Bharat Heavy Electricals Limited

(High Pressure Boiler Plant)
Tiruchirappalli – 620014, TAMIL NADU, INDIA

An ISO 9001 Company

CAPITAL EQUIPMENT / MATERIALS MANAGEMENT

ENQUIRY NOTICE INVITING TENDER	Phone: +91 431 257 79 38 Fax : +91 431 252 00 31 Email : tvenkat@bheltry.co.in Web : www.bhel.com

TWO PART BID Tender to be submitted in two Parts	Enquiry Number: 2621300073	Enquiry Date: 20.12.2013	Due date for submission of quotation: 30.01.2014

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

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

Item	Description	Qty.	Delivery Required	Delivery Terms Required
10	PLC/NC Based Tube Bending Machine (Clockwise) as per the technical specification & commercial conditions applicable (to be downloaded from web site www.bhel.com or http://tenders.gov.in)	1 No.	9 months from the date of Purchase Order	F.O.R, BHEL Stores, Trichy.
20	PLC/NC Based Tube Bending Machine (Counter Clockwise) as per the technical specification & commercial conditions applicable (to be downloaded from web site www.bhel.com or http://tenders.gov.in)	1 No.	9 months from the date of Purchase Order	F.O.R, BHEL Stores, Trichy.

Important points to be taken care during submission of offer:-

1. **Compliance Form No. TRY/IMP/01 & TRY/IND/01A and Annexure II (Details of Company Performance) to be filled and enclosed along with the offer failing which, the offer will not be considered for evaluation.**
2. **EMD for this Tender will be Rs. 2,00,000.00/-**
3. **Delivery shall not exceed 9 months from the date of Purchase Order.**
4. **Offer shall be evaluated for both items (Sl.No.10 & 20) as a single package (Overall L1 basis).**
5. **All updates, amendments, corrigenda, etc., (if any), for each tender will be posted only on the above websites from time to time, as and when required, until each tender is opened. There will be no publication of such updates, amendments, corrigenda, etc., through newspapers or any other media.**
6. **The time period required for Erection & Commissioning of the item shall be 2 months from the date of intimation from BHEL requesting supplier to depute Service Engineers about site readiness**

BHEL's General guidelines / instructions (refer MM/CE/GENL/001-EMD) including bank guarantee formats and list of consortium banks, commercial terms check-list can be downloaded from BHEL web site http://www.bhel.com or from the Government tender website http://tenders.gov.in (public sector units > Bharat Heavy Electricals Limited page) under Enquiry reference "2621300073".

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**

Sr. Manager / Capital Equipment / MM

T. VENKATESWARAN
Senior Manager
Capital Equipment / MM
BHEL, Tiruchirappalli - 620 014.

PLC/NC BASED TUBE BENDING MACHINE
PART – A

SECTION- 1: Qualifying Criteria

The BIDDER has to compulsorily meet the Qualifying Criteria indicated in **Section 1** to get qualified. Otherwise the technical offer will not be considered.

S NO.	REQUIREMENTS	VENDOR'S RESPONSE
1.1	The BIDDER / VENDOR (**OEM**) shall have a minimum TEN Years of Continuous Experience in Design, Manufacture & Supply of "PLC / NC / CNC based TUBE BENDING MACHINES". Vendor shall indicate the actual number of years of experience in the field.	
1.2	Only those vendors (**OEMs**) fulfilling the following conditions should quote: who have commissioned in the last 10 years (as on the original date of tender opening) at least **TWO"PLC/NC/CNCTUBE BENDING MACHINES" capable of bending tubes of diameter 47.63 mm or more with thickness up to 10 mm or more in multi-plane** **EITHER** (i) In at least any one country other than the country of origin to establish vendor's global business activity. **OR**(ii) In India and the referred machines are presently working satisfactorily for more than one year after commissioning (as on the original date of tender opening). The name and contact addresses of the customers to whom the Tube Bending Machines were supplied to be furnished with details. BHEL reserves the right to accept or reject the OEMs based on the assessment of their technical and financial capability.	
1.3	Vendor has to submit at least ONE PERFORMANCE CERTIFICATE from their customers in India or from the customers to whom the machine was supplied outside the country of origin to whom the Tube Bending Machine referred under clause 1.2 above, for satisfactory performance of the Tube Bending Machine, for a minimum period of one year from the date of commissioning(as on the original date of tender opening). Performance certificate as Original Certificate or E-mail directly from the customer may be submitted. The original certificate may be returned after verification by BHEL, if required. For obtaining the Performance certificate, a suggestive format is provided at the end of Part A.	
1.4	BHEL reserves the right to verify the information provided by the Vendor for the referred Tube Bending Machine at their referred customer's works. It shall be the responsibility of the vendor to facilitate the visit of BHEL's team at their referred customer works. The Travel, Board and Lodging expenses for BHEL Personnel shall be borne by BHEL. In case the information provided by vendor is found to be false/ incorrect, the offer shall be rejected.	

SECTION - 2:

The BIDDER / VENDOR are requested to provide the following information:-

S NO.	REQUIREMENTS	VENDOR'S RESPONSE
2.1	The BIDDER / VENDOR to furnish Reference List of Customers, with complete address, details of contact person, where Tube Bending Machine has been supplied in the past.	
2.2	Specify details of Tube Bending Machine supplied to other units of BHEL, if any (Year of commissioning with details etc.	
2.3	Details on SERVICE-AFTER-SALES Set-up in India including the Address of Agents / Service Centres in India.	
2.4	Any Additional data to supplement the manufacturing capability of the BIDDER for the subject equipment.	

SECTION – 3:

The BIDDER to note:

S NO.	REQUIREMENTS	VENDOR'S RESPONSE
3.1	The BIDDER / VENDOR shall submit the offer in TWO parts. 1. Technical Offer [**with PART A & PART B**] 2. Commercial Offer and Price bid.	
3.2	The Technical Offer shall contain complete details against all clauses of Technical Specifications given by BHEL.	
3.3	The Technical Offer shall be supported by copies of product Catalogues, Data Sheets and technical details of Bought- Out-Items.	
3.4	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.	

Suggestive Format of Performance Certificate:

The Performance should be certified by the customer on **Customer's Letter Head** and submitted along with the offer.

PERFORMANCE CERTIFICATE

1.0	**Tube Bending Machine** Supplied by : (Manufacturer's name)	
2.0	Make & Model number of the Machine	
3.0	Month & Year of Commissioning	
4.0	Application for which The Machine is used	
5.0	**Machine Details**	
5.1	Main Motor Power in KW	
5.2	Max Diax Max Thickness of tube can be bent on the machine.	
5.3	Tube material bent	
5.4	Carriage Travel in mm	
6.0	Performance of the Machine (Please tick the appropriate option)	Satisfactory Not Satisfactory
7.0	Service after sales (Please tick the appropriate option)	Satisfactory Not Satisfactory
8.0	Other remarks (if any)	
Date:		Signature & Seal of the Authority Issuing the Performance Certificate

TECHINCAL SPECIFICATION - PART B

PLC / NC based - TUBE BENDING MACHINES

Note:-

i. The Column **"Vendor's offer with Technical details & Remarks"** 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.

ii. The offer and all documents enclosed with offer should be in **English language** only.

	OEM	INDIAN AGENT
Name		PLC / NC based - TUBE BENDING MACHINES
Address		
Telephone no		
Fax no		
e-mail		

iii. Scope: - Design, Manufacture, Supply, Erection & Commissioning of PLC / NC based Tube Bending machines (**Clockwise-1No and Counter clockwise- 1No**) complying with the specification as below:

<table>
<tr><th>S. No.</th><th>BHEL SPECIFICATIONS</th><th>Vendor's OFFER</th></tr>
<tr><td>1.0</td><td>APPLICATION
a. These machines are meant for cold bending of seamless steel tubes in multi-plane axes for burner panels and panel access door opening bends of super critical Boilers.
b. The bending system of these machines shall be either Electro Hydraulic or All Electric draw bending type with PLC / NC control.
c. Machine 1 :CLOCKWISE - 1 No.
Machine 2 : COUNTER CLOCKWISE - 1 No.</td><td></td></tr>
<tr><td>2.0</td><td colspan="2">JOB DETAILS (TUBE CONFIGURATION and SPECIFICATION:</td></tr>
<tr><td>2.1</td><td>TUBE SIZES All are Outside Dia Controlled tubes with thickness tolerance of Max. +15 %
<table><tr><th>S.No</th><th>Tube OD mm</th><th>Min. Thick, mm</th><th>Max. Thick mm</th></tr><tr><td>1</td><td>38.1</td><td>3.8</td><td>10.0</td></tr><tr><td>2</td><td>41.3</td><td>4.0</td><td>8.2</td></tr><tr><td>3</td><td>42.4</td><td>4.2</td><td>10.0</td></tr><tr><td>4</td><td>44.5</td><td>4.0</td><td>10.0</td></tr><tr><td>5</td><td>47.63</td><td>5.0</td><td>10.0</td></tr></table></td><td></td></tr>
<tr><td>2.2</td><td>TUBE BEND DETAILS:
<table><tr><th>S. No</th><th>TUBE OD mm</th><th>Min Bend Radius mm</th><th>Max Bend Radius mm</th></tr><tr><td>1</td><td>38.1</td><td>R 48</td><td>R 75</td></tr><tr><td>2</td><td>41.3</td><td colspan="2">R 85</td></tr><tr><td>3</td><td>42.4</td><td colspan="2">R 85</td></tr><tr><td>4</td><td>44.5</td><td>R 65</td><td>R 100</td></tr><tr><td>5</td><td>47.63</td><td>R 51</td><td>R 95</td></tr></table></td><td></td></tr>
</table>

