Bharat Heavy Electricals Limited

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

ENQUIRY	Phone: +91 431 257 75 75 Fax : +91 431 252 07 19 Email : rrmanohar@bheltry.co.in Web : www.bhel.com

	Enquiry Number:	**Enquiry Date:**	**Due date for submission of quotation:**
	2620600050	**11.08.2006**	**21.09.2006**
Your are requested to quote the Enquiry number date and due date in all your correspondences. This is only a request for quotation and not an order			

Item	**Description**	**Quantity**	**Delivery Schedule**
10	CNC Tube Bending Machine with Multi Plane Bending facility as per the technical specification & commercial conditions applicable (to be downloaded from web site **www.bhel.com**)	2 Nos.	10.07.2007

Note:

(1) The detailed Technical Specification along with technical point-by-point confirmation, Commercial Terms & Conditions applicable for this Enquiry, Confirmation of acceptance for BHEL commercial terms & conditions and Price Bid formats have been posted in BHEL Corporate web site www.bhel.com under Enquiry reference "2620600050". Your offer should be based on all the above documents.

(2) Also, you are requested to fill in the Supplier Registration formats available in www.bhel.com (under Advancement – Supplier Registration) and send it along with your offer.

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 Dy. Genl. Manager / Capital Purchase / MM / Manufacturing

PART A

QUALIFYING CRITERIA FOR THE SUPPLY OF CNC TUBE BENDING MACHINE

SECTION – I

The BIDDER is expected to give complete details against each clause in the table given below, with additional sheets those may be attached (giving clear reference number) to furnish and cover the requisite details / documents.

S. No.	PARTICULARS	VENDOR's RESPONSE
1	Profile of the Company bringing-out the years of Experience of the BIDDER in the field of machine design, manufacture and supply of 'CNC Tube Bending Machines'	
2	Number of CNC TUBE BENDING MACHINEs supplied, installed and commissioned till date (with details on machine type / model, configuration, customer and quantity)	
3	YEAR of supply of latest CNC Tube Bending Machine and the Technical Specifications of the Machine supplied [Details to be furnished]	
4	Number of CNC Tube Bending Machines supplied, installed and commissioned till date for the CUSTOMERS who are mainly the manufacturers of Power Utility Boilers (of High Pressure Ratings), with brief technical specifications of the supplied machines.	
5	Details on the Firm's Registration and the FINANCIAL STRENGTH of the COMPANY (Balance Sheet for the last **3** years) shall be submitted with the TECHNICAL OFFER	

S. No.	PARTICULARS	VENDOR's RESPONSE
6	Details of Design Set-Up and Technology Back-Up assured for the PRINCIPAL Equipment Manufacturer & Supplier [Details on Experience of Design Personnel, Technology Tie-Up, R & D Facilities, etc. have to be furnished]	
7	Details on International Standards / Design Process Codes followed in Design and Manufacture of the Equipment. [Copy of the English Version of relevant portion of the Standards / Codes followed, to be furnished with the Technical Offer compulsorily]	
8	Comprehensive Details (including Test Charts) on Performance Prove-Out Testing (which will be conducted at the time of INSPECTION by CUSTOMER ENGINEERS) - of the Equipment Offered, to be given with the Technical Offer.	
9	Details of Quality System followed [Furnish the salient aspects of the Quality Assurance System followed] from the stage of raw material / bought-out-item sourcing to final performance testing at BIDDER's works (coming in various stages of machine building)	
10	Details on SERVICE-AFTER-SALES Set-Up in India including the Addresses of Agents / Service Centres in India. Competency & Experience of the Local Service Agency are to be elaborated.	
11	Any Additional Data to supplement the manufacturing capability of the BIDDER for the subject equipment.	

SECTION – II

The BIDDER / VENDOR has to compulsorily meet the following requirements to get qualified for submitting an offer for the CNC TUBE BENDING MACHINE.

S. No.	REQUIREMENTS	VENDOR's COMMENTS
12	The BIDDER / VENDOR shall have a minimum of TEN Years of Continuous Experience in the Design, Manufacture & Supply of CNC TUBE BENDING MACHINE.	
13	The BIDDER shall have supplied at least one number of CNC Tube Bending Machine (having similar CAPACITY and TECHNICAL SPECIFICATIONS given under PART B) in the recent past, say in the last five years.	
14	Reference List of Customers and Performance Certificate (for a period not less than two years) from minimum three CUSTOMERS, with full contact details of CONTACT PERSON, for whom the BIDDER had supplied similar type of CNC Tube Bending Machine, are to be provided with the Technical Offer.	
15	BIDDER has to co-ordinate for the visit of BHEL Team (at BHEL Cost) to the Customer's Works (preferably Power Utility Boiler Manufacturer), to witness capability of an existing CNC Tube Bending Machine, if warranted.	
16	BHEL is specific about the materials of construction, basic design/dimensional aspects of various sections, structural parts, machine base, etc. forming part of the proposed CNC Tube Bending Machine, as the machine is to be installed in a rough working environment in a major and heavy fabrication shopfloor. Hence complete details of machine building have to presented, to meet BHEL specification requirements, as this will be one of the pre-requisites for the technical qualification.	

SECTION – III

The BIDDER / VENDOR has to comply with the following, for accepting the Technical Offer for scrutiny by the Purchaser:

S.No.	REQUIREMENTS	VENDOR's COMPLIANCE
17	The BIDDER / VENDOR shall submit the offer in TWO PARTS - Technical **[with PART A & PART B]** & Commercial and Price Bid.	
18	The Technical Offer shall be supported by Product Catalogue and Data Sheets in ORIGINAL and complete technical details of 'Bought-Out-Items' with copies of Product Catalogue and Selection Criteria are to be enclosed.	
19	The Offer shall contain a comparative statement of Technical Specifications given by BHEL and the Offer Details submitted by the Bidder, against each clause. A just 'CONFIRMED' or 'COMPLIES' or 'YES' or 'NO-DEVIATION' or similar words in the technical comparative statement may lead to disqualification of the Technical Offer.	
20	The BIDDER / VENDOR shall assure a continuous support for the supply of SPARES and SERVICE for TEN Years, from the date of commissioning of the equipment at BHEL Works.	
21	The Commercial Offer (given with the Technical Offer) shall contain the Scope of Supply and the Un-Priced Part of the Price-Bid, for confirmation of the inclusion of all the accessories, toolings, attachments, auxiliary parts, spares, consumables, etc. with the main and basic equipment, to meet the technical specification requirements.	
22	Any soft copy, giving the salient features of the proposed machine or equipment with all sub-systems and auxiliaries, and /or showing live-demo of an existing and working machine of similar configuration and capacity will be highly appreciated by BHEL.	
23	BIDDER has to indicate the Country of Origin for the supply of equipment .	

S.No.	REQUIREMENTS	VENDOR's COMPLIANCE
24	The reference List of Customers shall be accompanied with the details (Phone Number /E-Mail ID) of the CONTACT PERSON for cross reference by BHEL	
25	In case of preliminary qualification of the offer, on technical grounds, the BIDDER may be called for a detailed technical discussion on the original technical offer at BHEL Works, with a notice period of not less than 2 weeks.	

PART B

TECHNICAL SPECIFICATIONS for CNC TUBE BENDING MACHINE

<table>
<tr><th>S. No.</th><th>PARTICULARS</th><th>BHEL SPECIFICATIONS</th><th>Bidder's OFFER [With Complete Technical Details]</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 for Power Boilers, Industrial Boilers and Process Industries.
B) The bending system shall be of Draw-Bending type by Electro-Hydraulic means and with CNC mode of operation.</td><td></td></tr>
<tr><td>2.0</td><td colspan="3">TUBE SPECIFICATIONS and RADII OF BENDS:</td></tr>
<tr><td>2.1</td><td colspan="2">TUBE OUTER DIAMETER AND THICKNESS:
All are OD (Outer Diameter) Controlled tubes with thickness tolerance of Max.+22 %</td><td></td></tr>
<tr><td></td><td colspan="2"><table>
<tr><th>S.No</th><th>OD, mm</th><th>THICKNESS, mm</th></tr>
<tr><td>1</td><td>31.8</td><td>3.2 / 3.6 / 4.0 / 5.0</td></tr>
<tr><td>2</td><td>38.1</td><td>3.2 / 4.0 / 5.0 / 6.3</td></tr>
<tr><td>3</td><td>44.5</td><td>4.0 / 4.5 / 5 / 6.3 / 8 / 9 / 10</td></tr>
<tr><td>4</td><td>47.63</td><td>5 / 6.3 / 8 / 10</td></tr>
<tr><td>5</td><td>51.0</td><td>3.6 / 4 / 4.5 / 5 / 6.3 / 8 / 10 / 12</td></tr>
<tr><td>6</td><td>54.0</td><td>3.6 / 4 / 4.5 / 5 / 6.3 / 8 / 10 / 12</td></tr>
<tr><td>7</td><td>57.0</td><td>4 / 5 / 6.3 / 8 / 10</td></tr>
<tr><td>8</td><td>60.3</td><td>4 / 5 / 6.3 / 8 / 10 / 12.5</td></tr>
<tr><td>9</td><td>63.5</td><td>4.8 / 5.6 / 6.3 / 10 / 12.5</td></tr>
<tr><td>10</td><td>76.1</td><td>7.1 / 10 / 12.5</td></tr>
<tr><td>11</td><td>88.9</td><td>4 / 5.5 / 6.3 / 12</td></tr>
</table></td><td></td></tr>
</table>

