CNC TUBE BENDING MACHINE (for OD up to 63.5)
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 "CNC TUBE BENDING MACHINES". Vendor shall indicate the actual number of years of experience in the field.	
1.2	Only those vendors (**OEMs**) should quote, who have commissioned in the last 10 years (as on the original date of tender opening) at least **ONE"CNC TUBE BENDING MACHINES "capable of bending tubes of diameter 63.5 mm or more with thickness up to 10 mm or morein multi-plane** **EITHER** (i) In at least 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 from the date of commissioning (as on the original date of tender opening). The name and contact addresses of the customers to whom the Tube Bending Machineswere supplied to be furnished with details.	
1.3	Vendor has to submit at least ONE PERFORMANCE CERTIFICATE for satisfactory performance of CNC Tube Bending machine as referred under clause 1.2 above, for a minimum period of one year from the date of commissioning (as on the original date of tender opening) from their customers in India or in any other country outside the country of origin, supplied and commissioned in the last 10 years. Performance certificate as Original Certificate or E-mail directly from the customermay 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. BHEL reserves the right to accept or reject the OEMs based on the assessment of their technical and financial capability.	

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 Machinehas 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, DataSheets 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	**CNC 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 Dia X Max Thickness of tube can be bent on the machine.	
5.3	Tube material	
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

PART B – TECHNICAL SPECIFICATION

CNC TUBE BENDING MACHINE (for OD up to 63.5)

Note:-

1.0 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.

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

Name & Address of the Vendor:	Name & Address of the Indian agent:
Telephone no.:	Telephone no.:
Fax no.:	Fax no.:
e-mail:	e-mail:

3.0 Scope: - Design, Manufacture, Supply, Erection & Commissioning of **CNC Tube Bending Machine (for OD up to 63.5) – 1 No**for BHEL complying with the specification as below.

<table>
<tr><th>S. No.</th><th colspan="2">PARTICULARS AND BHEL SPECIFICATIONS</th><th>Bidder's OFFER</th></tr>
<tr><td>1.0</td><td>APPLICATION</td><td>A) The machine is meant for cold bending of seamless steel tubes/ Tubes in multi-plane axes to form tubular coils, Access Door Openings for Power Boilers, Industrial Boilers and Process Industries.
B) The bending system of these machines shall be either Electro Hydraulic or All Electric draw bending type with CNC system.
C) CLOCKWISE Bending Machine - 1 No</td><td></td></tr>
<tr><td>2.0</td><td colspan="3">TUBE SPECIFICATIONS</td></tr>
<tr><td>2.1</td><td colspan="2"><table>
<tr><th>S.No</th><th>OD, in mm</th><th>THICKNESS, in mm</th><th>Max/Min ID, in mm</th></tr>
<tr><td>1</td><td>28.0</td><td>5.6</td><td>21.60/16.80</td></tr>
<tr><td>2</td><td>31.8</td><td>4.0 /4.57</td><td>25.40/22.60</td></tr>
<tr><td>3</td><td>38.1</td><td>4.57/5.59/7.11 / 9.65/ 10.67 / 11.0</td><td>28.96/16.10</td></tr>
<tr><td>4</td><td>41.3</td><td>7.4 / 8.2</td><td>26.50/24.90</td></tr>
<tr><td>5</td><td>42.4</td><td>4.57 / 5.59 / 6.6 / 7.11 / 7.62 / 8.6 / 9.1</td><td>33.26/24.20</td></tr>
<tr><td>6</td><td>44.5</td><td>4.19 / 5.59 / 6.1 / 7.11 / 8.1 / 8.7/ 10.92</td><td>36.12/22.66</td></tr>
<tr><td>7</td><td>47.63</td><td>5 / 6.3 / 8 / 10</td><td>37.63 / 27.63</td></tr>
<tr><td>8</td><td>48.3</td><td>6.6 / 8.1</td><td>35.10/32.10</td></tr>
<tr><td>9</td><td>51.0</td><td>4.19 / 5.59 / 6.6 / 7.62 / 8.64 / 9.6/ 10.0</td><td>42.62/31.00</td></tr>
<tr><td>10</td><td>54.0</td><td>9.14 / 13.49</td><td>35.72/27.02</td></tr>
<tr><td>11</td><td>57.0</td><td>4.19 / 7.62 / 8.64 / 9.4/ 12.7/ 14.3/ 15.09</td><td>48.62/26.82</td></tr>
<tr><td>12</td><td>63.5</td><td>3.81 / 4.19 / 4.57 / 5.59 / 8.64 / 12.7</td><td>55.88/38.10</td></tr>
</table>
Note: All are OD (Outer Diameter) Controlled tubes with thickness tolerance of Max.+12 %</td><td></td></tr>
</table>

<table>
<tr><th>S. No.</th><th>PARTICULARS AND BHEL SPECIFICATIONS</th><th>Bidder’s OFFER</th></tr>
<tr><td>2.2</td><td colspan="2">MATERIALS:</td><td></td></tr>
<tr><td></td><td colspan="2">a) Carbon Steel (ASTM): SA192, SA210A1, SA210C
b) Alloy Steel(ASTM): SA209T1, SA213T11, SA213T22, SA213T23, SA213T91,SA213T92
c) Stainless Steel (ASTM): Super 304H, SA 213 TP347H</td><td></td></tr>
<tr><td>2.3</td><td colspan="2">RADII OF BENDS:</td><td></td></tr>
<tr><td></td><td colspan="2">
<table>
<tr><th>S.No</th><th>OD (in mm)</th><th>Minimum Bend Radius in mm</th><th>Maximum Bend Radius in mm</th></tr>
<tr><td>1</td><td>28.0</td><td>R 41</td><td>R 56</td></tr>
<tr><td>2</td><td>31.8</td><td>R 40</td><td>R 48</td></tr>
<tr><td>3</td><td>38.1</td><td>R 48</td><td>R 75</td></tr>
<tr><td>4</td><td>41.3</td><td>R 70</td><td>R 85</td></tr>
<tr><td>5</td><td>42.4</td><td>R 70</td><td>R 85</td></tr>
<tr><td>6</td><td>44.5</td><td>R 48</td><td>R 100</td></tr>
<tr><td>7</td><td>47.63</td><td>R 51</td><td>R 95</td></tr>
<tr><td>8</td><td>48.3</td><td>R 54</td><td>R 100</td></tr>
<tr><td>9</td><td>51.0</td><td>R 76.5</td><td>R 100</td></tr>
<tr><td>10</td><td>54.0</td><td>R 65</td><td>R 76.5</td></tr>
<tr><td>11</td><td>57.0</td><td>R 85</td><td>R 100</td></tr>
<tr><td>12</td><td>63.5</td><td>R 76.5</td><td>R 130</td></tr>
</table>
</td><td></td></tr>
<tr><td>2.4</td><td colspan="2">JOB DETAILS: For Typical configuration of Jobs are given in separate annexures.</td><td></td></tr>
<tr><td>3.1</td><td>Bending Direction</td><td>CLOCKWISE</td><td></td></tr>
<tr><td>3.2</td><td>Type of Machine</td><td>CNC - Electro Hydraulic OR All Electric draw bending type</td><td></td></tr>
</table>