S. No.	BHEL SPECIFICATIONS		Vendor's OFFER
2.3	**TUBE MATERIAL:** **a. Carbon Steel:** SA192, SA210A1, SA210C **b. Alloy Steel:** SA209T1, SA213T11**,** SA213T22, SA213T91, T-23 **c. Stainless Steel** SA 213 TP304H, SA 213 TP321H, SA 213 TP347H		
2.4	**JOB DETAILS**: For Typical configuration of Job, Refer Annexure 1		
3.0	**QUALITY TOLERANCES FOR JOBS**		
3.1	**VISUAL DEFECTS**		
3.1.1	It shall be free from harmful surface visual defects such as wrinkles, tool marks and depressions etc		
3.2	**PERCENTAGE OVALITY**		
3.2.1	% Ovality = (Max.OD - Min.OD)/ Original OD} x100	Maximum allowed ovality is **10%**	
3.3	**PERCENTAGE THINNING**		
3.3.1	% of Thinning = { (T1-T2) / T1} X 100 where **T1** is the thickness measured at the end of the tube after bending, by drawing a line parallel to tube bend axis from **T2** is the minimum thickness observed in the tube after bending.	%Thinning shall not exceed [100 / {(4R/D)+2}] where **R** is the mean radius of bend to the centre line of the tube (in mm) **D** is the Nominal outside diameter of the tube (in mm)	
3.4	**FLATNESS ON BEND**	Flat Land width over the bend portion does not exceed 12.5mm.	
3.5	**BENDING ANGLE TOLERANCE**	± 0.5 deg	
3.6	**BEND RADIUS TOLERANCE**	± 2 mm	
3.7	**MINIMUM OD** (At any point of Bend)	= 0.895 x OD (Nom) + 0.233 x Min. Wall thickness	

S. No.	BHEL SPECIFICATIONS		Vendor's OFFER
3.8	**FLOW AREA** Actual Flow area = Area calculated from the imprints	Actual flow area at any location of the tube after bending shall be 80% minimum of actual flow area of the tube before bending.	
4.0	**OPERATING PARAMETERS:**		
4.1	Tube Diameter (Range)	38.1 to 47.63 mm (Please refer table at S.No. 2.1)	
4.2	Tube Wall Thickness	3.8 to 10.0 mm (Please refer table at S.No. 2.1)	
4.3	Bend Radius	R 48 to R 100 (Please refer table at S.No. 2.3)	
4.4	R/d Ratio (Minimum)	1.2	
4.5	Tube length handled – Tube feeding manually done	Minimum: 950mm Maximum: 5500 mm	
4.6	Tube Clamping Length required	60 mm	
4.7	Minimum End Limb Length	100 mm	
4.8	Bending Angle	0 to 180Deg	
4.9	Multi Plane Turning Angle	360Deg	
4.10	Min straight length between tangent points of adjacent bends	75 mm	
4.11	Bending Direction:	Machine 1: CLOCKWISE Machine 2: COUNTER CLOCKWISE	

S. No.	BHEL SPECIFICATIONS		Vendor's OFFER
4.12	Machine front body radius shall be minimum such that the bent tube does not foul with the machine body with minimum straight lengths of 75mm while tube rotation and multi-plane bending.	Vendor to confirm and specify the dimensions	
5.0	**PRODUCTIVITY**		
5.1	The machine should be capable of completing a minimum of 180 bends in a shift of 8 hours on tubes of dia 38.1mmx Th 9.5mm, Radius 75mm – multi-plane bends on burner panel circuits.	Vendor to confirm	
6.0	**MACHINE PARAMETERS**		
6.1	Maximum speed of bending arm in rpm / deg per second	Vendor to specify	
6.2	Max return speed of bending arm in rpm / deg per second	Vendor to specify	
6.3	Clamp Jaw Stroke length in mm	Vendor to specify	
6.4	Pressure die Stroke length in mm	Vendor to specify	
6.5	Carriage travel feed stroke: (around 2.5m)	Vendor to confirm / specify	
6.6	Carriage bed length	Vendor to specify	
6.7	Creep speed to be provided for bending arm during start and end of bending	Vendor to specify and confirm	
6.8	Creep speed to be provided for Clamp Jaw movement, Pressure Die forward / reverse stroke, Carriage movement.	Vendor to specify and confirm	

S. No.	BHEL SPECIFICATIONS		Vendor's OFFER
6.9	Traveling Speed of Carriage in metres per min. (around 20m/min). Speed shall be infinitely variable. Creep speed to be provided during start and end of the stroke	Vendor to specify /confirm range of speed	
6.11	Mandrels	Mandrels not required	
6.12	Height of Bending die centre line from Floor level (around 1250 mm)	Vendor to specify	
6.13	Maximum Bending Torque	Vendor to specify	
6.14	Maximum Tube rotation torque, suitable to rotate the tubes with multi-plane bends as given in the typical configurations in the annexures.	Vendor to specify	
6.15	Max Section Modulus of tube that can be bent in the machine	Vendor to specify	
6.17	Main Pump Motor capacity in kW	Vendor to specify	
6.19	Carriage drive motor power rating, kW	Vendor to Specify	
6.20	Tube rotation drive motor rating, kW	Vendor to Specify	
6.16	Maximum Operating Pressure	Vendor to specify	
6.21	Hydraulic Tank Capacity	Vendor to specify	
6.18	Total Power Requirement in kVA	Vendor to specify	
7.0	**MACHINE OPERATING SYSTEM SPECIFICATIONS:**		
7.1	SPEEDS :		
7.1.1	Tube Rotation Speed - Steplessly variable	Vendor to specify range in rpm	
7.1.2	Bending Speed - Steplessly Variable	Vendor to specify range in rpm	

S. No.	BHEL SPECIFICATIONS		Vendor's OFFER
7.2	RESOLUTION:		
7.2.1	Tube Feed/Transport	Vendor to specify in mm	
7.2.2	Tube Rotation	Vendor to specify in deg	
7.2.3	Bending	Vendor to specify in deg	
7.3	REPEATABILITY:		
7.3.1	Tube Feed/Transport	Vendor to specify in mm	
7.3.2	Tube Rotation	Vendor to specify in deg	
7.3.3	Bending	Vendor to specify in deg	
8.0	**GENERAL DESIGN & CONSTRUCTIONAL FEATURES :** Configuration of machine to be explained by vendor through GA drawings and relevant sketches in the offer.		
8.1	**Bend die construction**		
8.1.1	Bend die mounting plate shall be designed such that there is no interference with multi-plane bends while bending multi-plane bend configurations. Vendor to provide detailed sketch/drawing.		
8.1.2	Split die actuation to be provided in the machine. Lift has to be more than 5mm and not more than 20mm.Vendor to specify the lift in mm.		
8.1.3	Split die actuation to be achieved only from the bottom of the machine and NOT overhead.		
8.1.4	Bend die mounting shall be of quick type with only hand tightening.		
8.1.5	Provision for bend to bend ('S' bends) clamping to be confirmed.		
8.1.6	Design of the DIE-BOSS (Bending Table) on which the BENDING FORMER is mounted has to suit the FORMER mounting details given in Annexure - 2. (This is required to enable use of existing bending formers available with BHEL.)		