<table>
<tr><th>S. No.</th><th>BHEL SPECIFICATIONS</th><th>Bidder's OFFER [With Complete Technical Details]</th></tr>
<tr><td>2.2</td><td>MATERIALS:</td><td></td></tr>
<tr><td></td><td>a. Carbon Steel:
SA192, SA210A1, SA210C
b. Alloy Steel:
SA209T1, SA213T11,
SA213T22, SA213T91, T-23, T-93
c. Stainless Steel
SA 213 TP304H, SA 213 TP321H, SA 213 TP347H</td><td></td></tr>
<tr><td>2.3</td><td>RADII OF BENDS:</td><td></td></tr>
<tr><td></td><td>
<table>
<tr><th>S.No</th><th>TUBE OUTER DIAMETER (in mm)</th><th>RADIUS OF BEND (in mm)</th></tr>
<tr><td>1</td><td>31.8</td><td>R 40, 48</td></tr>
<tr><td>2</td><td>38.1</td><td>R 48, 51, 65</td></tr>
<tr><td>3</td><td>44.5</td><td>R 65, 143</td></tr>
<tr><td>4</td><td>47.63</td><td>R 114, 152</td></tr>
<tr><td>5</td><td>51.0</td><td>R 76.5, 151</td></tr>
<tr><td>6</td><td>54.0</td><td>R 76.5, 165</td></tr>
<tr><td>7</td><td>57.0</td><td>R 100</td></tr>
<tr><td>8</td><td>60.3</td><td>R 200</td></tr>
<tr><td>9</td><td>63.5</td><td>R 100, 160, 200,320</td></tr>
<tr><td>10</td><td>76.1</td><td>R 200, 300</td></tr>
<tr><td>11</td><td>88.9</td><td>R 240</td></tr>
</table>
</td><td></td></tr>
<tr><td>2.4</td><td>JOB DETAILS: Refer Annexure 1</td><td></td></tr>
</table>

S. No.	BHEL SPECIFICATIONS		Bidder's OFFER [With Complete Technical Details]
3.0	**TOLERANCES FOR BENDS**		
3.1	**VISUAL DEFECTS**		
3.1.1	It shall be free from harmful surface visual defects, such as scoring marks, wrinkles, tool marks and depressions, etc		
3.2	**PERCENTAGE OVALITY**		
3.2.1	% Ovality ={(Max.OD - Min.OD)/ Original OD} x100	To be Less than 10%	
3.3	**PERCENTAGE THINNING**		
3.3.1	% Thinning = {(t1 - t2)/ t1}x100, where, t1–actual wall thickness before bending t2–actual wall thickness after bending	Maximum allowed Thinning is 8%	
3.4	**FLATNESS**		
3.4.1	Cold Bending operation	No flatness allowed	
3.5	**Bending Angle**	± 0.5°	
3.6	**Bend Radius**	± 3 mm	

S. No.	BHEL SPECIFICATIONS		Bidder's OFFER [With Complete Technical Details]
4.0	**OPERATING PARAMETERS:**		
4.1	Tube Diameter	Minimum: 31.8 mm Maximum: 88.9mm	
4.2	Tube Wall Thickness	As given in the table (Sl.No. 2.1)	
4.3	Bend Radius	Minimum: 40mm Maximum: 320mm	
4.4	R/d Ratio	**1.2**	
		1 (Optional)	
4.5	Tube length handled	Minimum: 950mm Maximum: 22000mm	
4.6	Tube Clamping Length required	50mm for tubes upto OD 51mm 1xD for tubes above OD 51mm	
4.7	End Limb Length	100mm	
4.8	Bending Angle in Job	0° to 180°	
4.9	Multi Plane Turning Angle	360°	
4.10	Bending Direction	Clockwise / Anti- Clockwise (Will be informed at the time of ordering)	
4.11	Tube batch quantity	Each lot will have max. of 50 tubes for a particular bend configuration	
4.12	Reference tube size for establishing the machine capacity	Diameter x thickness 88.9 x 12 ; 76.1 x 12.5 (180° bend in Alloy steel)	

S. No.	BHEL SPECIFICATIONS		Bidder's OFFER [With Complete Technical Details]
4.13	**PRODUCTIVITY**		
4.13.1	No.of bends per shift in OD 51 x 8mm / Alloy Steel Tubes for batch production jobs with Radius 151mm - Angle 180° bends	300 bends in one 8 hour shift	
4.14	'S' bend configuration (zero distance between bends)	Machine to be capable of making 'S' bends	
5.0	**MACHINE PARAMETERS**		
5.1	Maximum Bending arm Bending Speed in rpm	Vendor to specify	
5.2	Maximum Bending arm Reverse Speed in rpm	Vendor to specify	
5.3	Clamp Jaw Stroke length in mm	Vendor to specify	
5.4	Pressure die Stroke length in mm	Vendor to specify	
5.5	Follower Jaw Retraction Slide Stroke in mm	Vendor to specify	
5.6	Creep speed to be provided for Bending arm during start and end of bending	Vendor to specify and confirm	
5.7	Creep speed to be provided for Clamp Jaw movement, Pressure Die forward / reverse stroke, Carriage movement.	Vendor to specify and confirm	
5.8	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 creep speed	

S. No.	BHEL SPECIFICATIONS		Bidder's OFFER [With Complete Technical Details]
5.9	Mandrels	Mandrels not required	
5.10	Tube Working Height.	Maximum - 1200mm from ground level	
5.11	Maximum Bending Torque	Vendor to specify	
5.12	Maximum Section Modulus of tube that can be bent in the machine	Vendor to specify	
5.13	Maximum Operating Pressure	Vendor to specify	
5.14	Main Pump Motor capacity in kW	Vendor to specify	
5.15	Total Power Requirement in kVA	Vendor to specify	
5.16	Hydraulic Tank Capacity	Vendor to specify	
5.17	**CNC AXES SPECIFICATIONS:**		
5.17.1	**SPEEDS :**		
5.17.1.1	Y-axis : Tube Feed/Transport Speed - Steplessly variable	Vendor to specify range in mm/min	
5.17.1.2	B-axis : Tube Rotation Speed - Steplessly variable	Vendor to specify range in rpm	
5.17.1.3	C-axis : Bending Speed - Steplessly Variable	Vendor to specify range in rpm	
5.17.2	**RESOLUTION:**		
5.17.2.1	Y-axis : Tube Feed/Transport	Vendor to specify	
5.17.2.2	B-axis : Tube Rotation	Vendor to specify	
5.17.2.3	C-axis : Bending	Vendor to specify	

S. No.	BHEL SPECIFICATIONS		Bidder's OFFER [With Complete Technical Details]
5.17.3	**REPEATABILITY:**		
5.17.3.1	Y-axis : Tube Feed/Transport	Vendor to specify	
5.17.3.2	B-axis : Tube Rotation	Vendor to specify	
5.17.3.3	C-axis : Bending	Vendor to specify	
6.0	**GENERAL DESIGN & CONSTRUCTIONAL FEATURES**		
6.1	**Foundation:**		
6.1.1	Foundation of the machine shall be designed suitably, if any. Vendor to provide details of the type of foundation with X axis, Y axis, force diagram with foundation details, drawing and bolt. If there is no foundation, the machine shall be placed on anti-vibratory pads.		
6.2	**Controls:**		
6.2.1	The three axis controls viz, bending angle, rotation angle and distance between bends of 3-Axes shall be PC based CNC programmable type. Collet axis centering, in line with CLR of bend die shall also be through CNC programme.		
6.2.3	Machine shall be operated in three modes viz., Manual, semi-Automatic and Automatic		
6.2.4	Boosting facility shall be available to control thinning. The extent of boosting shall be set through CNC program by the operator.		
6.2.5	CNC System Remote Operator Control panel shall be Self Standing - PC Based touch screen type control panel with 10m long cable having protective sheathing and plug-in connectors through closed cable ducts.		
6.2.6	The bending process auto and feed back field start and stop initiating field sensors, such as encoders, limit switch, feed back devices shall be suitably placed for easier accessibility rigidly.		