S. No.	PARTICULARS AND BHEL SPECIFICATIONS		Bidder's OFFER
4.0	**QUALITY TOLERANCES FOR JOBS**		
4.1	**VISUAL DEFECTS**		
4.1.1	It shall be free from harmful surface visual defects such as wrinkles, tool marks and depressions etc		
4.2	**PERCENTAGE OVALITY**		
4.2.1	% Ovality = (Max.OD - Min.OD)/ Original OD} x100	Maximum allowed ovality is **10%**	
4.3	**PERCENTAGE THINNING**		
4.3.1	% 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)	
4.4	**FLATNESS ON BEND**	Flat Land width over the bend portion does not exceed 12.5mm.	
4.5	**BENDING ANGLE TOLERANCE**	$\pm$ 0.5 deg	
4.6	**BEND RADIUS TOLERANCE**	$\pm$ 2 mm	
4.7	**MINIMUM OD** (At any point of Bend)	= 0.895 x OD (Nom) + 0.233 x Min. Wall thickness	
4.8	**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.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS		Bidder's OFFER
5.0	**OPERATING PARAMETERS:**		
5.1	Tube Diameter	Minimum: 28.0 mm Maximum: 63.5 mm	
5.2	Tube Wall Thickness	As given in the table (Clause No. 2.1)	
5.3	Section modulus	Vendor to specify the max. section modulus of tube than can be bent in cm3.	
5.4	Bend Radius (Refer clause No. 2.3)	Minimum: 40 mm Maximum: 130 mm	
5.5	**R/d Ratio** **(Bend Radius / Tube Diameter)**	**1.2** for all tube sizes mentioned under Sl.No.2.1	
		1.1 for tube OD ≥ 44.5 for tubes with minimum 15% wall thickness	
5.6	Tube length handled – Automatic tube feeding from tube rack	Minimum: **3000mm** Maximum**: 15000mm**	
5.7	Tube length handled – Tube feeding manually done	Minimum: **500mm** Maximum: 3000mm	
5.8	Tube Clamping Length required	50mm for tubes upto OD 51mm 1xD for tubes above OD 51mm	
5.9	Min straight length between tangent points of adjacent bends	75 mm	
5.10	End Limb Length	100mm for ≤ 90 deg bends 200mm for 180 deg bends	
5.11	Bending Angle in Job	0 to 180deg	
5.12	Multi Plane Turning Angle	360deg	
5.13	Tube batch quantity	Batch qty varies from single tube to 100 tubes	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS		Bidder's OFFER
5.14	Machine front body radius shall be minimum such that the bent tube does not foul with the machine body with minimum straight lengths between bends while tube rotation and multi-plane bending.	Vendor to specify the minimum straight distance between bends for rotation without fouling with the base or machine body. Vendor to study the drawings provided in the Annexure and offer a suitable design. Vendor to confirm and specify the dimensions.	
5.15	**'S' bend configuration (zero distance between bends)**	Machine to be capable of making 'S' bends	
5.16	**PRODUCTIVITY**		
5.16.1	No.of bends per shift on Tubes with OD 38.1mm and Radius 75mm	Vendor to calculate the total time required to complete the bends as given in Annexure 3 from start to finish in auto cycle. Productivity per shift shall be calculated based on this.	
6.0	**MACHINE PARAMETERS**		
6.1	Maximum Bending arm Bending Speed in rpm	Vendor to specify	
6.2	Maximum Bending arm Reverse Speed in rpm	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 : 6000 to 7000mm	Vendor to confirm	
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	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS		Bidder's OFFER
6.8	Creep speed to be provided for Clamp Jaw movement, Pressure Die forward / reverse stroke, Carriage movement.	Vendor to specify and confirm	
6.9	Traveling Speed of Carriage in m / min	Not less than 30 m / min. Speed shall be variable. Creep speed to be provided during start and end of the stroke. Vendor to specify range of speed	
6.10	Transfer mechanism of tube from tube rack to in feed roller stand to feed through carriage	Quick feeding of tubes such that the required productivity is achieved as per clause 5.13 Vendor to explain the arrangement.	
6.11	Mandrels	Mandrels not required	
6.12	Tube Working Height	1000 to 1250mm from ground level	
6.13	Maximum Bending Torque	Vendor to specify	
6.14	Maximum Tube rotation torque	Vendor to specify	
6.15	Maximum Section Modulus of tube that can be bent in the machine	Vendor to specify	
6.16	Maximum Operating Pressure	Vendor to specify	
6.17	Main Pump Motor capacity in kW	Vendor to specify	
6.18	Total Power Requirement in kVA	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	
6.21	Hydraulic Tank Capacity (if Electro hydraulic)	Vendor to specify	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS		Bidder's OFFER
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	
7.2	RESOLUTION:		
7.2.1	Tube Feed/Transport	Vendor to specify	
7.2.2	Tube Rotation	Vendor to specify	
7.2.3	Bending	Vendor to specify	
7.3	REPEATABILITY:		
7.3.1	Tube Feed/Transport	Vendor to specify	
7.3.2	Tube Rotation	Vendor to specify	
7.3.3	Bending	Vendor to specify	
8.0	**GENERAL DESIGN & CONSTRUCTIONAL FEATURES**		
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. Split die actuation opening should be sufficient enough to easily remove the 180 deg. bends		