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
8.2	**Clamping and Clamp Jaw construction**	
8.2.1	The bending machine shall have swing arm type of Tube bending arrangement. NO overhead clamping type.	
8.2.2	Clamp jaw shall be easily removable and mountable with least effort by the operator with quick clamping mechanism. The mounting detail of the clamp jaw to be explained.	
8.2.3	There shall NOT be any pads to change over diameters.	
8.2.4	The clamping by standard straight movement of clamp jaw for clamping	
8.2.5	Height adjustment for adjusting the clamp jaw height to be provided	
8.3	**Follower jaw construction**	
8.3.1	Follower jaw should be of single piece construction for the full length and suitable for making 180 degree bends in a single stroke.	
8.3.2	Follower jaws shall be easily removable and mountable. Provision for handling by crane to be provided like eye hooks.	
8.4	**Carriage Construction:**	
8.4.1	Carriage movement sensor shall be of non-contact type	
8.4.2	Carriage to be provided with a Tube Gripping Device - Collet Type, for feeding Tubes into the machine. Collet design should ensure anti-slip gripping of tubes.	
8.4.3	Collet shall be suitably designed to allow the weld butt joints between tubes, through the collet freely. A weld reinforcement of maximum 3mm per side (6mm on diameter) can be considered for designing collet.	
8.4.4	Vendor to give details of the different collet arrangements and their ranges that will be needed for various diameters as per our specification.	
8.4.5	The carriage size shall be such that the carriage does not foul / interfere with long end limb of 180 degree bends of close radius.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
8.4.6	Carriage shall be of rigid construction with capability of handling the entire range of tubes mentioned in this specification. The collet shall open once the tube is clamped by the bending former and while bending is in progress. This shall be repeated for all the bends. The carriage should travel up to Centre of bending former.	
8.4.7	Tube recapture for shorter trailing lengths of tubes shall be provided.	
8.4.8	The sliding carriage guide way and the gripping arrangement of carriage over the slide way shall be rigid enough so that the carriage does not lift. The design details to be briefly explained by the vendor.	
8.4.9	Supports to prevent sagging of tube during tube feeding. Vendor to Specify with details of how this is achieved in their machine.	
8.5	**Tube Loading :**	
8.5.1	Tube loading shall be done manually through the collet from the front of the carriage.	
8.6	**Sliding surfaces**	
8.6.1	Sliding surfaces shall have metal to metal contact. NO pads or Hylam strips in between shall be used	
9.0	**CONTROL PANEL:**	
9.1	The following three parameters shall be programmable. 1. Bending angle 2. Rotation angle 3. Distance between bends.	
9.2	Machine shall be operated in three modes viz., Manual, Semi-Automatic and 'Automatic after loading of tube'	
9.3	XYZ and YBC Programming capability. Both to be interchangeable.	
9.4	Control system shall be preferably PLC with MMI.	

<table>
<tr><th>S. No.</th><th>BHEL SPECIFICATIONS</th><th>Vendor's OFFER</th></tr>
<tr><td>9.5</td><td>Self-standing MMI touch screen type of operator control panel having protective sheathing and plug-in connectors through closed cable ducts shall be provided. The control panel shall have centralized controls of operation, to be located in front and away from the machine with a minimum 10 metres long control cable and mounted on a movable trolley. Vendor to confirm</td><td></td></tr>
<tr><td>9.6</td><td>Safety devices for hydraulic circuit, emergency stop buttons to be provided in the operator panel as well as in the machine panel and suitable interlock safety systems. Vendor to confirm</td><td></td></tr>
<tr><td>9.7</td><td>Collet axis centering, in line with Centre line radius of bend die shall be adjusted manually. Suitable Pointer and scale has to be provided. Vendor to explain the arrangement in the offer.</td><td></td></tr>
<tr><td>9.8</td><td>The bending process auto and feedback field start and stop initiating field sensors, such as encoders, limit switch, feedback devices shall be suitably placed for easier accessibility rigidly.</td><td></td></tr>
<tr><td>10.0</td><td>TOOLINGS</td><td></td></tr>
<tr><td>10.1</td><td>List of tooling (Standard Clamp jaws, Bending formers, Follower jaw/ Pressure die etc) for the sizes mentioned below to be quoted item wise separately. Independent Follower jaws and Clamp Jaws for each diameter shall be quoted, for sizes given below. There shall NOT be any pads to change over
<table>
<tr><th>S.No</th><th>Tool Size</th><th>Clockwise M/c</th><th>Counter Clockwise M/c</th></tr>
<tr><td>1</td><td>Dia 38.1 X R75</td><td>1 Set</td><td>1 Set</td></tr>
<tr><td>2</td><td>Dia 41.3 X R85</td><td>1 Set</td><td>1 Set</td></tr>
<tr><td>3</td><td>Dia 42.4 X R85</td><td>1 Set</td><td>1 Set</td></tr>
</table>
Note: Detailed Manufacturing drawings for all Toolings are to be submitted for BHEL approval before manufacturing. Three sets of Tooling drawings are to be submitted with machine documents in case of an order.</td><td></td></tr>
</table>