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
6.2.7	All alarm tripping logics and control logics incorporated in the machine to be listed out by the vendor.	
6.3	**Carriage Construction:**	
6.3.1	Carriage movement sensor shall be of non-contact type	
6.3.2	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.	
6.3.3	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. Also a tolerance of +1% on Outside diameter may be considered	
6.3.4	Vendor to give details of the different collet arrangements and their ranges that will be needed for various diameters as per our specification.	
6.3.5	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 back 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.	
6.3.6	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 details to be furnished by the vendor.	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
6.4	**Tube Loading Facility**	
6.4.1	Loading stand / Tube storage rack shall be provided and positioned behind the machine parallel to the machine bed. The stand shall suitable to load a bundle of tubes containing 50 tubes with tube kick off (vertical type) arrangement upto 22 metre long tubes.	
6.4.2	The following shall be provided in the machine: Tube machine shall have automatic loading of tube. Tube kick off from the tubes storage rack on to the tube feed rollers. Automatic tube feeding with feed rollers along the bed. Tube feeding through the collet from the rear of the carriage. Automatic Tube end sensing and positioning of tube to the programmed length for the first bend	
6.5	**Bend die construction**	
6.5.1	Bend die mounting plate shall be designed such that there is no interference with multi-plane bends while bending multi-plane bend configurations.	
6.5.2	Split die actuation to be provided in the machine.	
6.5.3	Bend die mounting shall be of quick type with only hand tightening.	
6.5.4	Independent Bend dies for all sizes mentioned in the specification shall be quoted item-wise in the offer.	
6.5.5	Provision for bend to bend ('S' bends) clamping.	
6.5.6	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 bending formers available with BHEL.)	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
6.6	**Follower jaw construction**	
6.6.1	Follower jaw shall be provided in segments and to be mountable independently	
6.6.2	Follower jaw shall be provided in two segments and to be mountable independent. One segment with sufficient length for bending upto 120° and the smaller segment with sufficient length for bending 60°.	
6.6.3	Independent Follower jaws for each diameter shall be quoted, for all diameters as given in the specification. There shall NOT be any pads to change over diameters.	
6.6.4	Follower jaws shall be easily removable and mountable with least effort by the operator with rugged design.	
6.7	**Clamping and Clamp Jaw construction**	
6.7.1	The bending machine shall have swing arm type of Tube bending arrangement. NO overhead clamping type.	
6.7.2	Clamp jaw shall be easily removable and mountable with least effort by the operator with quick clamping mechanism.	
6.7.3	Independent clamp jaws for each diameter shall be quoted, for all diameters as given in the specification. There shall NOT be any pads to change over diameters.	
6.7.4	The options of clamping by (a) standard Straight movement of clamp jaw for clamping OR (b) Clamp-jaw engage for bending and retract into the bending arm after the bending, before the bending arm comes to the home position. (Retraction into the bending arm after bending, below the level of bending former and come up to clamping position before bending for engaging the clamp jaw.)	
6.7.5	Height adjustment for adjusting the clamp jaw height to be provided	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
6.8	**Sliding surfaces**	
6.8.1	Sliding surfaces shall have metal to metal contact. NO pads or Hylam strips in between shall be used	
6.9	**CNC SYSTEM FEATURES:**	
6.9.1	To provide latest CNC System - Details to be specified in the offer clearly. (with PC Based CNC & PLC Control). CNC System shall be preferably of Fanuc make. NOTE: The offered system shall not become obsolete in the next seven years.	
6.9.2	Control system shall be preferably CNC with PLC.	
6.9.3	Real time bending to be displayed with details such as bending angle, distance of carriage movement, rotation angle etc.	
6.9.4	Input shall be through either manual data feed or through an external computer.	
6.9.5	Recognition of collision point of the Tube rotation device and counter pressure rail.	
6.9.6	Auto-Display of machine positions on the screen during manual operation.	
6.9.7	Display in 17 inches flat color monitor.	
6.9.8	Auto calculation of co-ordinate conversion from Cartesian co-ordinates into bending machine co-ordinates and vice-versa.	
6.9.9	Spring back and Stretch automatic calculation facility.	
6.9.10	Spring back and Stretch automatic compensation facility.	
6.9.11	Vendor to provide details of how the stretch compensation is done and the intermediate distance between bends is controlled.	
6.9.12	Pre-programming and storage of number of different bending tool-data.	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
6.9.13	Counter for recording no. of bends produced per shift.	
6.9.14	Automatic diagnostic alarm feature with error code and message display.	
6.9.15	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.	
6.9.16	System shall have the facility to display Memory details.	
6.9.17	System Software to be stored in EPROM along with Flash Memory.	
6.9.18	The supplier shall give software back up.	
6.9.19	A standard RS 232 C (V 24) interface to connect IBM compatible computer.	
6.9.20	Remote access through network - internet, for remote diagnosis shall be provided.	
6.9.21	USB Ports for connectivity to be provided	
6.9.22	Additional external standard 104key Keyboard and Optical Mouse.	
6.9.23	Pen drive of 512MB capacity of reputed make shall be provided with the machine for storing programs.	
6.9.24	The computer shall have CD read and write drive.	
6.9.25	UPS for 1 hour back up time for PC shall be provided	
6.9.26	Remote Operator Control Unit (with 10 meter long cable having protective sheathing and plug-in connectors through closed cable ducts).	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
6.10	**Hydraulics**	
6.10.1	All Hydraulic valves to be of modular construction. All hydraulic operating components to be mounted on the manifold in a centralized place in convenient location for easy approach for Maintenance. Preferably away from the frame and on the side of the machine.	
6.10.2	Hydraulic power pack and Oil tank shall be separate from the Machine and positioned behind the machine conveniently to attend to any maintenance problems	
6.10.3	Hydraulic hose end fittings shall be welded nipple joints of suitable material - preferable MS female swivel nut with 24^0 cone.	
6.10.4	Hydraulic circuits shall be designed with minimum number of control valves and to suit oil of ISO VG 46 or 68 only. Also minimum number of check-points to be provided wherever pressure is required to be read for setting and trouble shooting. Minimess Pressure Gauge - 1 No with Connecting Hose to be provided.	
6.10.5	The hydraulic oil cooling unit shall be tropicalized. An Oil-Chiller to be provided to maintain oil temperature not exceeding 40 deg C.	
6.10.6	The machine shall be suitable for an ambient temperature of +50 deg C and relative humidity of 85% respectively. Vendor to provide details of Oil chiller - refrigeration type for required tank capacity to maintain oil temperature not exceeding 40 deg C.	
6.10.7	All hydraulic Tubelines to be neatly laid out.	
6.10.8	Lubricator, Regulator, Filter and hand wheel valve shall be fitted at the centralized location for any pneumatic circuits	
6.11	**Lubrication**	
6.11.1	Centralized Automatic Lubrication system with a provision for adjusting the timer shall be provided for the machine.	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
6.12	**Electrical Points:**	
6.12.1	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.	
6.12.2	Control circuit voltage should be 24 V DC.	
6.12.3	Control panel shall have built in 230V, 5 amps, 3 pin plug.	
6.12.4	Machine panel shall be adequately illuminated for maintenance purpose.	
6.12.5	Control Panels and Operating Panel shall be air-conditioned.	