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
8.1.3	Split die actuation to be achieved only from the bottom of the machine and NOT overhead.Split die actuation mechanism to be rigid enough to withstand the bending load – Vendor to provide the design details	
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.)	
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	Independent clamp jaws for each diameter shall be quoted, for all diameters as given in the specification.Clamp jaws for clamping curved portion for making zero distance between bends ('S' bends) shall also be quoted.	
8.2.4	There shall NOT be any pads to change over diameters.	
8.2.5	The clamping by standard straight movement of clamp jaw for clamping	
8.2.6	Height adjustment for adjusting the clamp jaw height to be provided	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
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	Independent Follower jaws for each diameter shall be quoted, for all diameters as given in Clause 11.0 under Toolings. There shall NOT be any pads to change over diameters.	
8.3.3	Follower jaws shall be easily removable and mountable. Provision for handling by crane to be provided like eye hooks.	
8.4	**Booster Unit**	
8.4.1	Type of Boosting : Back boosting / Clamp boosting / Pressure die assist boosting. Vendor to specify.	
8.4.2	The booster clamping arrangement shall be explained by the vendor in their offer. The booster clamping arrangement shall not limit the movement of carriage upto the bend die.	
8.4.3	Maximum Booster force. Vendor to specify	
8.4.4	Boosting shall be programmable. It should be possible to set the required boosting power in the program. Vendor to Confirm - Details to be furnished	
8.5	**Carriage Construction:**	
8.5.1	Carriage movement sensor shall be of non-contact type	
8.5.2	Collet axis centering, in line with Centre line radius of bend die shall be automatic. Vendor to confirm and provide details.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
8.5.3	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.	
8.5.4.	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.	
8.5.5	Vendor to give details of the different collet arrangements and their ranges that will be needed for various diameters as per our specification.	
8.5.6	The carriage size shall be such that the carriage does not foul / interfere with long end limb of 180 degree bends of close radius.	
8.5.7	Carriage shall be of rigid construction with capability of handling the entire range of tubes/ Tubes mentioned. The carriage shall receive the tube from the loading stand located at the rear side of the machine bed and position the tube through carriage collet to the bender. The collet shall open once the tube is clamped to the bending former. As the bend is under progress, the carriage shall reverse back and position automatically to the programmed length / hitching length for the following bend. This shall be repeated for all the bends. The carriage should travel up to Centre of bending former.	
8.5.8	Tube recapture for shorter trailing lengths of tubes shall be provided.	
8.5.9	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.	
8.5.10	Supports to prevent sagging of tube during tube feeding. Vendor to Specify with details of how this is achieved in their machine.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
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	
8.7	**Tube Loading Facility**	
8.7.1	Loading stand / Tube storage rack shall be provided and positioned behind the machine parallel to the machine bed.Vendor to provide details.	
8.7.2	Maximum tube length: 15meters and Minimum tube length: 3 meters. Tubes lesser than 3 meters shall be loaded manually from the front. Vendor to confirm.	
8.7.3	The stand shall be suitable to load a bundle of tubes weighing **20** tons. Vendor to confirm.	
8.7.4	The slope of the storage rack shall hold 40 tubes of dia 38.1mm and the straight portion of the storage rack shall have a width of around 1200 mm to hold the tube bundles. Vendor to confirm.	
8.7.5	The following shall be provided in the machine: Vendor to confirm. a) Tube bending machine shall have automatic loading of tube. b) Tube kick off from the tubes storage rack on to the tube feed rollers for tubes of **maximum 15 meter long**and a **minimum of 3 meters**long. c) Tube kick off –Pneumatic/Electric/Hydraulic –Vendor to specify d) Automatic tube feeding with feed rollers along the bed. e) Tube feeding through the collet from the rear of the carriage. f) Automatic Tube end sensing and positioning of tube to the programmed length for the first bend g) To reduce noise, Teflon beading to be provided on the loading tube storage supports.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
9.0	**FOUNDATION:**	
9.1	Vendor to indicate whether Civil foundation is required. The shop floor at BHEL works has 200mm concrete thickness with M15 concrete mix.Civil foundation work is under the scope of BHEL. Vendor to note and confirm. If there is no foundation, the machine shall be placed on anti-vibratory pads. Anti-vibratory pads to be provided by vendor.	
9.2	**Machine Levelling & Anchoring System:** Complete anchoring system including foundation bolts, anchoring materials, fixators, levelling shoes, anti-vibratory pads etc. shall be supplied with the machine.	
10.0	**MACHINE OPERATING CONTROL SYSTEM FEATURES:**	
10.1	Machine operating control system shall be provided with latest CNC System - Details to be specified in the offer clearly.	
10.2	Machine shall be operated in three modes viz., Manual, Semi-Automatic and Automatic.	
10.3	The following parameters shall be programmable by the operator. 1. Bending angle, Bending Speed 2. Rotation angle, Rotation Speed 3. Distance between bends, Carriage travel speed 4. Boosting segmentally 5. Collet axis centering in line with CLR of bend die 6. Stretch and Spring Back 7. Bend configuration input through XYZ co-ordinates / YBC co-ordinates, both shall be mutually convertible 8. Vendor to specify any other parameter that could be programmed	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
10.4	Real time bending to be displayed with details such as bending angle, distance of carriage movement, rotation angle etc.	
10.5	Bending Simulation to view bend configuration in 3D shall be provided.	
10.6	Recognition of collision point of the Tube rotation device with counter pressure rail, Carriage with Tube kick-off system etc.	
10.7	Auto-Display of machine positions on the screen during manual operation.	
10.8	Display in flat color monitor. Vendor to specify their standard Monitor size and furnish details such as make and model.	
10.9	Self-standing 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. Operator control panel shall be housed in dust proof enclosure.Vendor to confirm	
10.10	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	
10.11	Auto calculation of co-ordinate conversion from Cartesian co-ordinates into bending machine co-ordinates and vice-versa.	
10.12	Spring back and Stretch automatic compensation facility.	
10.13	Pre-programming and storage of number of different bending tool-data.	
10.14	Automatic diagnostic alarm feature with error code and message display.	
10.15	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.	
10.16	System shall have the facility to display Memory details.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
10.17	System Software to be stored in Memory. Vendor to specify the type of memory.	
10.18	The supplier shall give software back up. The supplier shall give software (with necessary setup files for installation in any PC/laptop) and CNC program back up. Licensed Software of CNC system shall be suitable for Windows 7.	
10.19	Interfacing Cable for CNC CPU & MMI to be Supplied by Vendor.Vendor to confirm.	
10.20	A standard RS 232 C (V 24) interface to connect IBM compatible computer.	
10.21	Remote access to the machine through network - internet for remote tele-diagnosis.	
10.22	USB Ports for connectivity to be provided	
10.23	Protection against virus and malwares should be provided without compromising the system performance	
10.24	Additional external standard 104key Keyboard and Optical Mouse.	
10.25	The computer shall have CD / DVD read and write drive.	
10.26	One additional hard disk fully loaded with complete software and clearly written Instructions to take back-up and reloading of a new hard disk to be provided	
10.27	Power failure backup module for smooth shutdown of the system.	
10.28	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.	

<table>
<tr><th>S. No.</th><th>PARTICULARS AND BHEL SPECIFICATIONS</th><th>Bidder’s OFFER</th></tr>
<tr><td>11.0</td><td>TOOLINGS</td><td></td></tr>
<tr><td>11.1</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
Tube Dia / Radius</th><th>Clock Wise
Machine</th></tr>
<tr><td>1</td><td>Dia 38.1 X R75</td><td>1 Set</td></tr>
<tr><td>2</td><td>Dia44.5 X R 48</td><td>1 Set</td></tr>
<tr><td>3</td><td>Dia51 x R 76.5</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>
<tr><td>12.0</td><td>DRAWING APPROVAL</td><td></td></tr>
<tr><td>12.1</td><td>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.</td><td></td></tr>
</table>