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
11	**DRAWING APPROVAL**	
11.1	GA drawings, Machine detailed constructional (main & sub assembly) drawings with dimensions Hydraulic / Pneumatic / Lubrication / Electrical / Electronic circuits with detailed BOM, are to be submitted within 45 days from the date of ordering (in case of an order) for approval by BHEL before start of manufacturing. BHEL shall provide approval within 15 days after all the clarifications sought have been submitted by supplier.	
12	**FOUNDATION:**	
12.1	Supplier to submit Civil Foundation layout drawing with details of static & dynamic loads, within one month after BHEL approval of manufacturing drawings. The shop floor at BHEL works has 200mm concrete thickness with M15 concrete mix.Based on the submitted foundation layout, BHEL shall prepare Civil Foundation drawing. Civil foundation work is under the scope of BHEL. If there is NO foundation, then the machine shall be placed on anti-vibratory pads	
12.2	**LEVELLING & ANCHORING SYSTEM**	
12.3	Complete anchoring system including foundation bolts, anchoring materials, fixtures, leveling shoes, pads / anti-vibratory padsetc shall be supplied with the Machine.	
13	**MACHINE OPERATING CONTROL SYSTEM FEATURES:**	
13.1	PLC / NC & MMI Shall be of Latest Version. Vendor to confirm and details to be specified clearly.	
13.2	All sequence of operation of the machine shall be through PLC/NC control. Machine shall be able to operate through auto and manual cycles. Vendor to confirm	
13.3	Real time bending to be displayed with details such as bending angle, distance of carriage movement, rotation angle etc.	
13.4	Auto-Display of machine positions on the screen during manual operation.	
13.5	Display in flat color monitor. Vendor to specify their standard Monitor size and furnish details such as make and model.	
13.6	Auto calculation of co-ordinate conversion from Cartesian co-ordinates into bending machine co-ordinates and vice-versa.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
13.7	Pre-programming and storage of number of different bending tool-data.	
13.8	Automatic diagnostic alarm feature with error code and message display.	
13.9	System shall have the facility to display Memory details.	
13.10	System Software to be stored in Memory along with Flash Memory.	
13.11	The supplier shall give software (with necessary setup files for installation in any PC/laptop) and PLC program back up.Licensed Software of PLC / NC& MMI suitable for Windows 7 to be Supplied by vendor.	
13.12	A standard RS 232 C (V 24) interface to connect IBM compatible computer.	
13.13	Connectivity to be provided. Protection against virus and malwares should be provided without compromising on the system performance.	
13.14	Interfacing Cable for PLC / NC CPU & MMI to be Supplied by Vendor.Vendor to confirm	
13.15	Power failure backup module for smooth shut down of the system shall be provided.	
14	**HYDRAULICS**	
14.1	All Hydraulic valves to be of modular construction. All hydraulic operating components to be mounted on the manifold in a centralized place at convenient location for minimum piping and easy approach for Maintenance. Hydraulic system layout to be provided.	
14.2	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 (1.0 to 1.5m length) to be provided. Vendor to confirm.	
14.3	Maximum Operating Pressure of hydraulic system. The maximum pressure of the system should preferably not to exceed 315 bar. Vendor to specify	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
14.4	It should be possible to replace hydraulic elements like valves, manifolds etc without disturbing the associated pipelines. The positioning of hydraulic elements should allow easy maintenance. Vendor to specify	
14.5	Pumps, valves, accessories etc. shall be of Bosch-Rexroth / Vickers or reputed make acceptable to BHEL. (Details to be submitted). The seals used in cylinders shall be of Merkel / Parker / Bushak + Shamban / Hunger / Simrit make and shall withstand an over-loading of 25 % Vendor to confirm & furnish details.	
14.6	The Power pack should be designed taking into account the energy efficiency (Hi-low pump system, proper unloading during idling, etc.). The motor used for pumps shall be of energy efficient ones. Vendor to specify	
14.7	Each pump should have an independent motor. Tandem pumps shall be avoided. Vendor to specify	
14.8	Pump unloading feature during idle running to be provided for energy conservation.	
14.9	Hydraulic circuit is to be designed with minimum number of control valves. It should be possible to replace hydraulic elements like valves, manifolds etc., without disturbing the associated pipelines. The positioning of hydraulic elements should allow easy maintenance. Vendor to furnish details	
14.10	All oil pipelines shall be of seamless steel and should undergo pickling process.	
14.11	All cylinders used in the machine should have standard bore and rod sizes. The piston rod shall be hard chrome plated. Vendor to specify	
14.12	Cylinder design shall be such that the lock nut on rod end can withstand the full load even the piston is at its extreme position. Cylinder seals also should not get affected during the above operation. Vendor to confirm	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
14.13	Refrigerant type Cooling system of sufficient capacity to maintain complete Hydraulic System at a temperature not exceeding 40 deg C irrespective of the ambient conditions. Vendor to confirm & furnish details. The components used in Chiller unit should be of reputed standard make acceptable to BHEL. The hydraulic oil cooling unit shall be tropicalized.	
14.14	Main Pump flow in lpm and Motor Power in kW Vendor to specify	
14.15	Hydraulic Oil Tank / Reservoir capacity (in litres) Vendor to specify	
14.16	Maximum Operating Pressure of hydraulic system. Vendor to specify	
14.17	Servo valves, if any, should be mounted close to their actuators Vendor to confirm	
14.18	The control voltages for all the Solenoids of the valves shall be of 24- V DC and all solenoid operated DC valves should have manual override provision and LED indications. Vendor to specify	
14.19	All the pipe / hose end fittings shall be of standard weld nipple with O ring seating type (DIN 3865 or equivalent). No ferrule joints are to be used in the hydraulic system. All threaded connections shall be of metric sizes. Vendor to confirm	
14.20	Hydraulic power pack and Oil tank shall be separate from the Machine and positioned behind the machine conveniently to attend to any maintenance problems	
14.21	All hydraulic pipelines, hoses and electrical control cables to be neatly laid out with proper clamps and flexible hose conveyors wherever required. Vendor to confirm	
14.22	The flexible hoses used in the system shall be of Gates / Aeroquip / Parker or any other reputed make acceptable to BHEL. Vendor to specify	
14.23	The pipelines to be painted with standard colors as per the color coding accepted internationally for hydraulic systems. Vendor to furnish details.	
14.24	All oil pipelines shall be of seamless steel and should undergo pickling process. Vendor to confirm	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
14.25	All hydraulic Tube lines to be neatly laid out.	
14.26	All the components in the hydraulic power pack shall be provided with identification numbers, as per the hydraulic circuit and should be pasted with metallic identification number plates. Vendor to confirm	
14.27	Suitable filtration system should be provided with Duplex / standby filter units. It is preferable to use re-usable type of filter elements in the system. The filter unit shall be of HYDAC / PARKER / REXROTH or equivalent reputed make acceptable to BHEL. (Details to be submitted). Vendor to specify	
14.28	Failure indication for oil level, temperature, pressure, filter clogging should be provided. Vendor to confirm & furnish details	
14.29	Safety interlock / automatic shut off provision during hose failures, chiller failure, low oil level etc. Details should be submitted. Vendor to specify	
14.30	First fill of Hydraulic oil/ Lubrication oil or Grease to be provided by Vendor. Vendor to confirm	
14.31	Safety interlocks like auto shutoff during low oil level , sudden hose failure etc,. shall be incorporated. Vendor to specify and give details	
14.32	Pressure gauge at the working level of the operator is to be provided for indicating working pressure.	
14.33	Pressure setting adjustment (Pressure relief valve) has to be provided at operator level, to adjust the pressure based on requirement. Vendor to confirm.	
14.34	Suitable leakage oil collection metallic tray to be provided wherever required. Vendor to confirm	
14.35	Suitable vibro-mounts, compensators (flexible bellows), flexible hose at the pump outlet, polypropylene clamps for pipes & hoses, etc are to be provided to minimize the vibration induced and transmitted to the hydraulic joints. Vendor to confirm	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
15	**LUBRICATION**	
15.1	Centralized Automatic Lubrication system with a provision for adjusting the timer shall be provided for the machine. Vendor to confirm.	
16	**PNEUMATIC SYSTEM**	
16.1	The pneumatic operated elements of the machine shall work efficiently with BHEL compressed air supply at a pressure of 5 kg/cm2. If higher air pressure is required for efficient operation of the machine, vendor shall furnish the information for Air Compressor of suitable capacity.	
16.2	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.	
16.3	Hydraulic, Pneumatic & Lubricating 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.	
16.4	Pneumatic components shall be of FESTO / SMC / NORGREN makeonly	
16.5	Lubricator, Regulator, Filter and hand wheel valve shall be fitted at the centralized location for any pneumatic circuits	
17	**ELECTRICAL & ELECTRONICS SYSTEMS**	
17.1	415V + 10% / -10%, 50HZ +/-1.5 HZ, 3 Phase AC (3 wire system without neutral) Power Supply Source will be provided by BHEL at a single point near the machine, as per layout recommended by Vendor. All types of 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. Vendor to confirm	
17.2	Wiring: All electrical motors, limit switches etc, on the machine shall be Wired using PVC sheathed cable running in conduits to cable ducts to common terminal block. External wiring from / to control panel, control desk, external motors etc shall be by means of screened multi-core cables. All machine cables shall be of copper.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
17.3	Control circuit voltage should be 24 V DC	
17.4	All electrical equipment shall be Tropicalized and shall have IP 54 degree of protection. Vendor to confirm	
17.5	All electrical control cabinets & panels should be dust and vermin proof. Vendor to confirm	
17.6	All electrical components in the cabinets should be mounted on DIN Rail. Vendor to confirm	
17.7	Air Conditioners with Dehumidifiers of suitable capacity to be provided for all Electrical / Electronic Panels / Cabinets including Operator's Panel considering specified ambient conditions. Make: Rittal / Warner & Finley or any other reputed make acceptable to BHEL. Detailed specifications to be submitted.	
17.8	All electrical panels should be provided with CFL lamps for sufficient illumination and electric power receptacles of 220 Volts, 5/15 Amp, 3 pin. AC. All adapters/receptacles should have compatibility with Indian equivalents. Vendor to confirm	
17.9	All limit switches used in the machine shall be sturdy and rigid and shall not fail frequently due to vibrations in the actuating mechanisms. The vendor may employ non-contact type limit switches/limit switches with metallic rollers having less spring-like properties to avoid vibration. Vendor to confirm.	
17.10	All components / devices / terminals are to be incorporated with ferrules. Vendor to confirm	
17.11	All cables moving with traversing axes should be installed in metallic cable drag chain. Additionally, all the cable trays required for laying of cables should be included in the offer. Vendor to confirm	
17.12	Vendor should ensure the proper earthing for the machine and its accessories. Vendor to confirm	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
17.13	All electrics such as contactors, relays, MCBs, MCCBs, limit switches and other control elements shall be of reputed make like Siemens, L&T, BCH, and Tele-technique/Schneider or any other reputed makes acceptable to BHEL. Vendor to confirm	
