes of Jobs Performed in the machine
 - a. Tube diameter :
 - b. Tube thickness (maximum) :
 - c. Length & Width of Coil :
6. Performance of the Machine : Best in the market /
(Strike off whichever is not applicable) Satisfactory /
Good /
Average /
Not Satisfactory
7. Any other remarks:

Date:

Signature & Seal of the Authority
Issuing the Performance Certificate