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
12.2	**FOUNDATION DRAWING**	
12.2.1	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	
13.0	**HYDRAULICS (Applicable if the machine offered is Electro-Hydraulic)**	
13.1	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.	
13.2	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.	
13.3	Maximum Operating Pressure of hydraulic system. The maximum pressure of the system should preferably not to exceed 315 bar. Vendor to specify	
13.4	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	
13.5	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.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
13.6	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	
13.7	Each pump should have an independent motor. Tandem pumps shall be avoided. Vendor to specify	
13.8	Pump unloading feature during idle running to be provided for energy conservation.	
13.9	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	
13.10	All oil pipelines shall be of seamless steel and should undergo pickling process.	
13.11	All cylinders used in the machine should have standard bore and rod sizes. The piston rod shall be hard chrome plated. Vendor to specify	
13.12	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	
13.13	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.	
13.14	Main Pump flow in lpm and Motor Power in kW Vendor to specify	
13.15	Hydraulic Oil Tank / Reservoir capacity (in litres) Vendor to specify	
13.16	Maximum Operating Pressure of hydraulic system. Vendor to specify	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
13.17	Servo valves, if any, should be mounted close to their actuators Vendor to confirm	
13.18	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	
13.19	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	
13.20	Hydraulic power pack and Oil tank shall be separate from the Machine and positioned behind the machine conveniently to attend to any maintenance problems	
13.21	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	
13.22	The flexible hoses used in the system shall be of Gates / Aeroquip / Parker or any other reputed make acceptable to BHEL. Vendor to specify	
13.23	The pipelines to be painted with standard colors as per the color coding accepted internationally for hydraulic systems. Vendor to furnish details.	
13.24	All oil pipelines shall be of seamless steel and should undergo pickling process. Vendor to confirm	
13.25	All hydraulic Tube lines to be neatly laid out.	
13.26	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	
13.27	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	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
13.28	Failure indication for oil level, temperature, pressure, filter clogging should be provided. Vendor to confirm & furnish details	
13.29	Safety interlock / automatic shut off provision during hose failures, chiller failure, low oil level etc. Details should be submitted. Vendor to specify	
13.30	First fill of Hydraulic oil to be provided by Vendor. Indian equivalent shall be mentioned. Vendor to confirm	
13.31	Safety interlocks like auto shutoff during low oil level , sudden hose failure etc,. shall be incorporated. Vendor to specify and give details	
13.32	Pressure gauge at the working level of the operator is to be provided for indicating working pressure.	
13.33	Pressure setting adjustment (Pressure relief valve) has to be provided at operator level, to adjust the pressure based on requirement. Vendor to confirm.	
13.34	Suitable leakage oil collection metallic tray to be provided wherever required. Vendor to confirm	
13.35	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	
14.0	**LUBRICATION**	
14.1	Automatic centralized lubrication system with timer control and suitable metering cartridges shall be provided. Vendor to confirm	
14.2	First filling of Lubrication Oil & Grease to be provided by Vendor. Indian equivalent shall be mentioned. Vendor to confirm.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
15.0	**PNEUMATIC SYSTEM**	
15.1	The pneumatic operated elements of the machine shall work efficiently with BHEL compressed air supply at a pressure of 5.5 to 6.0 kg/cm2.	
15.2	BHEL will provide compressed air at only one point near / on the machine. Vendor shall provide suitable filter-regulator-lubrication (FRL) unit fitted with hand wheel valve at this point.	
15.3	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.	
15.4	Pneumatic components shall be of FESTO / SMC / NORGREN make only	
16.0	**PIPING**	
16.1	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. Vendor to confirm	
17.0	**ELECTRICAL & ELECTRONICS SYSTEMS**	
17.1	415V (± 10%), 50HZ (± 3%), 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.	
17.2	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	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
17.3	Wiring: All electrical motors, limit switches etc, on the machine shall be Wired using PVC sheathed screened 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.	
17.4	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 such as Encoders, limit switch, feed back devices shall be suitably placed to have easy accessibility for maintenance	
17.5	Control circuit voltage should be 24 V DC	
17.6	All alarm tripping logics and control logics incorporated in the machine to be listed out by the vendor.	
17.7	All electrical equipment shall be Tropicalized and shall have IP 54 degree of protection. Vendor to confirm	
17.8	All electrical control cabinets & panels should be dust and vermin proof. Vendor to confirm	
17.9	All electrical components in the cabinets should be mounted on DIN Rail. Vendor to confirm	
17.10	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. Specification to be submitted.	
17.11	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	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
17.12	Control panel shall have built in 230V, 5 amps, 3 pin plug.	
17.13	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.	
17.14	All components / devices / terminals are to be incorporated with ferrules. Vendor to confirm	
17.15	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	
17.16	Cables shall be routed through totally enclosed cable trays. There shall not be cable trenches.	
17.17	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	
17.18	Motors & other electrical components shall conform to IEC or Indian Standards	
17.19	Type of drives used for motors to be indicated. Electrical drives shall be of Siemens / ABB /L&T/ Eurotherm / Yaskawa / Mitsubishi or any other reputed makes acceptable to BHEL. Vendor to confirm	
17.20	Vendor should ensure the proper earthing for the machine and its peripherals. Earth electrode with connecting conductors with suitable earth resistance value (preferably less than 1.5 ohm) shall be supplied with the machine. The location for earth pit shall be indicated in the machine foundation drawing. Accordingly Earth pit will be provided by BHEL. Earth Electrode maintenance shall be mentioned in the O&M manual.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS		Bidder's OFFER
18.0	**ULTRA ISOLATION TRANSFORMER**		
18.1	Vendor to provide the technical / capacity details of Ultra-Isolation Transformer suitable for the machine.	Vendor to confirm	
18.2	Procurement of Ultra Isolation Transformer is in BHEL Scope.	Vendor to Note	
19.0	**SERVO VOLTAGE STABILISER (SVS):**		
19.1	Vendor to provide the technical / capacity details of Servo Voltage stabilizer suitable for the machine.	Vendor to Confirm	
19.2	Procurement of Servo Voltage Stabiliser is in BHEL Scope.	Vendor to note	
20.0	**PREFERRED MAKES OF COMPONENTS**		
20.1	The PLC system used in the machine shall be of Siemens/Allen Bradley/ Mitsubishi or any other reputed makes acceptable to BHEL.		
20.2	All hydraulic elements shall be of EATON-VICKERS / BOSCH-REXROTH or any international reputed make acceptable to BHEL.		
20.3	All hydraulic hoses shall be preferably of GATES / PARKER HANFFIN / AEROQUIP make or reputed makes acceptable to BHEL.		
20.4	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.		
20.5	The filter unit used in the hydraulic power pack shall be of Hydac / Parker / Rexroth/EATON-Vickers or equivalent reputed make acceptable to BHEL.		
20.6	Lubrication system used in the machine should be of SKF/CENLUB or reputed make acceptable		
20.7	All Pneumatic components used in the machine should be of FESTO/SMC makes only		