6.12.6	Type of drives used for motors to be indicated.	
6.12.7	The machine shall be suitable for 415V ± 10%, 50±3% Hz, 3 Phase, 3 wire system	
6.12.8	Electrics shall be tropicalised & shall have IP 54 protection	
6.13	**Components used:**	
6.13.1	All motors shall be from reputed makers like SIEMENS, ABB, Allen Bradley conforming to IEC Standards.	
6.13.2	All hydraulic elements shall be of VICKERS / REXROTH, DENISONS make.	
6.13.3	All hydraulic hoses shall be preferably of GATES make.	
6.13.4	All electrical items shall be of reputed make like SEW / ROCKWELL Allen Bradley/ Telemechanique / Delta	
6.13.5	All components/devices/terminals are to be incorporated with ferrules.	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
7.0	**OPTIONAL ACCESSORIES:**	
7.1	Automatic clamping jaw changing device - interchanging between Straight clamp jaw and Curved clamp jaw for making 'S' bends.	
7.2	Bending Tool Changing Device.	
7.3	AUTOCAD integration - Facility to download AutoCAD drawings of Tube bends and convert to operating programs.	
7.4	CAD / CAM interface / Compatibility.	
7.5	Any Other Optional Accessories: Additional Optional Accessories which enhance the productivity of the machine to be described by the supplier with the offer.	
8.0	**GENERAL POINTS**	
8.1	Make and Model of the machine to be mentioned. Detailed catalogs of the machine to be sent with the offer.	
8.2	Complete description of all systems & sub-systems shall form part of the technical bid.	
8.3	A schematic diagram showing the layout of the machine & associated systems with salient dimensions shall be submitted along with the offer.	
8.4	The operating sequence of the machine with broad outline of various operations involved should be furnished with the offer.	
8.5	Standards for Design, Manufacture and testing of the machine shall be in accordance with internationally accepted standards.	
8.6	The factor of safety considered for designing the machine, for certain load bearing components such as chain drive, Former mounting spindle, hydraulic cylinders etc. shall be furnished with the offer.	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
9.0	**TOOLINGS**	
9.1	List of tooling (Standard Clamp jaws, Bending formers, Follower jaw/ Pressure die etc) for the sizes mentioned in specification and any optional tooling should be listed and quoted out item wise separately.	
10.0	**AMBIENT CONDITIONS**	
10.1	The tube-bending machine with all Sub-Systems shall be suitable for operation in an ambient temperature varying from 25 to 50°C and with a Relative Humidity varying from 45% to 90% at the Factory Location.	
10.2	The entire equipment shall be Tropicalized in Design and Construction	
10.3	The offered equipment, CNC System and Hydraulic system has to work in a normal fabrication shop environment in ambient conditions.	
11.0	**SAFETY**	
11.1	SICK laser mechanism to be provided for safety	
11.2	All other safety features provided in the machine shall be specified by the vendor.	
12.0	**PAINTING:**	
12.1	The heavier machine parts are to be heat-treated after fabrication (including castings and forgings) and shot blasted for surface preparation prior to painting.	
12.2	One coat of Primer with 25μ of DFT (Dry Film Thickness) and 48 hours of compulsory curing after painting.	
12.3	Polyurethane Paint. Colour shade will be specified at the time of releasing purchase order.	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
13.0	**SPARES (to be recommended by the vendor)**	
13.1	Itemized breakup of mechanical, hydraulic, electrical and electronic spares used on the machine in sufficient quantity as per recommendation of Vendor for 2 years of trouble free operation on three shifts continuous running basis should be offered by vendor. The list to include following, in addition to other recommended spares: **(Unit Price of each item of spare should be offered)**	
13.2	**a) Mechanical & Hydraulic Spares:** All types of Pumps, Valves, Pressure Switches, Transducers, Flow Switches, Filters, Seals, O-rings, Hydraulic Hoses etc.	
13.3	**b) Electrical /Electronic / CNC Spares:** All types of Relays, Contactors, Proximity Switches, Push Buttons, Indicating Lamps, Semiconductor Fuses, Special Fuses, Circuit Breakers, Main Power Switch, Encoders, Spares for CNC, Servo Motors for Feed Drives, Power Module & Control Cards for Main Drive as well as Feed Drives etc.	
13.4	All types of spares for total machine and accessories should be available for at least ten years after supply of the machine. If machine or control is likely to become obsolete in this period, the vendor should inform BHEL sufficiently in advance and provide drawings of parts / details of spares & suppliers to enable BHEL to procure these in advance, if required	
13.5	Recommended set of spares for all attachments are to be offered with details.	
13.6	Vendor to confirm that complete list of spares for machine and accessories, along with item part no / specification / type / model, and name & address of the spare supplier shall be furnished along with documentation to be supplied with the machine	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
13.7	**Essential Spares**	
13.7.1	Mechanical & Hydraulic spares: 1. Spares for mechanical wearing components due to linear movements & rotation, - 4 Nos each 2. Spares for hydraulics Power Pack, Sealing rings, Hydraulic valve 'O' rings, O rings etc - 4 Nos each	
13.17.2	Electrical & Electronics: - 1. CNC and PLC PCBs (I/O card, digital to analogue card, CPU card, power supply board etc.) display unit, HMI etc., - 4 Nos each 2. Field sensors, such as encoders, optical sensors, proximity switch, limit switches, push buttons, indicating lamps etc. - 4 Nos. each.	
14.0	**DOCUMENTATION:**	
14.1	**Three** sets of following documents (3 Hard copies), in English language should be supplied along with the machine:	
14.1.1	Operating manuals of Machine & CNC system	
14.1.2	Programming Manuals of Machine & CNC system	
14.1.3	Detailed Maintenance manual of machine with all drawings of machine assemblies/sub-assemblies/parts including Electrical / Pneumatic/ Hydraulic circuit diagrams. All Assembly/ Sub Assembly Drawings shall be supplied with the part list also	
14.1.4	Maintenance, Interface & commissioning manuals for CNC system	
14.1.5	Machine data/ Commissioning data to be provided.	
14.1.6	Manufacturing drawings for all supplied and required toolings like Clamp jaws, Bending formers, Follower jaw / Pressure die, 'S' bend clamps if any, Former mounting spindle, adapters, sleeves etc.	
14.1.7	Catalogues, O&M Manuals of all bought out items including drawings, wherever applicable.	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
14.1.8	Detailed specification of all rubber items and hydraulic/lube fittings	
14.1.9	PLC program print-outs with comments in English.	
14.1.10	PLC program and data on CD	
14.1.11	Complete back-up of hard disk on GHOST CD and clear written Instructions (3 copies) to take back-up and reloading of a new hard disk.	
14.1.12	Complete Master List of parts used in the machine shall be submitted by the vendor.	
14.1.13	Complete list of Alarm log, Error code, error messages & remedies and on line fault diagnostics to be provided by the vendor.	
14.2	One additional set of all the above documentation on CD.	
15.0	**INSPECTION**	
15.1	The Machine shall be offered for inspection and performance trials to test the design capabilities of the machine, by BHEL Engineers before Dispatch at Supplier's works.	
16.0	**ACCEPTANCE CRITERIA**	
16.1	All the features of the machines shall be operated and shown and to work as given in the specification, at supplier's works during inspection and during commissioning at BHEL works.	
16.2	The prove-out trials shall be for the Tube sizes, bend pattern given by BHEL during the technical discussions / at the time of releasing the Purchase Order. The bends have to pass the quality tests of all parameters (like Ovality, thinning, angle, distance between bends etc) as mentioned in the specification.	
16.3	The production output of the machine shall be proved out by the commissioning Engineer at BHEL works for the Production rate mentioned in the specification.	
16.4	Bending on all thin walled Tubes (as per our specification) shall be proved out during commissioning.	