17.14	Electrical drives shall be of Siemens / ABB /L&T/ Eurotherm / Yaskawa / Mitsubishi or any other reputed makes acceptable to BHEL. Vendor to confirm	
18	**PREFERRED MAKES OF COMPONENTS**	
18.1	The PLC system used in the machine shall be of Siemens/Allen Bradley/ Mitsubishi/ Delta / Messungor other reputed makes acceptable to BHEL.	
18.2	All hydraulic elements shall be of EATON-VICKERS / BOSCH-REXROTH or any international reputed make acceptable to BHEL.	
18.3	All hydraulic hoses shall be preferably of GATES / PARKER HANFFIN / AEROQUIP make or reputed makes acceptable to BHEL.	
18.4	The seals used in cylinders shall be of Merkel / Parker / Bushak + Shamban / Hunger / Simrit make and shall withstand an over-loading of 25 % Vendor to confirm & furnish details.	
18.5	The filter unit used in the hydraulic power pack shall be of Hydac / Parker / Rexroth/EATON-Vickers or equivalent reputed make acceptable to BHEL.	
18.6	Lubrication system used in the machine should be of SKF/CENLUB or reputed make acceptable	
18.7	All Pneumatic components used in the machine should be of FESTO/SMC makes only	
18.8	All motors shall be from makers like SIEMENS, ABB, Allen Bradley, Crompton Greaves, Kirloskar, Hindustan, Bharat Bijlee, GEC or any other internationally reputed makes conforming to IEC/IS Standards, acceptable to BHEL. Electrical motors should be of Energy efficient EFF1/IE2 class.	
18.9	All electrical items shall be of from SEW / ROCKWELL Allen Bradley/ Telemechanique / Delta/ L&T/ Siemens/ GE or reputed makes acceptable to BHEL.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
18.10	Encoders and digital display units shall be of HEIDENHAIN / FAGER /ASM make	
18.11	All the VFDs used in the machine shall be of Siemens/ ABB/ Mitsubishi/ Allen Bradley/ Yaskawa/ Danfoss or other reputed makes acceptable to BHEL.	
18.12	All components/devices/terminals are to be incorporated with numbered ferrules.	
19	**SAFETY**	
19.1	All the safety features provided in the machine shall be listed out by vendor.	
20	**ENVIRONMENTAL PERFORMANCE OF THE MACHINE:**	
20.1	Maximum noise level shall be 85 dB (A) at normal load condition, 1 metre away from the machine with correction factor for back ground noise, if necessary this will be measured as per international standards like DIN 45635-16. Vendor to demonstrate compliance to noise level, if so required. Vendor to confirm	
20.2	If any safety / environmental protection enclosure is required it shall be built in the machine by the vendor.Vendor to confirm	
20.3	Paint of the machine should be oil / coolant resistant and should not peel off and mix up with coolant.Vendor to confirm	
21	**AMBIENT CONDITIONS & THERMAL STABILITY**	
21.1	Total machine and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies. Ambient Conditions: Temperature: +10 to +50 Degree Celsius and Relative Humidity: 90% maximum, both do not occur simultaneously.	
21.2	The entire equipment shall be Tropicalized in Design and Construction	
21.3	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.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
22	**TOOLS FOR ERECTION, OPERATION & MAINTENANCE**	
22.1	The vendor shall bring special tools and equipment required for erection and commissioning the machine .Necessary tools like Torque Wrench, Spanners, Keys, Grease guns etc. for operation & maintenance of the machine should be supplied. List of such tools shall be submitted with offer.	
23	**MACHINE SPARES**	
23.1	Item-wise break-up of mechanical, hydraulic, electrical 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)	
23.2	**Mechanical & Hydraulic Spares:** Bearings, Couplings, Gears and all types of Pumps, Valves / Pressure switches / transducers/ gauges / Flow Switches / Filters / Cylinder seal kit / All O- rings & Oil seals, Each type of Hydraulic Hoses,etc. <u>The vendor has to quote the following essential Spares compulsorily</u>: a) For Mechanical wearing components due to linear movements & rotation, couplings, bearings etc. - 2 Sets b) For Hydraulic Power Pack, Each type of hydraulic valves & pump, Complete Seal kit for all hydraulic cylinders, filters and each type of hydraulic hoses used in the machine etc., - 2 Sets	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
23.3	**Electrical / Electronic / Control System Spares:** All types of Relays, Contactors, Proximity Switches, Push Buttons, Indicating Lamps, Semiconductor Fuses, Special Fuses, Circuit Breakers, Main Power Switch, Encoders, Spares for CNC, Servo Motors for Feed Drives, Drive and Power Module & Control Cards for Main Drive as well as Feed Drives etc. <u>Essential Spares for vendor has to quote compulsorily</u> a) **Each type** of PLC / NC - PCBs (I/O card, digital to analogue card, CPU card, power supply board etc.) display unit, HMI etc., - **2 sets** each b) **Each type** of Field sensors, such as encoders, optical sensors, proximity switch, limit switches, push buttons, indicating lamps etc. - **2 sets** each	
23.4	All types of spares for total machine and accessories should be available for at least seven 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 & Vendors to enable BHEL to procure these in advance, if required.	
23.5	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.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
24	**DOCUMENTATION :**	
24.1	The following documents in English language should be supplied along with the machine: **Hard Copies - 3 Sets** **In CD form - 1 Set** **Vendor to confirm** 1. Operating manuals of Machine & its Control System 2. One set of approved drawings (GA, mechanical, electrical,hydraulic,pneumatic & lubrication) 3. Programming manuals of Machine & its Control System 4. Maintenance manuals with drawings of machine assemblies / sub-assemblies with parts list 5. Electrical circuit diagrams with bill of materials, component layout drawings for operator and control panels clearly indicating arrangement of electrical components in the panels 6. Hydraulic circuit diagrams with bill of materials 7. Pneumatic circuit diagrams with bill of materials 8. Lubrication circuit diagram with bill of materials 9. Maintenance & Interface manuals, Installation support guides etc for Machine Control System 10. Manufacturing drawings for all tooling's ordered with machine under clause No 10.0 11. Catalogues, O&M manuals for all bought out items used in the machine. 12. Detailed specification of all rubber items / hydraulic / lubrication fittings 13. Complete master list of parts used in the machine 14. PLC program print-outs/ladder logic with comments in English 15. PLC program backup and data, PLC software (installable on any PC/laptop) on CD 16. Complete list of Alarm log, Error code, error messages & remedies and on line fault diagnostics to be provided by the vendor.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
25	**MACHINE PRE-DESPATCH INSPECTION AND ACCEPTANCE CRITERIA:**	
25.1	Complete machines shall be assembled and offered for inspection and performance trials to test the design capabilities of the machine, by BHEL Engineers before Dispatch at Supplier's works. <u>Acceptance Criteria during pre-dispatch inspection:</u> a) Physical Inspection and Design/Constructional/Dimensional Compliance as per the approved drawings. b) All the features of the machine construction shall be operated and shown in good working condition as per the Technical Specification and Drawings approved by BHEL. c) Prove-out trials shall be done on tubes that are supplied by BHEL and bends as required by BHEL during technical discussion. d) Quality tests are to be conducted by the supplier, on the bends made during prove-out trials and the results should be within the tolerance limits as per Clause No 3.0.	
26	**ERECTION & COMMISSIONING**	
26.1	Vendor to provide supervision for carrying out the erection, start up, testing of machine, it's control system & all associated equipment supplied. 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.	
26.2	Successful proving of BHEL components by the Vendor shall be considered as part of commissioning. All tests, as mentioned at Specification Clause No. 25.0 (Machine Acceptance) shall form part of the commissioning activity.	
26.3	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 colors of paint used.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
27	**MACHINE INSPECTION AND TESTS TO BE CARRIED FOR COMMISSIONNG AT BHEL WORKS**	
27.1	After the machine has been erected and energized, a few idle runs have to be done to demonstrate the good working condition of the machine.Successful proving of BHEL components by the Vendor shall be considered as part of commissioning. <u>Acceptance Criteria during commissioning:</u> a) Physical Inspection and Design/Constructional/Dimensional Compliance. Ensuring proper working of all components and accessories of the machine erected. b) Prove out trials to be conducted on the tubes given by BHEL with the toolings supplied along with the machine. c) Quality tests will be conducted by BHEL, on the bends made during prove-out trials at BHEL and the results should be within the tolerance limits as per Clause No 3.0. d) Actual jobs shall be loaded to see the performance of the machine during continuous running for two 8 hr shifts. e) Productivity should be proven as per clause No 5.1 on actual jobs or test pieces.	
28	**TRAINING**	
28.1	**The training shall be imparted in the following disciplines:** a. Safety, b. Operation of the machine, c. Machine Operation programming, d. Trouble-Shooting, e. Software Application, f. All special features of the machine to be explained	
28.2	The supplier shall train TWO BHEL Engineers in Operation and Maintenance (Mechanical, Hydraulics/Electrical/ Electronics and Programming) of the Machine for FIVE working days at supplier's works after the pre-dispatch inspection.	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
28.3	Travel, board & lodging for the BHEL Engineers who will be visiting supplier's works for pre-dispatch inspection and training, shall be borne by BHEL. Vendor to note	
28.4	Training on Operation and maintenance of BHEL machine operators of complete machine minimum 5 days by the Vendor's experts/engineers during commissioning and prove out at BHEL works	
28.5	Training on Trouble Shooting & maintenance of Mechanical, Hydraulic, Electrical, Electronic systems, PLC / NC System to be imparted to Maintenance Staff for minimum 2days during commissioning at BHEL.	
29	**PAINTING**	
29.1	a) The heavier machine parts are to be shot blasted for surface preparation prior to painting. b) One coat of Primer c) Two coats of Polyurethane Paint (Colour–Reseda Green–RAL 6011)	
29.2	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 colors of paint used in the machine	
30	**PACKING**	
30.1	Rigid packing for all items of complete machine, all Accessories and other supplied items to avoid any damage/loss in transit. All loose and small parts to be packed in sealed boxes. All electrical and electronic items to be packed separately to prevent any damage during transit. Vendor to confirm	
31	**PERFORMANCE GUARANTEE**	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
31.1	The complete equipment shall be guaranteed for a minimum period of 12 months from the date of commissioning or 18 months from the date of dispatch whichever is earlier.	
32	**GENERAL POINTS**	
32.1	Make and Model of the machine to be mentioned. Detailed catalogs of the machine to be sent with the offer.	
32.2	Complete description of all systems & sub-systems shall form part of the technical bid.	
32.3	A schematic diagram showing the layout of the machine & associated systems with salient dimensions shall be submitted along with the offer. Hydraulic system layout to be provided.	
32.4	The operating sequence of the machine with broad outline of various operations involved should be furnished with the offer.	
32.5	Quality plan followed in Vendor's works	
32.6	Standards for Design, Manufacture and testing of the machine shall be in accordance with internationally accepted standards.	
32.7	The factor of safety considered for designing the machine, for certain load bearing components shall be furnished with the offer.	
32.8	Floor area required (Length, Width, Height) for complete machine & accessories	
32.9	Total connected load in kVA	
32.10	Total weight of the machine	
32.11	Weight of heaviest part of machine	
32.12	Weight of the heaviest assembly/subassembly of Machine	
32.13	Dimensions of largest part/ subassembly/ assembly of the machine	