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
20.8	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.	
20.9	All electrical items shall be of from SEW / ROCKWELL Allen Bradley/ Telemechanique / Delta/ L&T/ Siemens/ GE or reputed makes acceptable to BHEL.	
20.10	Encoders and digital display units shall be of HEIDENHAIN / FAGER /ASM make	
20.11	All the VFDs used in the machine shall be of Siemens/ ABB/ Mitsubishi/ Allen Bradley/ Yaskawa/ Danfoss or other reputed makes acceptable to BHEL.	
20.12	All components/devices/terminals are to be incorporated with numbered ferrules.	
21.0	**SAFETY**	
21.1	All the safety features provided in the machine shall be listed out by vendor.	
22.0	**MACHINE LIGHTS**	
22.1	Machine Spot Lights for sufficient illumination to be provided for clear visibility at the bending area. Vendor to Confirm	
22.2	All light fittings, consumables, adapters/receptacles should have compatibility with Indian equivalents. Vendor to Confirm	
22.3	A magnetic base 24- volt portable spotlight with sufficiently long cable should be provided. Vendor to Confirm	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
23.0	**AMBIENT CONDITIONS & THERMAL STABILITY**	
23.1	Total machine and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies. Ambient Conditions: Temperature: +5 to +50 Degree Celsius and Relative Humidity: 90% maximum, both do not occur simultaneously.	
23.2	The entire equipment shall be Tropicalized in Design and Construction	
23.3	The offered equipment, Hydraulic system has to work in a normal fabrication shop environment in ambient conditions.	
23.4	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 a year. Vendor to ensure and confirm the same.	
24.0	**ENVIRONMENTAL PERFORMANCE OF THE MACHINE:**	
24.1	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. Vendor to confirm	
24.2	If any safety / environmental protection enclosure is required it shall be built in the machine by the vendor. Vendor to confirm	
24.3	Paint of the machine should be oil / coolant resistant and should not peel off and mix up with coolant. Vendor to confirm	
25.0	**TOOLS FOR OPERATION & MAINTENANCE:**	
25.1	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.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
26.0	**SPARES (to be recommended by the vendor)**	
26.1	Item wise 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 shall be offered by vendor. The list to include following, in addition to BHEL recommended spares: **(Unit Price of each item of spare should be offered)**	
26.2	**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. - 1 Set 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., - 1 Set	
26.3	**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., - 1 set each b) **Each type** of Field sensors, such as encoders, optical sensors, proximity switch, limit switches, push buttons, indicating lamps etc. - 1 set each	
26.4	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 & suppliers to enable BHEL to procure these in advance, if required	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
26.5	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.	
27.0	**DOCUMENTATION:**	
	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 11.0 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. CNC program backup and data, CNC 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.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
28.0	**MACHINE PRE-DISPATCH INSPECTION AND ACCEPTANCE AT SUPPLIER'S WORKS: (Test /Activities to be performed at vendor's work.**	
28.1	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 4.0.	
29.0	**MACHINE INSPECTION AND TESTS TO BE CARRIED FOR COMMISSIONNG AT BHEL WORKS**	
29.1	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 4.0. 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 5.13 on actual jobs or test pieces.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
30.0	**ERECTION AND COMMISSIONING**	
30.1	The supplier shall depute his engineer(s) for supervising & execution of the erection and commissioning of the machine at BHEL works and prove-out trials Supplier shall be responsible for carrying out the erection and commissioning of the Vertical Offset Press. Required technical personnel and labour required for the same shall be provided by the vendor. Tools, tackles, required for the same shall be a arranged for by the vendor.	
30.2	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.	
30.3	Successful proving of BHEL components by the Vendor shall be considered as part of commissioning. All tests, as mentioned at Specification Clause No. 30.1 (Machine Acceptance) shall form part of the commissioning activity.	
30.4	Portion, if any, of the machine, accessories and other supplied items where paint has rubbed off or peeled during transit or erection should be repainted and merged with the original surrounding paint by the vendor. For this purpose, the vendor should supply sufficient quantity of touch-up paint of various colors of paint used.	
31.0	**TRAINING**	
31.1	The supplier shall train Three BHEL's Engineers in Operation and Maintenance (Mechanical, Hydraulics, Electrical/ Electronics) of the Machine at supplier's works for a period of 5 working days.	
31.2	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.	
31.3	The supplier shall impart training to BHEL's Machine Operators and Maintenance crew in Operation and Maintenance (Mechanical, Hydraulics Electrical/ Electronics) during commissioning of the Machine at BHEL works for not less than 5 working days.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
31.4	**The training shall be 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 g. Electrical / Mechanical / Electronics systems	
32.0	**PAINTING:**	
32.1	The heavier machine parts are to be heat-treated after fabrication (including castings and forgings) and shot blasted for surface preparation prior to painting.	
32.2	One coat of Primer with 25microns of DFT (Dry Film Thickness)	
32.3	Finish coat by Polyurethane Paint. Colour shade: RAL 6011 (Reseda Green)	
33.0	**PACKING**	
33.1	Sea worthy and 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	
34.0	**GENERAL POINTS**	
34.1	Make and Model of the machine to be mentioned. Detailed catalogs of the machine to be sent with the offer.	
34.2	Complete description of all systems & sub-systems shall form part of the technical bid.	
34.3	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.	
34.4	The operating sequence of the machine with broad outline of various operations involved should be furnished with the offer.	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
34.5	Quality plan followed in Vendor's works	
34.6	Is the machine suitable for CAD/CAM interface / compatibility?	
34.7	Standards for Design, Manufacture and testing of the machine shall be in accordance with internationally accepted standards.	
34.8	The factor of safety considered for designing the machine, for certain load bearing components shall be furnished with the offer.	
34.9	Floor area required (Length, Width, Height) for complete machine & accessories	
34.10	Total connected load in kVA	
34.11	Total weight of the machine	
34.12	Weight of heaviest part of machine	
34.13	Weight of the heaviest assembly/subassembly of Machine	
34.14	Dimensions of largest part/ subassembly/ assembly of the machine	
35.0	**GUARANTEE**	
35.1	Equipment has to be guaranteed for its performance, for a minimum of 12 months from the date of commissioning. Or 18 months from the date of supply whichever is earlier	

S. No.	PARTICULARS AND BHEL SPECIFICATIONS	Bidder's OFFER
36.0	**SCOPE OF SUPPLY**	
36.1	**Supplier Scope** 1. Design, Manufacture, Supply, Erection, Commissioning and prove out of CNC Tube bending machine. 2. Infeed stand along with tube conveying system. 3. Toolings& Spares as per PO 4. All anchoring & foundation bolts, levelling plates for the complete machine 5. First fill of Hydraulic Oil, Lubrication Oil, Grease 6. Levelling Instruments, Power Tools / Hand Tools for erection. 7. Welding machines and consumables required for erection 8. Commissioning Engineer with erection crew 9. Job Quality and Productivity Prove-out	
36.2	**BHEL Scope** 1. Drawings approval 2. Civil foundation work as per manufacturer's drawing 3. Tube materials for trials and prove out 4. EOT Crane inside shop 5. Single Compressed air point at the location indicated in the drawing 6. Single Electrical Supply point at the location indicated in the drawing 7. ULTRA ISOLATION TRANSFORMER &SERVO VOLTAGE STABILISER (SVS)	