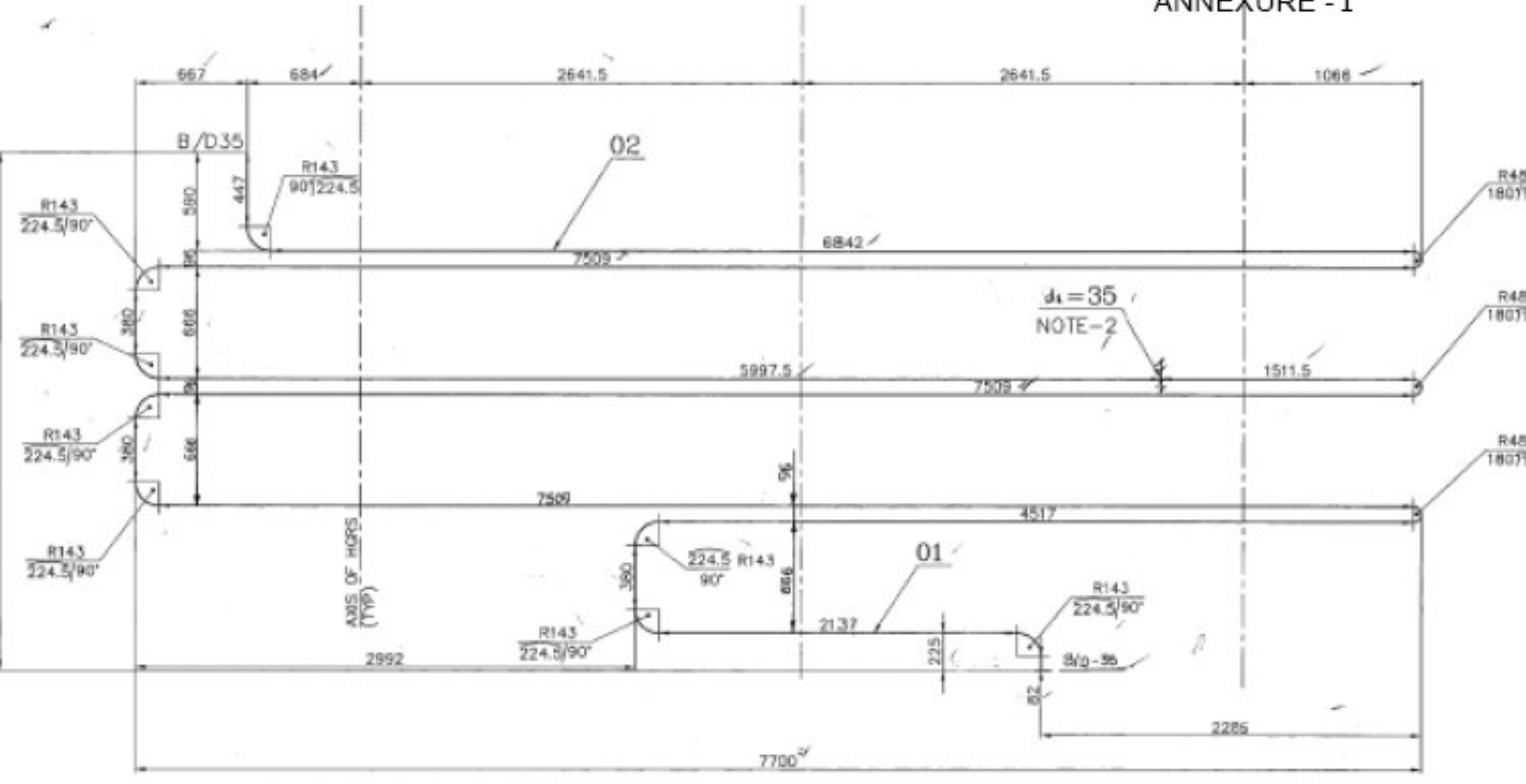
S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
17.0	**ERECTION AND COMMISSIONING**	
17.1	The supplier shall depute his engineer(s) for supervising the erection and commissioning of the machine at BHEL and prove-out trials	
18.0	**TRAINING**	
18.1	The supplier shall train Four BHEL's Engineers in Operation and Maintenance (Mechanical, Electrical/ Electronics and CNC System) of the Machine at supplier's works for a period not less than 10 working days.	
18.2	The supplier shall impart training to BHEL's Machine Operators and Maintenance crew in Operation and Maintenance (Mechanical, Electrical/ Electronics and CNC System) after the commissioning of the Machine at BHEL works for not less than 10 working days.	
18.3	The training shall include specialized coaching in a. Safety b. Operation of the machine c. CNC System Operation, d. Trouble-Shooting, e. Software Application f. All special features of the machine g. Electrical / Mechanical / Electronics systems	
18.4	Co-ordination for a visit of BHEL Personnel to an industry having similar / identical machine & system, in case of order realization, for system acquaintance & performance feedback	

S. No.	BHEL SPECIFICATIONS	Bidder's OFFER [With Complete Technical Details]
19.0	**GUARANTEE**	
19.1	Equipment has to be guaranteed for its performance, for a minimum of 24 months from the date of commissioning.	