S. No.	BHEL SPECIFICATIONS	Vendor's OFFER
33	**SCOPE OF SUPPLY**	
33.1	**SUPPLIER'S SCOPE** a) Design, Manufacture, Supply, Erection, Commissioning and prove out of Tube Bending machines. b) Complete set of Toolings as specified c) Machine drawing and Foundation drawing to be submitted for BHEL approval d) First fill of Hydraulic Oil, Lubrication Oil and Grease e) All anchoring & foundation bolts, levelling plates for the complete machine. f) Levelling Instruments, Power Tools / Hand Tools / Special tools for erection and commissioning of the machine. g) Commissioning spares h) Engineers for supervision for erection and commissioning i) Job Quality Prove out at Vendor's works j) Job Quality and Productivity Prove-out at BHEL's works	
33.2	**BHEL SCOPE** a) Drawings approval b) Civil foundation work as per manufacturer's foundation layout c) Unloading of machine consignment at BHEL works d) Tubes for job trials and prove out at BHEL e) EOT Crane inside shop f) Single Compressed air point at the location indicated in the drawing g) Single Electrical Supply point at the location indicated in the drawing h) Welding machines and consumables required for erection if any	

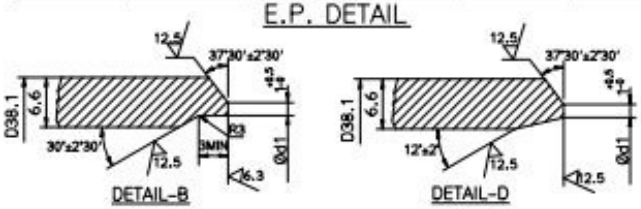
Annexure1:Bend Configurations

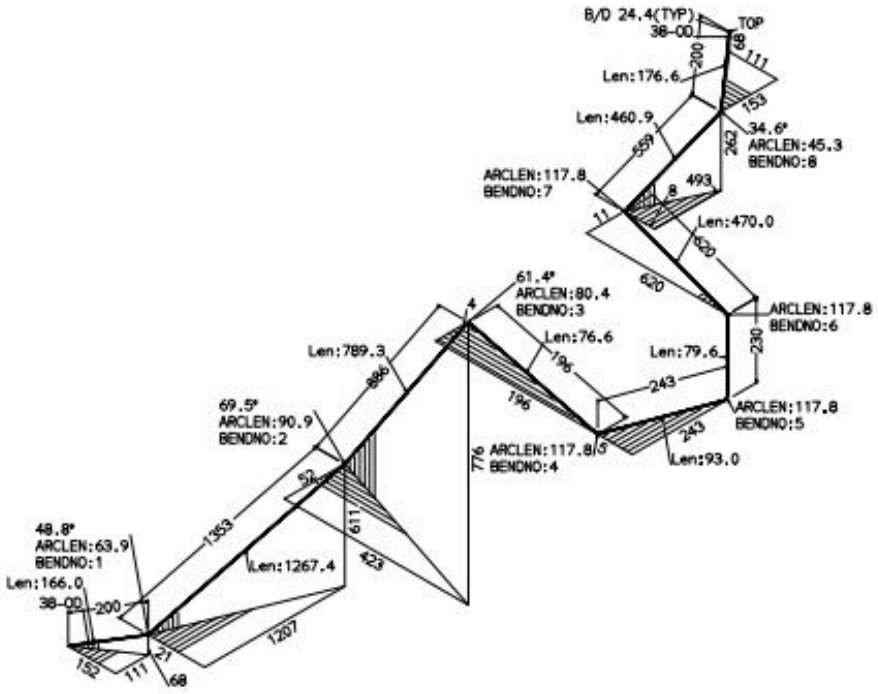
1. **Drawing 06652**
2. **Drawing 06659**
3. **Drawing 06676**
4. **Drawing 06687**
5. **Drawing 07522**

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD.NO TP 023 0299

BEND	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8
ROT ANG	235° 37'	281° 40'	273° 19'	270°	90°	117° 58'	185° 18'

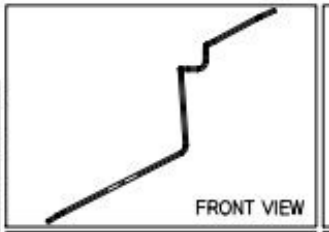
E.P. DETAIL

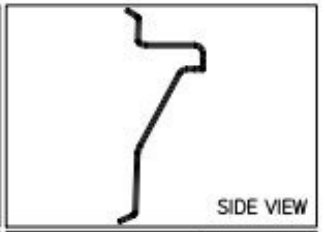


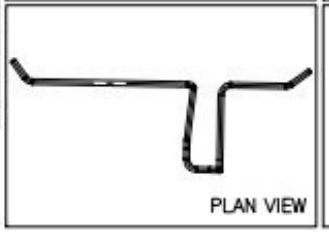


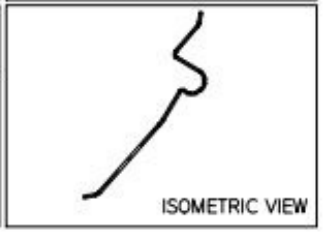
COORDINATES TABLE

	X	Y	Z
START	0	0	0
BEND 1	110.57	-152.19	67.92
BEND 2	1318.25	-173.27	678.69
BEND 3	1266.09	-596.27	1455.31
BEND 4	1262.67	-792.39	1455.31
BEND 5	1505.63	-796.63	1455.31
BEND 6	1505.63	-796.63	1684.96
BEND 7	1516.45	-176.73	1684.96
BEND 8	2010.28	-185.35	1947.29
END	2162.47	-74.78	2015.22









NOTE:

1. NO SHOP JOINT PERMITTED WITHIN A TUBE
2. TUBE HAS TO BE ROTATED CLOCKWISE AS PER THE ROTATION ANGLE
3. BEND ANGLE IS 90° UNLESS SPECIFIED
4. RADIUS OF THE BEND = 75
5. FOR DESIGN PARAMETERS REFER ASSEMBLY DRAWING
6. QTY REQUIRED PER BOILER IS 1
7. PAINT THE WORD "TOP" AND MARK NO "WB-2_TB36 " NEAR THE TOP END OF THE TUBE
8. PIPE OD MARKED NEAR TUBE ENDS ARE TO BE READ AS PER BOM

TUBE : D 38.1 X t 6.6 - L 4331.3

Material : SA213 T12

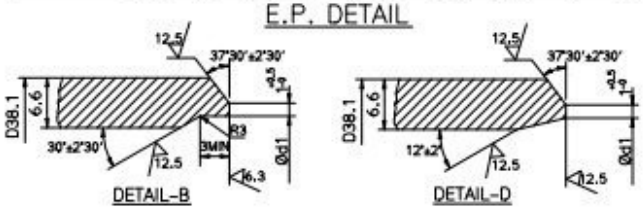
Drg.No. 06652

BHEL, TRICHY

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD.NO TP 023 0299

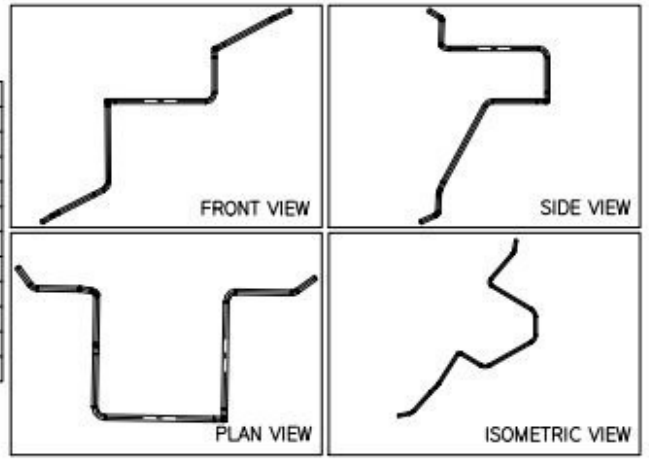
BEND	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9
ROT ANG	176° 18'	60° 34'	278° 12'	270°	270°	90°	117° 58'	185° 18'