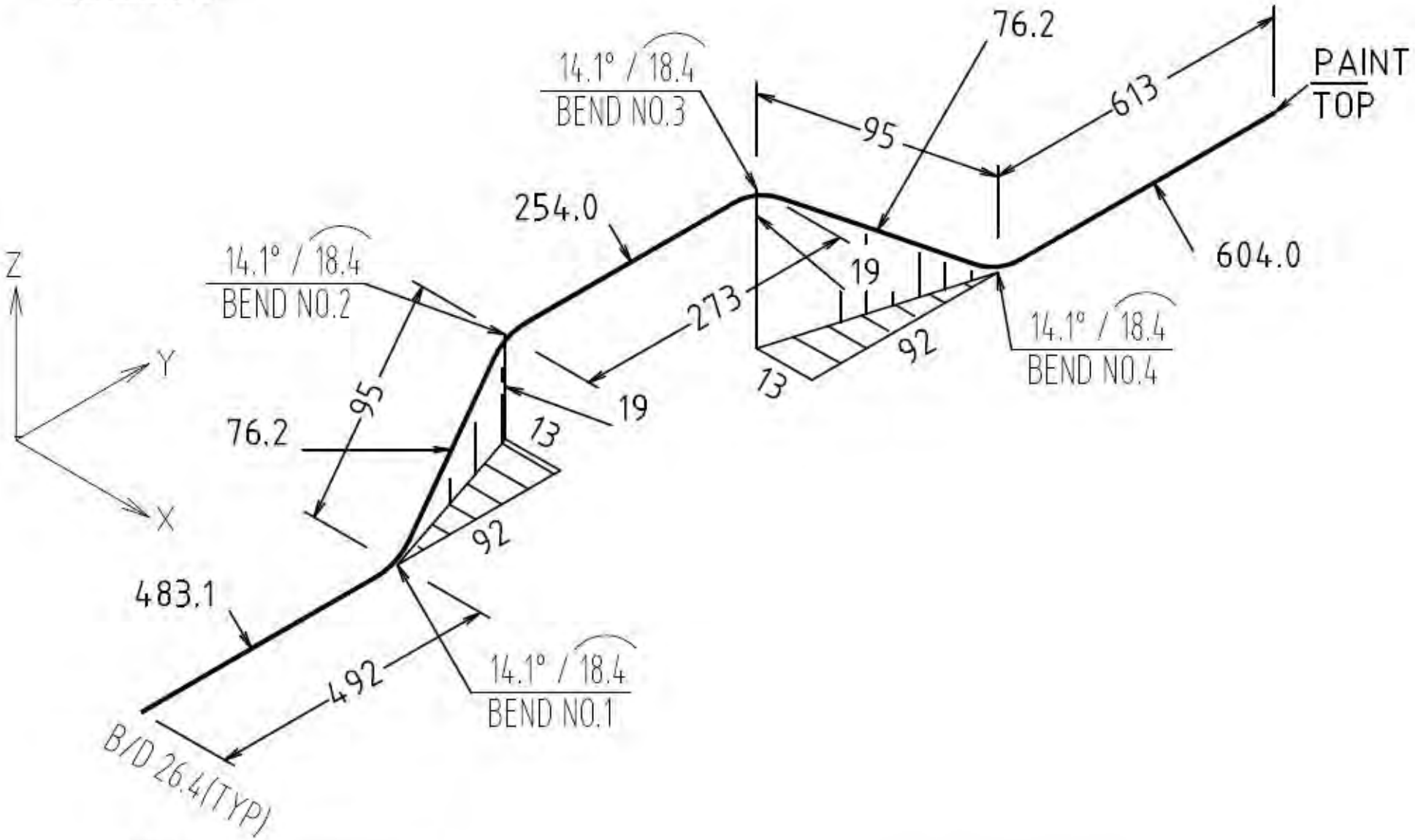
Enclosures:

Annexure-1 Bend configuration:

Annexure-2 Typical Bending formers in BHEL

Annexure-3 Typical Bending drawing for productivity.

Annexure -1



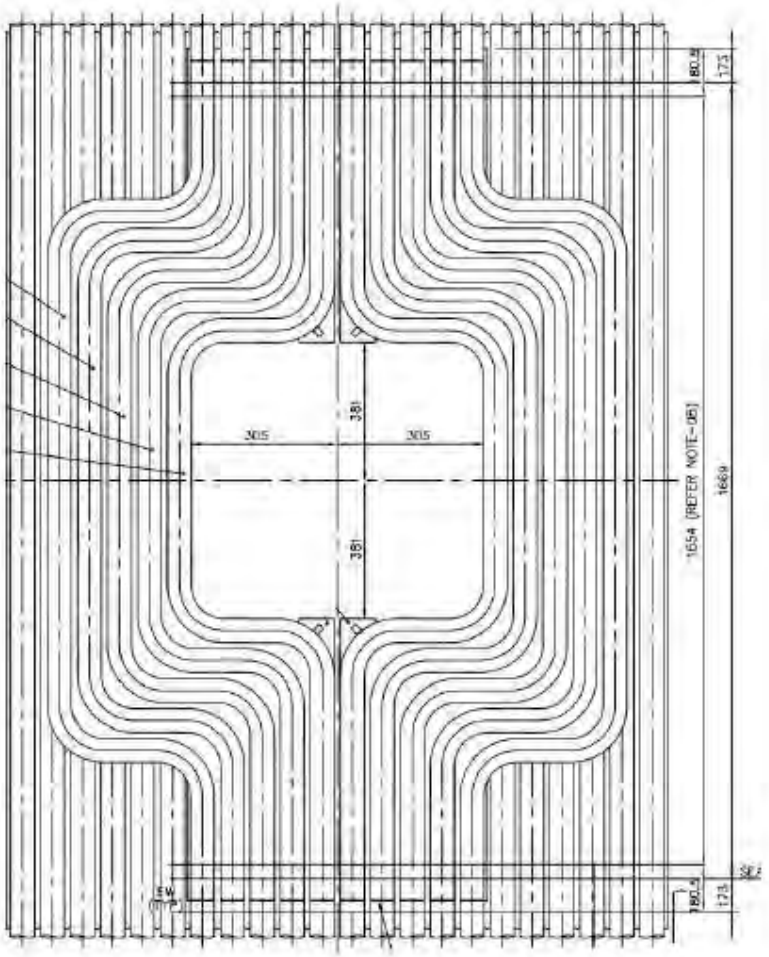
NOTE:

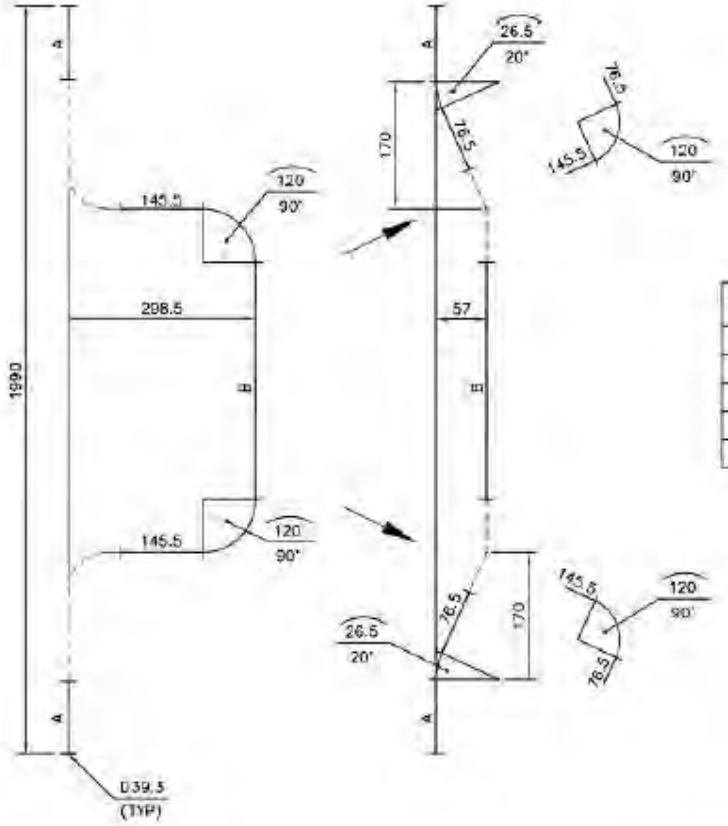
1) Tube - D 38.1 x 5.59
L 1567.1 mm

2) Bend Radius- R75.0 mm

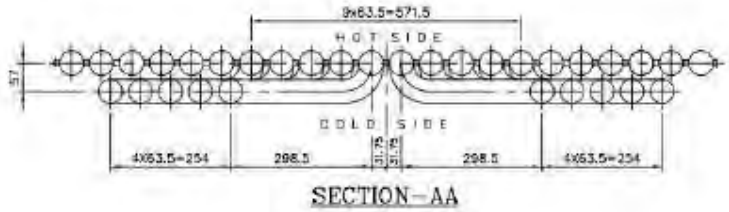
DRG No.: PEFP-09B-01

Annexure-1





ITEM NO.	A	B	DEV. LENGTH
01	418.5	660	2474
02	361.5	774	2474
03	304.5	888	2474
04	247.5	1002	2474
05	190.5	1116	2474



SECTION – AA

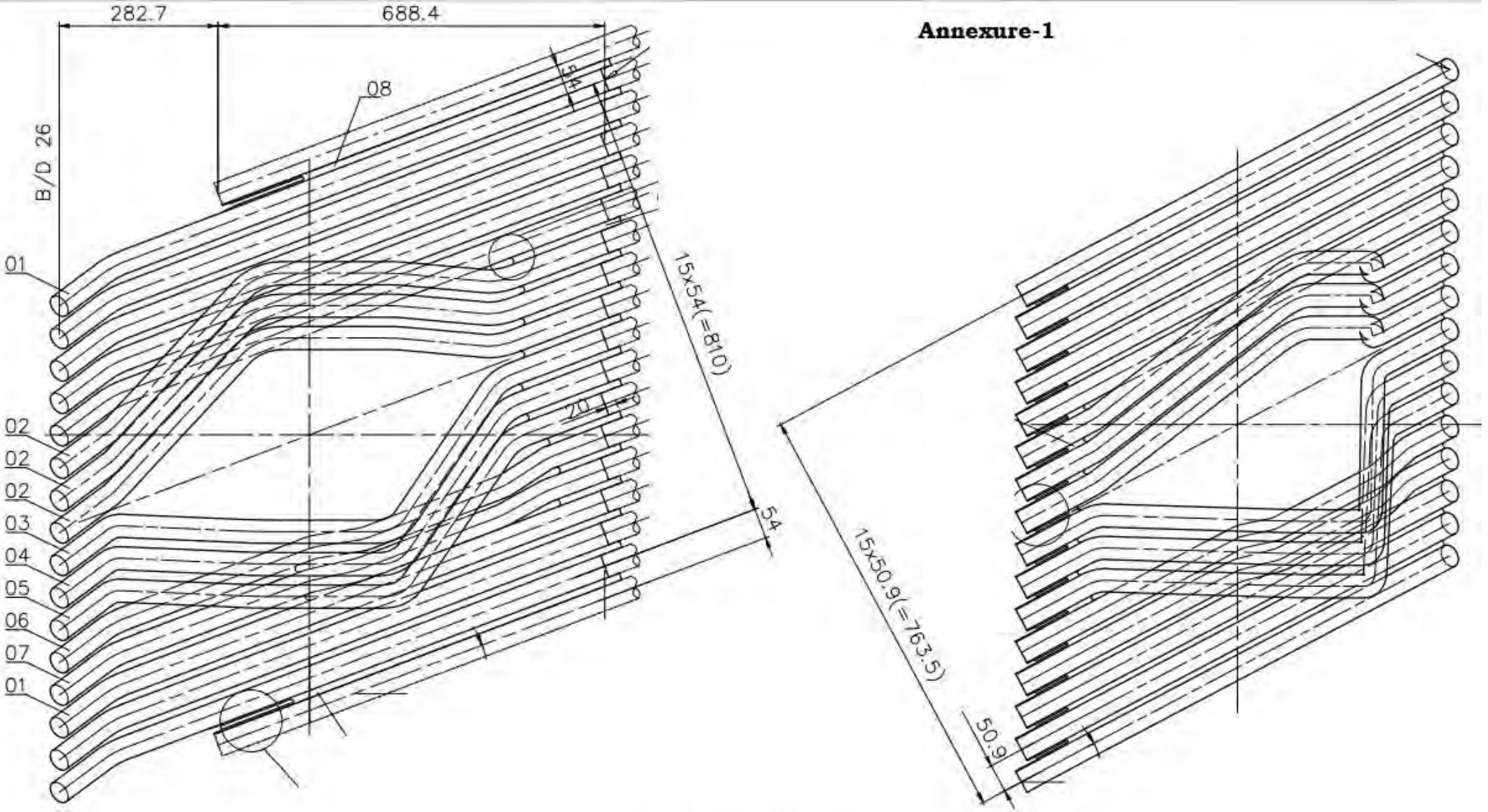
Tube Dia. 51mm x Th. 6mm

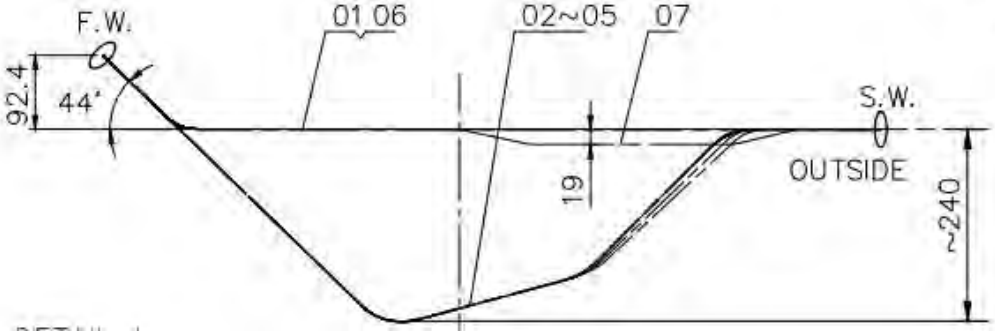
Radius of bend: 76.5mm

ACCESS DOOR OPENING BENDS

DRG. No.: PEFP-09B-02

Annexure-1



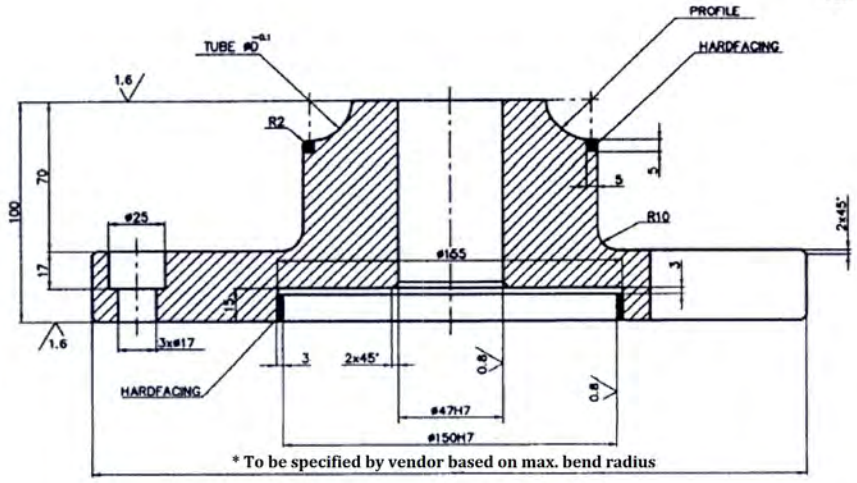


NOTE:

1) Tube- D 41.3 x 7.4

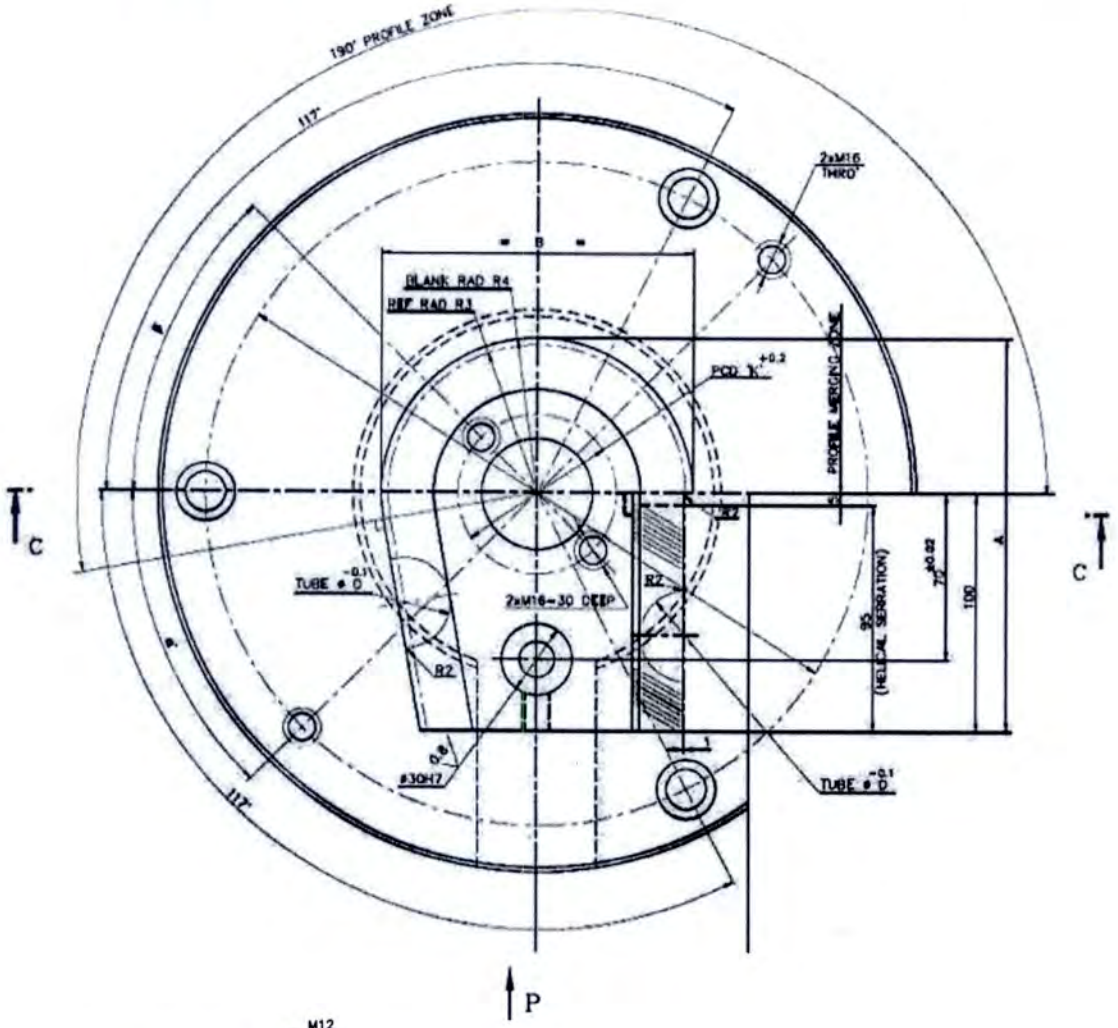
2) Bend Radius- R75 mm

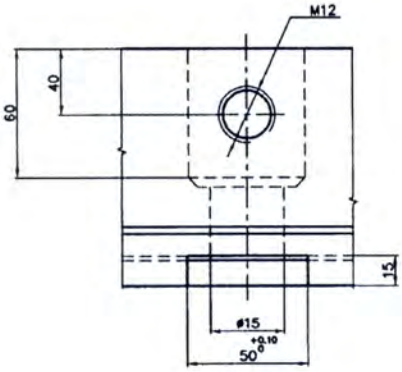
DRG No.: PEFP-09B-03



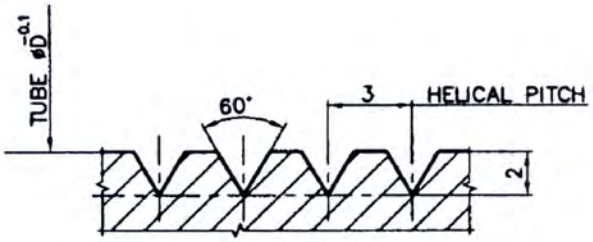
Typical Dimensions for Former

SECTION –CC



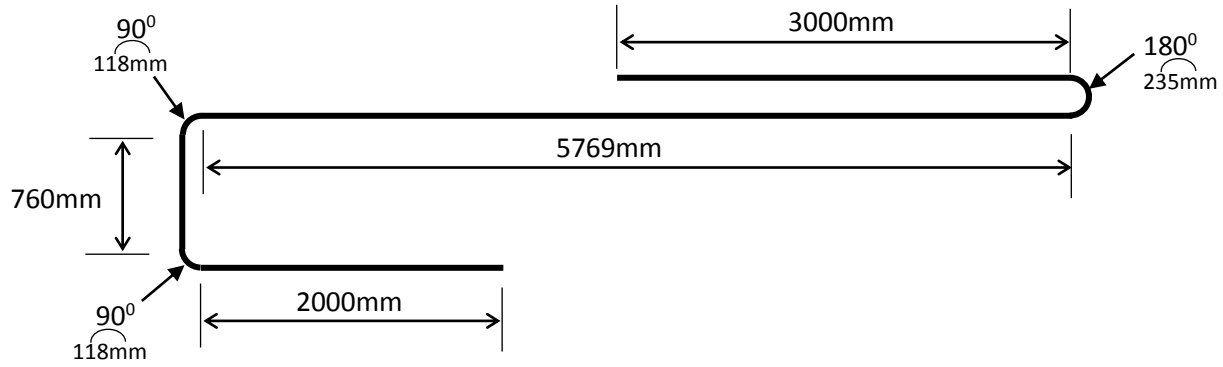


VIEW–P



DETAIL OF HELICAL SERRATIONS
SCALE 2:1

Annexure-3



TUBE DIA. 38.1mm x TH. 5.59mm
Tube Length: 12000mm
Radius of Bend: 75mm

BHEL, TRICHY