Enclosures:

a) **Annexure-1 Bend Configurations**
b) **Annexure-2 Typical Bending formers in BHEL**

ANNEXURE - 1

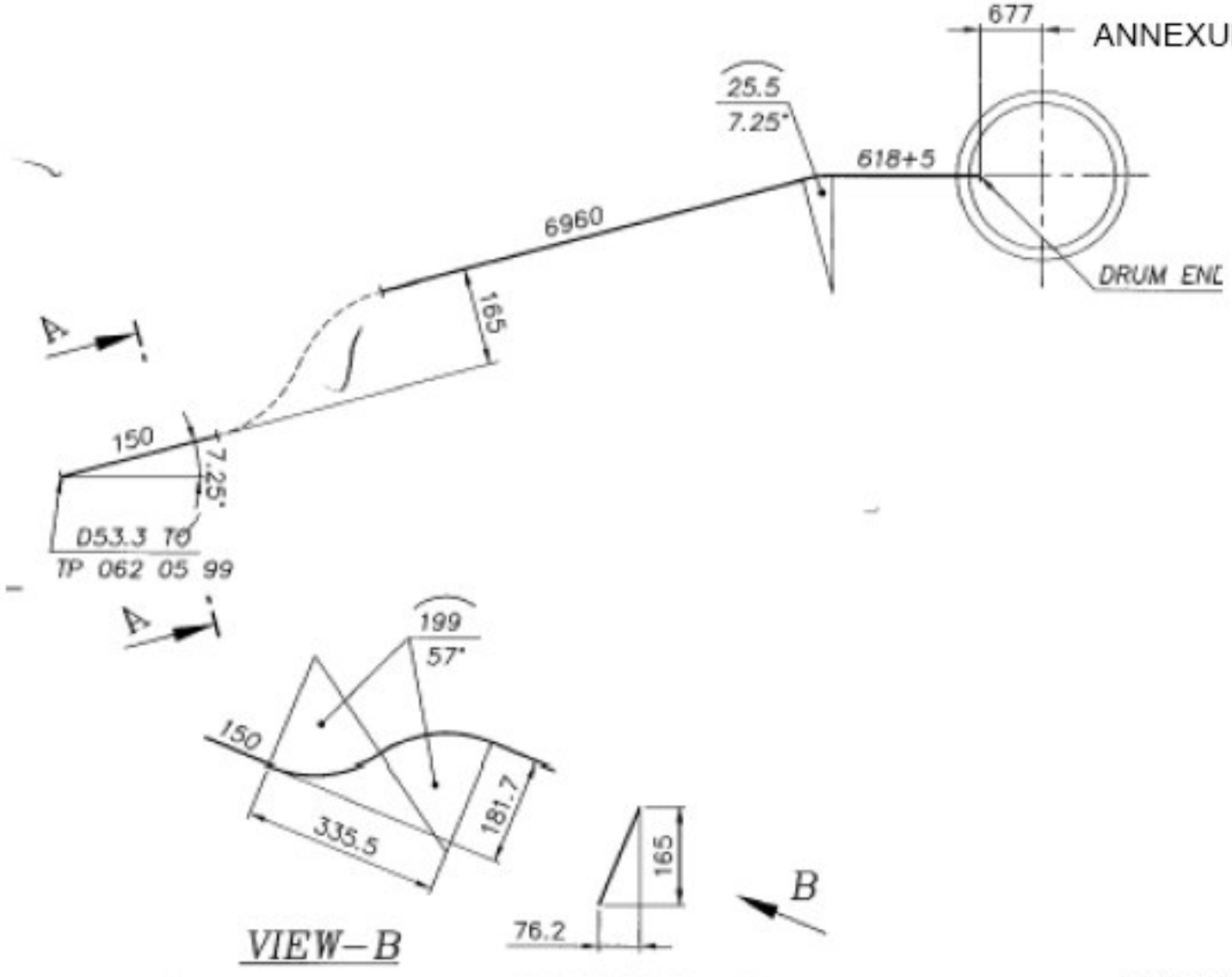


LTSH bend

BEND CONFIGURATION - 1
Drg No : CABS-1-05-01

BHEL, Tiruchirappalli

ANNEXURE - 1



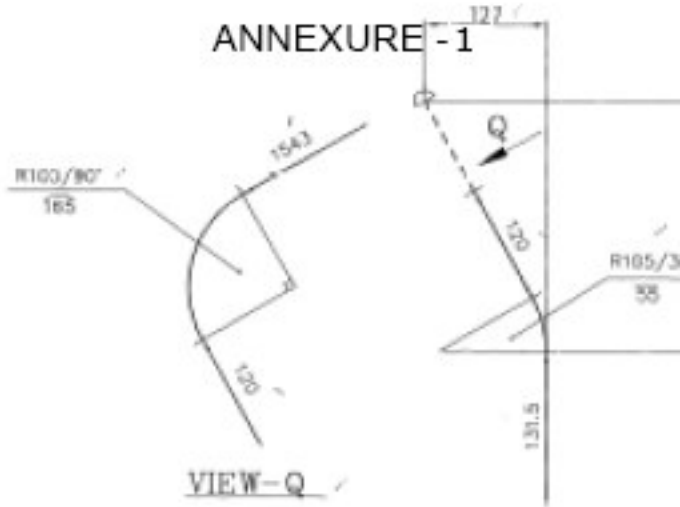
Roof tube bend

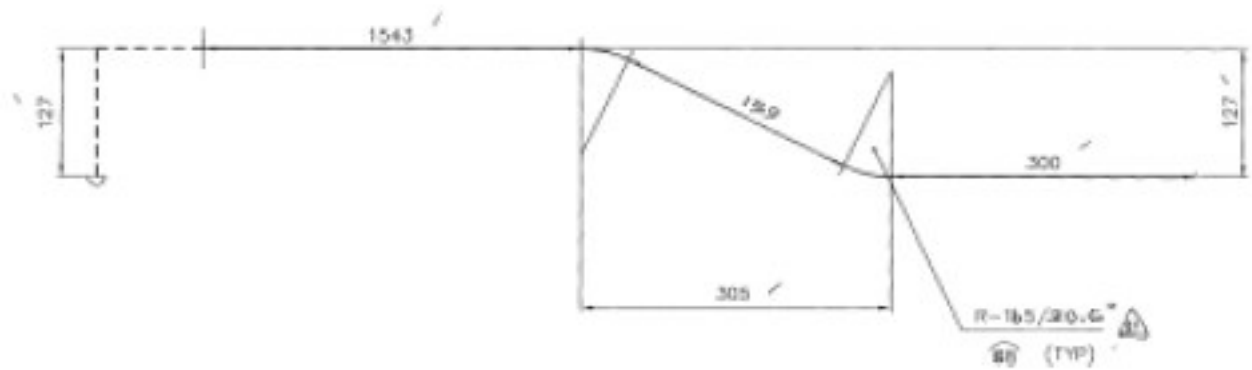
BEND CONFIGURATION - 2

Drg No : CABS-1-05-02

BHEL, Tiruchirappalli

ANNEXURE - 1





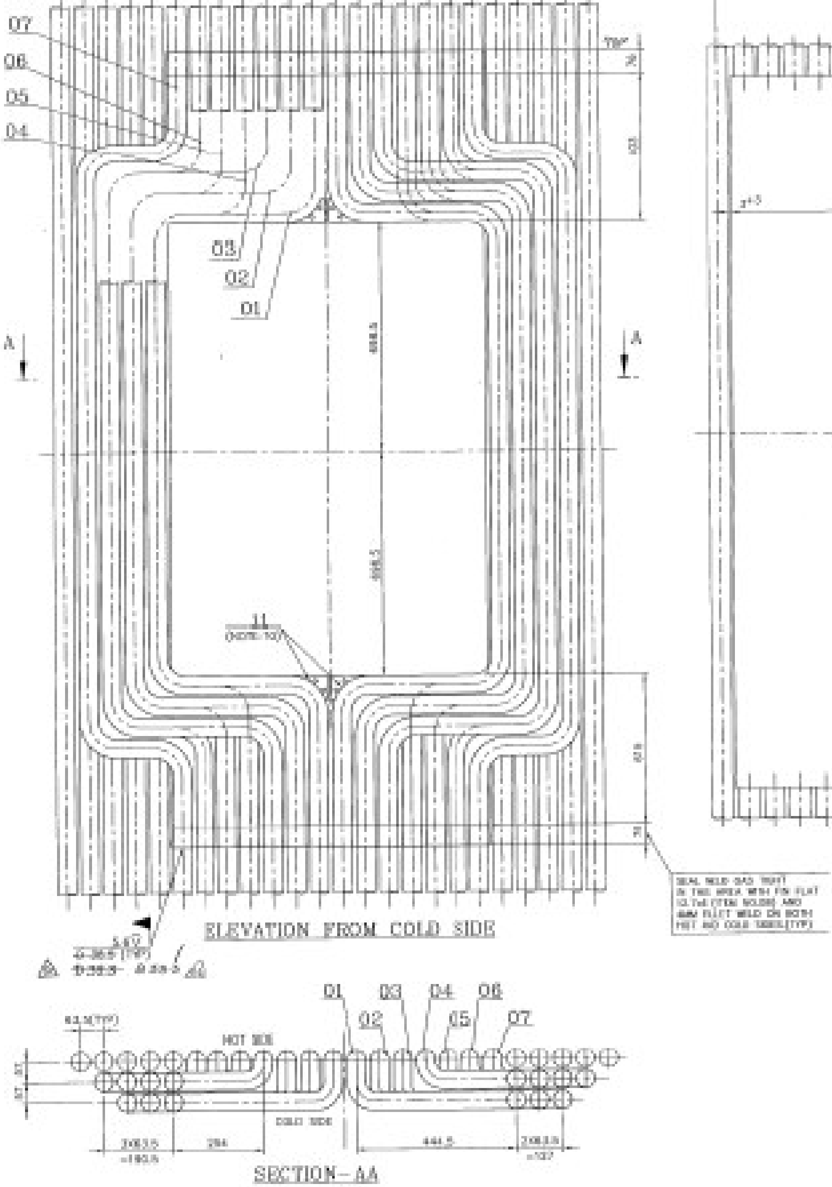
RH cross over tube bend

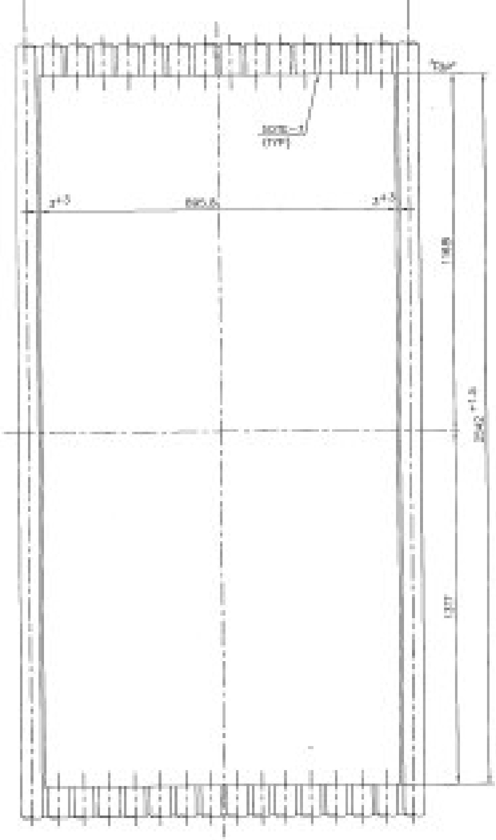
BEND CONFIGURATION - 3

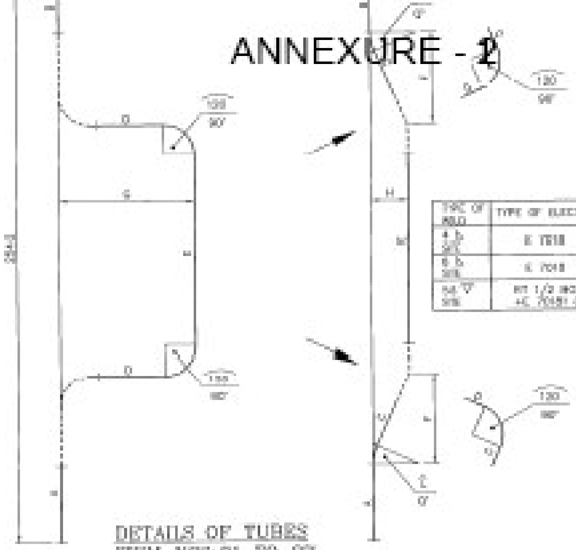
Drg No : CABS-1-05-03

BHEL, Tiruchirappalli

ANNEXURE - 2



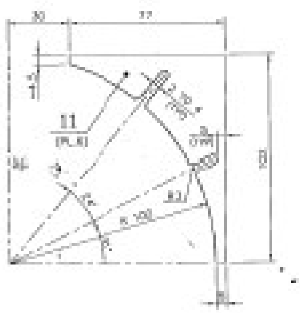




TYPE OF WELD	TYPE OF ELECTRODE	LENGTH (M)
[illegible]	E 7018	≈ 9.5
[illegible]	E 7018	≈ 10
[illegible]	RT 1/2 IRG (A) +C 7018 (A)	28 Nos.

DETAILS OF TUBES
ITEM NOS: 01 TO 07

ITEM NO.	A	B	C	D	E	F	G	H	I	θ°	DEV.LENGTH
01	487	275	76	291.5	1289	168	444.5	114	52.5	38°30'	3377
02	430	218	70	291.5	1409	168	444.5	114	52.5	38°30'	3377
03	373	161	76	291.5	1523	168	444.5	114	52.5	38°30'	3377
04	483	271	76.5	101	1295	170	254	57	26.5	30°	3937
05	426	214	76.5	101	1409	170	254	57	26.5	30°	3937
06	369	157	76.5	101	1523	170	254	57	26.5	30°	3937
07	312	100	76.5	101	1637	170	254	57	26.8	30°	3937