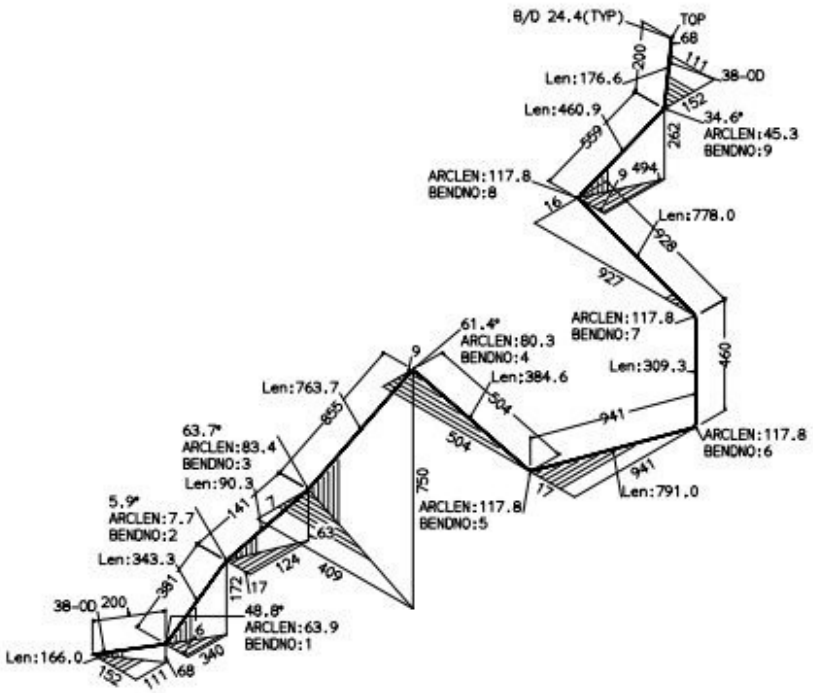
E.P. DETAIL



COORDINATES TABLE

	X	Y	Z
START	0	0	0
BEND 1	110.57	-152.19	67.92
BEND 2	450.68	-158.12	239.93
BEND 3	575.34	-174.65	303.11
BEND 4	568.20	-584.09	1053.44
BEND 5	559.40	-1088.16	1053.44
BEND 6	1500.26	-1104.58	1053.44
BEND 7	1500.25	-1104.58	1512.74
BEND 8	1516.45	-176.73	1512.74
BEND 9	2010.28	-185.35	1775.07
END	2162.47	-74.78	1843.00





NOTE:
1. NO SHOP JOINT PERMITTED WITHIN A TUBE
2. TUBE HAS TO BE ROTATED CLOCKWISE AS PER THE ROTATION ANGLE
3. BEND ANGLE IS 90° UNLESS SPECIFIED
4. RADIUS OF THE BEND = 75
5. FOR DESIGN PARAMETERS REFER ASSEMBLY DRAWING
6. QTY REQUIRED PER BOILER IS 1

TUBE : D 38.1 x t 6.6 - L 5015.6mm

Material : SA213 T12

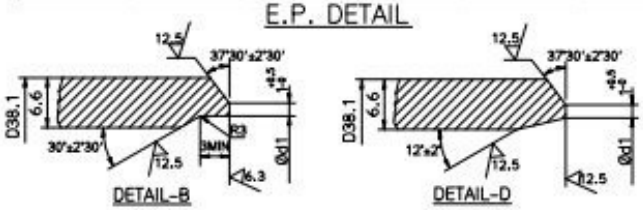
Drg.No. 06659

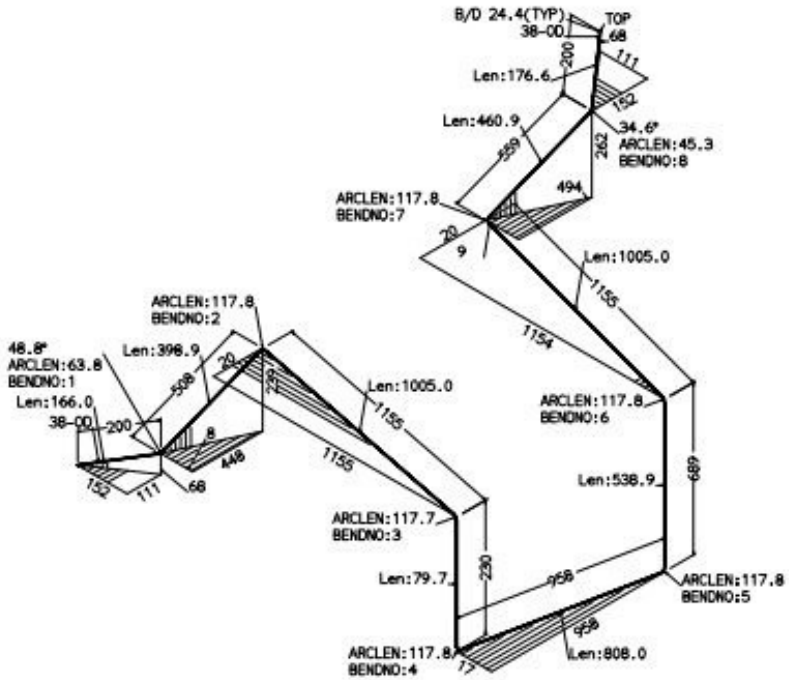
BHEL, TRICHY

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD.NO TP 023 0299

BEND	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8
ROT ANG	177° 24'	298° 6'	270°	0°	90°	117° 58'	185° 18'

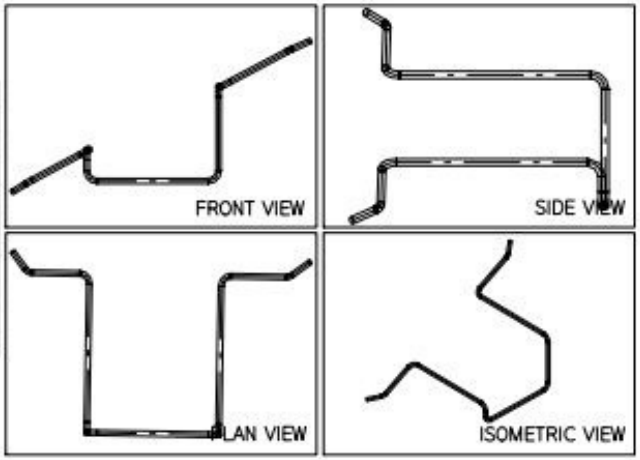
E.P. DETAIL





COORDINATES TABLE

	X	Y	Z
START	0	0	0
BEND 1	110.57	-152.19	67.92
BEND 2	558.60	-160.01	307.09
BEND 3	538.44	-1314.83	307.09
BEND 4	538.44	-1314.83	77.44
BEND 5	1496.29	-1331.55	77.44
BEND 6	1496.29	-1331.55	766.39
BEND 7	1516.45	-176.73	766.39
BEND 8	2010.28	-185.35	1028.72
END	2162.47	-74.78	1096.64



NOTE:
1. NO SHOP JOINT PERMITTED WITHIN A TUBE
2. TUBE HAS TO BE ROTATED CLOCKWISE AS PER THE ROTATION ANGLE
3. BEND ANGLE IS 90° UNLESS SPECIFIED
4. RADIUS OF THE BEND = 75
5. FOR DESIGN PARAMETERS REFER ASSEMBLY DRAWING
6. QTY REQUIRED PER BOILER IS 1

TUBE : D38.1 x t 6.6 - L 5455mm

Material : SA213 T12

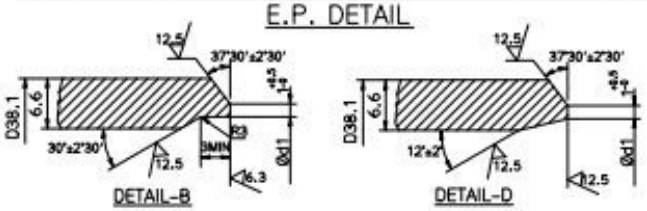
Drg.No. 06676

BHEL, TRICHY

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD.NO TP 023 0299

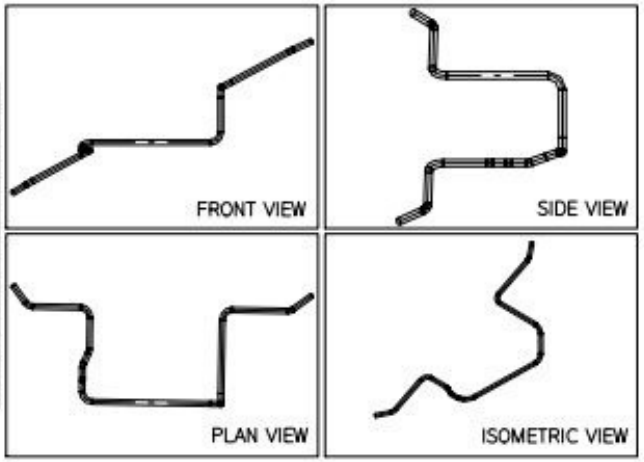
BEND	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 - 10
ROT ANG	177° 24'	28° 6'	180°	270°	90° 6'	250° 6'	90°	117° 58'	185° 18'