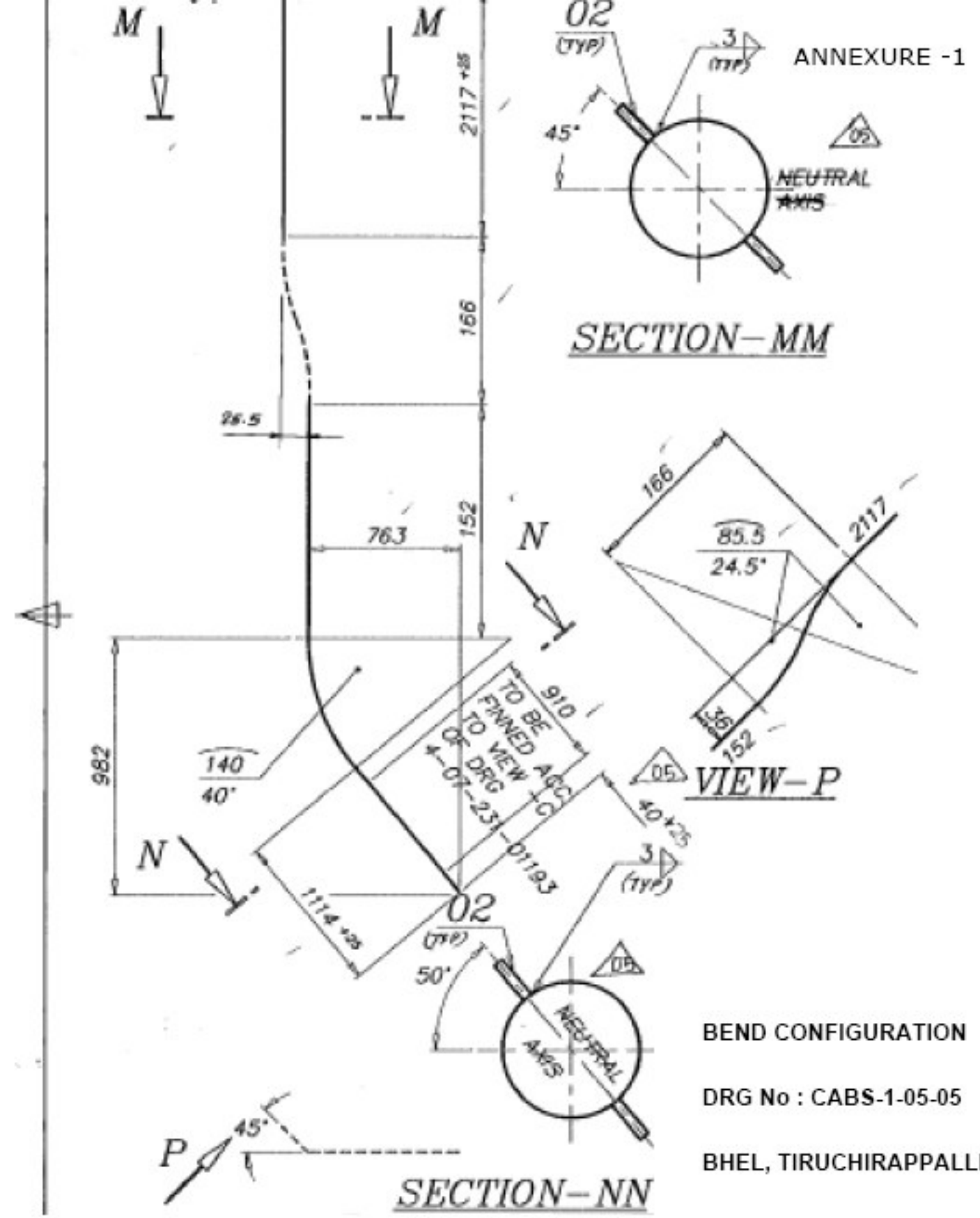
BEND CONFIGURATION - 4

Drg No : CABS-1-05-04

BHEL, Tiruchirappalli

Scaffoled door opening bends

ANNEXURE -1



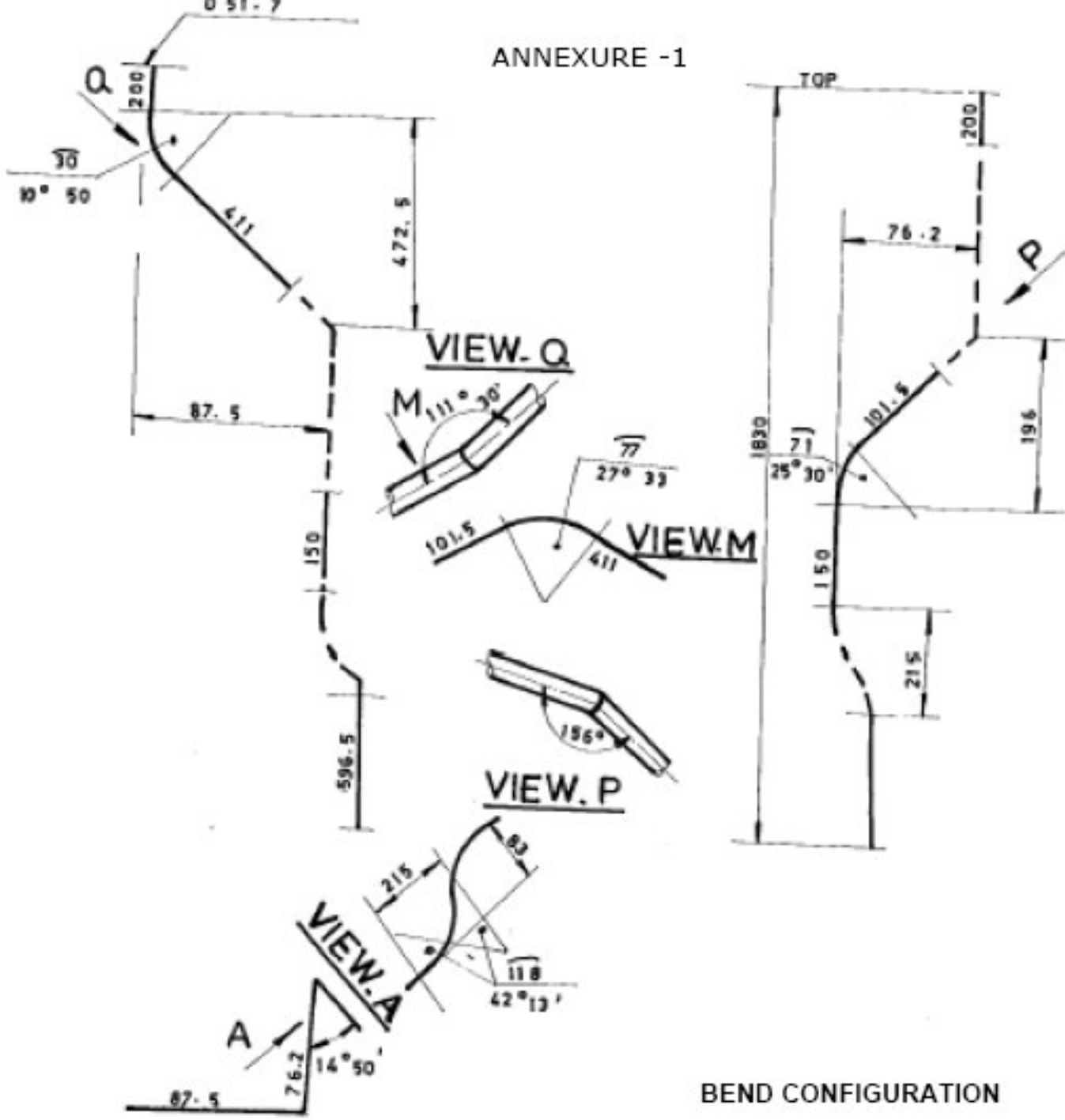
BEND CONFIGURATION

DRG No : CABS-1-05-05

BHEL, TIRUCHIRAPPALLI

Lower corner transition bend

ANNEXURE -1



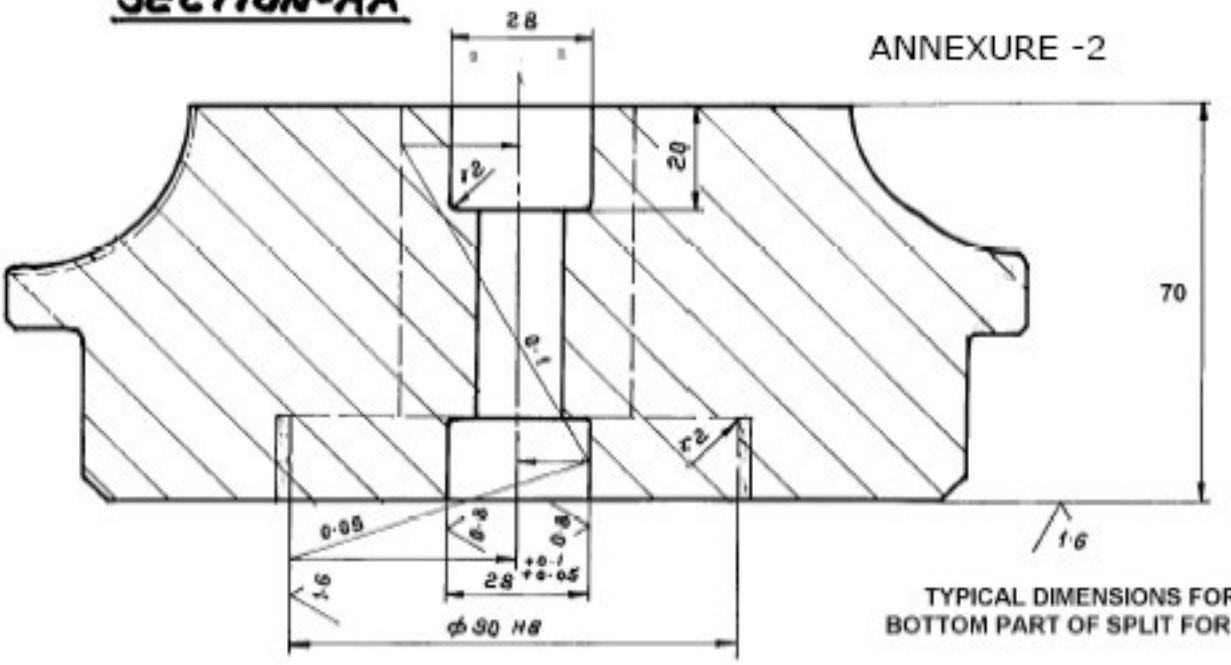
BEND CONFIGURATION

DRG No : CABS-1-05-06

BHEL, TIRUCHIRAPPALLI