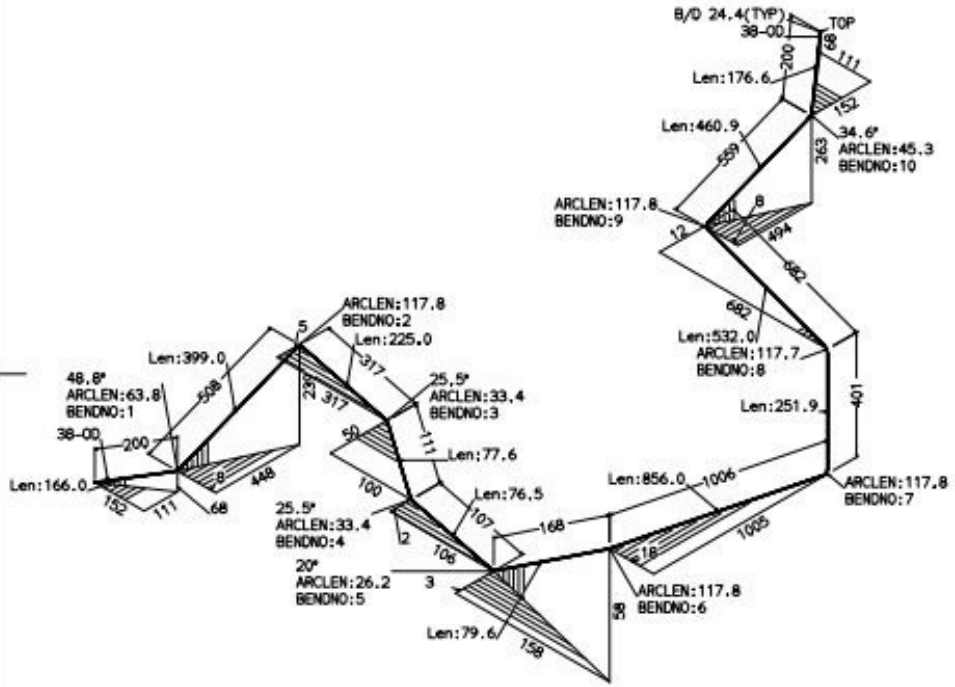
E.P. DETAIL



COORDINATES TABLE

	X	Y	Z
START	0	0	0
BEND 1	110.57	-152.19	67.92
BEND 2	558.60	-160.01	307.11
BEND 3	553.07	-476.93	307.11
BEND 4	503.32	-576.71	307.11
BEND 5	501.45	-683.35	307.11
BEND 6	498.70	-841.06	364.52
BEND 7	1504.55	-858.62	364.52
BEND 8	1504.55	-858.62	766.41
BEND 9	1516.45	-176.73	766.41
BEND 10	2010.28	-185.35	1028.74
END	2162.47	-74.78	1096.66





NOTE:
1. NO SHOP JOINT PERMITTED WITHIN A TUBE
2. TUBE HAS TO BE ROTATED CLOCKWISE AS PER THE ROTATION ANGLE
3. BEND ANGLE IS 90° UNLESS SPECIFIED
4. RADIUS OF THE BEND = 75
5. FOR DESIGN PARAMETERS REFER ASSEMBLY DRAWING
6. QTY REQUIRED PER BOILER IS 17

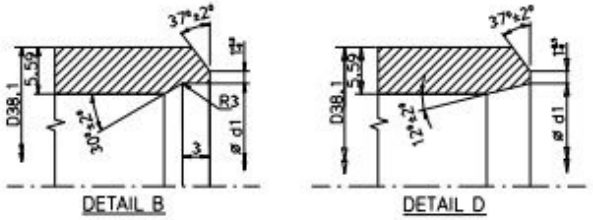
TUBE : D38.1 x t 6.6 - L 4092.1mm

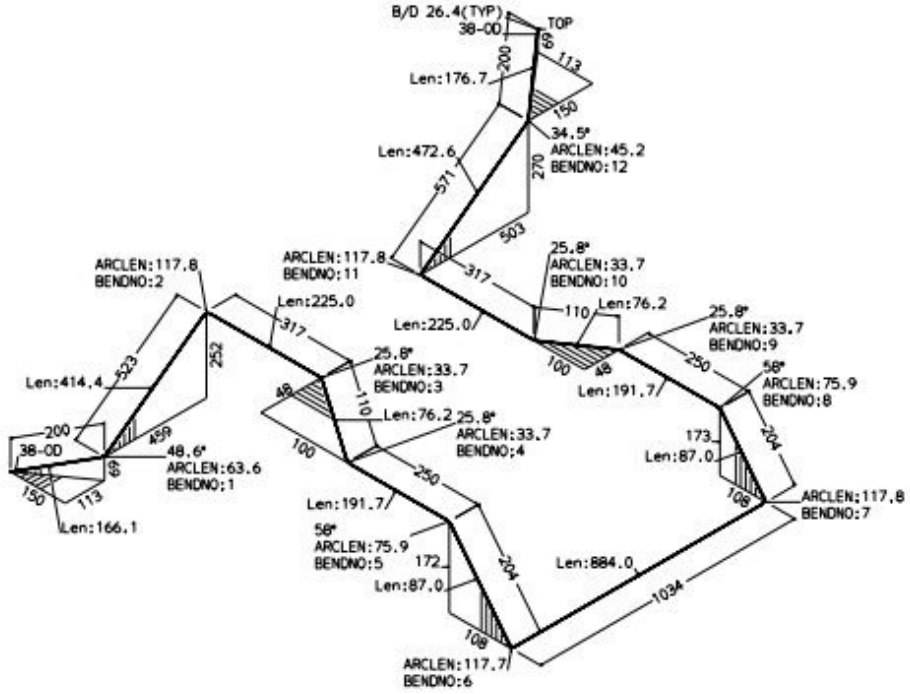
Material : SA213 T12

Drg.No. 06687

BHEL, TRICHY

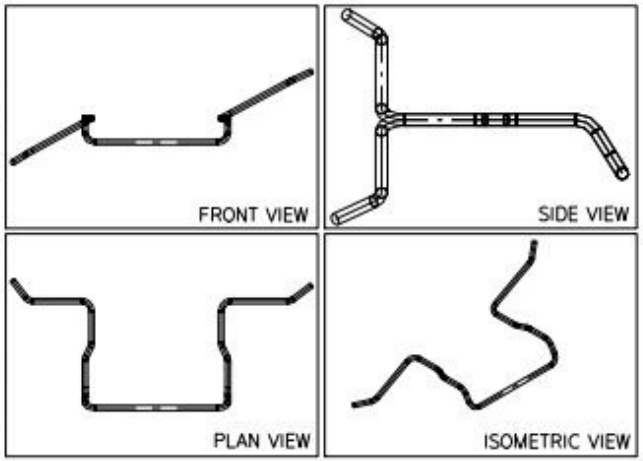
BEND	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 - 10	10 - 11	11 - 12
ROT ANG	177° 33'	28° 44'	180°	90°	270°	0°	90°	270°	180°	28° 13'	184° 57'





COORDINATES TABLE

	X	Y	Z
START	0	0	0
BEND 1	112.92	-149.85	69.23
BEND 2	571.80	-149.85	320.72
BEND 3	571.80	-466.99	320.72
BEND 4	523.80	-566.51	320.72
BEND 5	523.80	-816.95	320.72
BEND 6	523.80	-924.85	148.05
BEND 7	1557.80	-924.85	148.04
BEND 8	1557.80	-816.95	320.72
BEND 9	1557.80	-566.51	320.72
BEND 10	1509.80	-467.00	320.72
BEND 11	1509.80	-149.85	320.72
BEND 12	2012.92	-149.85	590.52
END	2162.77	-36.93	659.75



TUBE : D38.1 x t 5.59 - L 4140.5mm

Material : SA213 T12

NOTE:

1. NO SHOP JOINT PERMITTED WITHIN A TUBE
2. TUBE HAS TO BE ROTATED CLOCKWISE AS PER THE ROTATION ANGLE
3. BEND ANGLE IS 90° UNLESS SPECIFIED
4. RADIUS OF THE BEND = 75
5. FOR DESIGN PARAMETERS REFER ASSEMBLY DRAWING
6. QTY REQUIRED IS 8
7. PAINT THE WORD "TOP" AND MARK NO "WB-37 TB-41 " NEAR THE TOP END OF THE TUBE
8. PIPE OD MARKED NEAR TUBE ENDS ARE TO BE READ AS PER BOM

Drg.No. 07522

BHEL, TRICHY