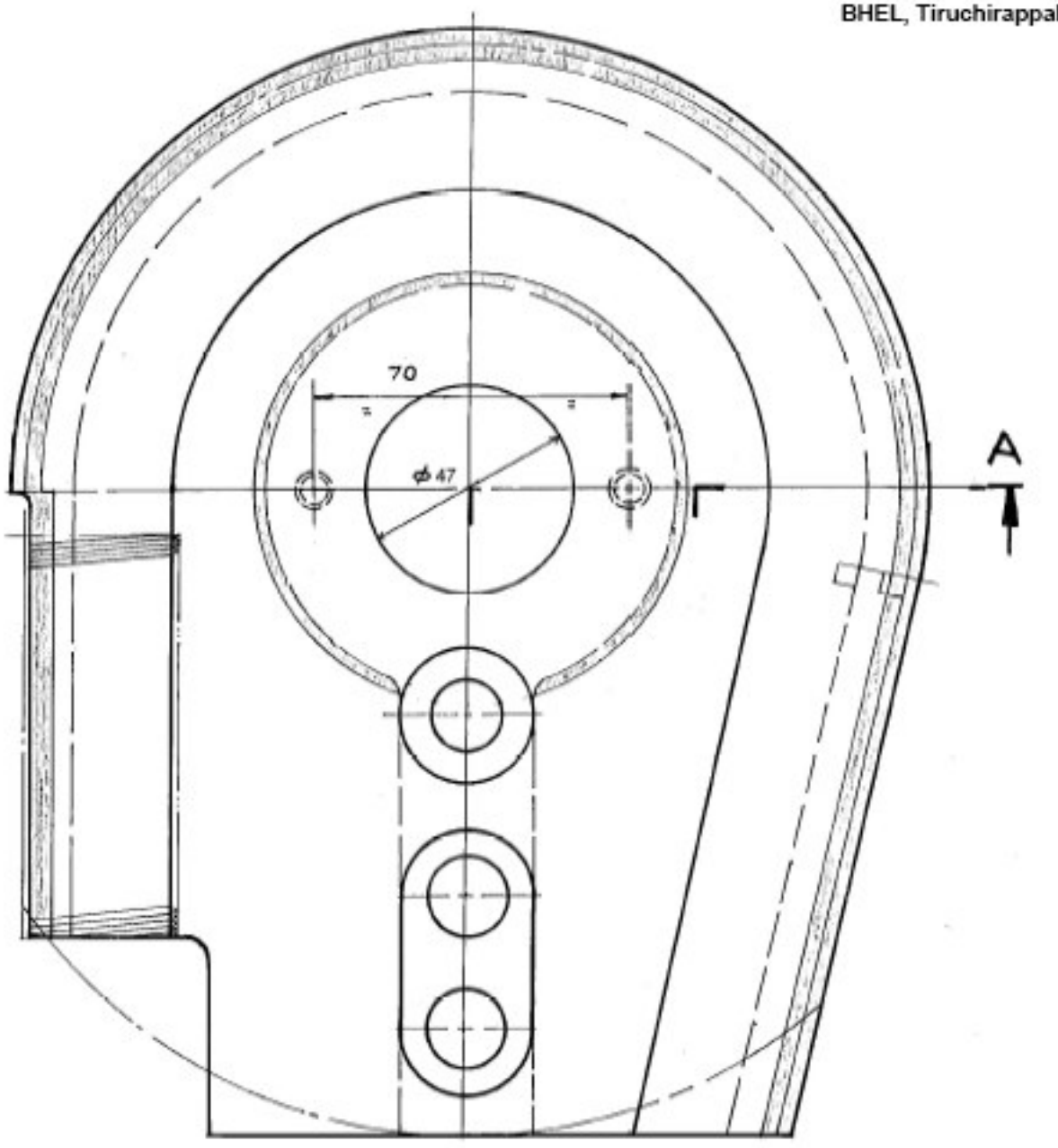
Burner panel bend

ANNEXURE -2



TYPICAL DIMENSIONS FOR
BOTTOM PART OF SPLIT FORMER

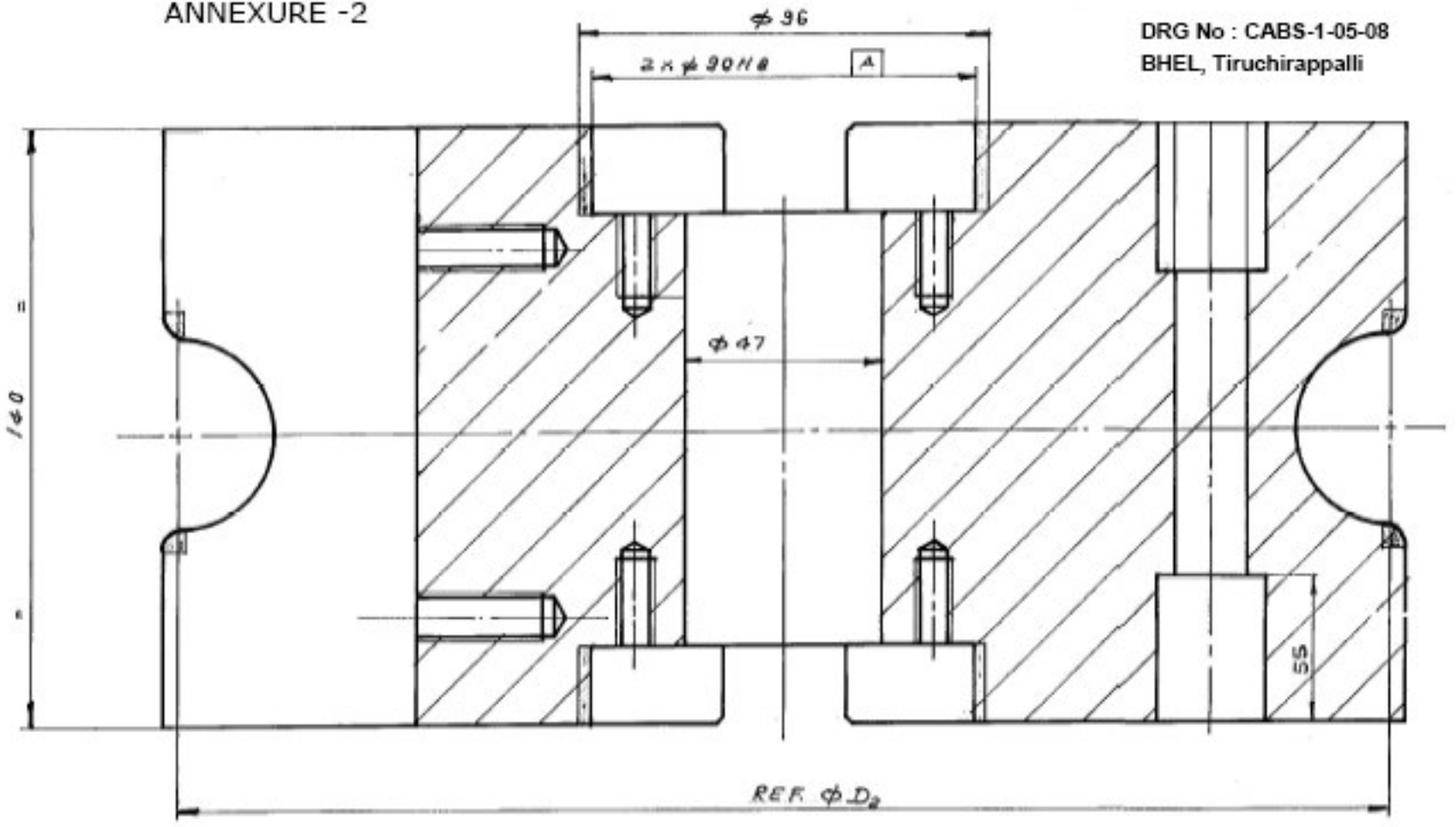
DRG No : CABS-1-05-07
BHEL, Tiruchirappalli



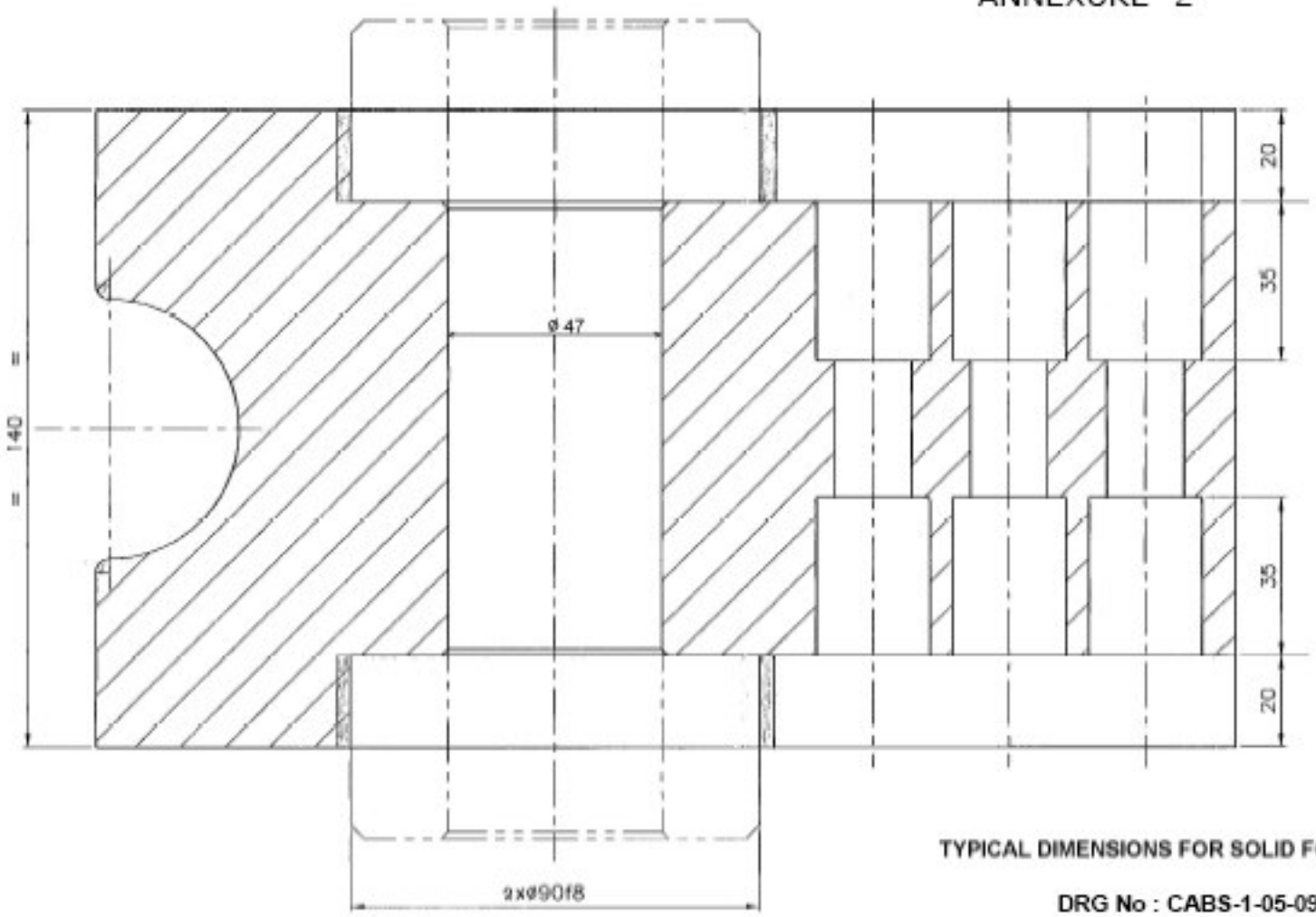
TYPICAL DIMENSIONS FOR SOLID FORMER

ANNEXURE -2

DRG No : CABS-1-05-08
BHEL, Tiruchirappalli



ANNEXURE -2



TYPICAL DIMENSIONS FOR SOLID FORMER

DRG No : CABS-1-05-09
BHEL, Tiruchirappalli