Bharat Heavy Electricals Limited

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

An ISO 9001 Company

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

	Enquiry Number:	**Enquiry Date:**	**Due date for submission of quotation:**
	2620700035	**14.07.2007**	**07.09.2007**
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 Header Stub Bending Machine – CNC Tube bending machine as per the technical specification & commercial conditions applicable (to be downloaded from web site www.bhel.com or http://tenders.gov.in)	1 No.	15.06.2008

BHEL commercial terms & conditions with Price Bid and Bank Guarantee formats along with technical specifications can be downloaded from BHEL web site http://www.bhel.com or from the Government tender website http://tenders.gov.in (public sector units > Bharat Heavy Electricals Limited page) under Enquiry reference "2620700035".

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

PART A

SECTION – I: QUALIFYING CRITERIA

The BIDDER / VENDOR (OEM) has to meet the following requirements to get qualified for submitting an offer for CNC Tube Bending Machine.

S. No.	REQUIREMENTS	VENDOR's COMMENTS
1	The Bidder / Vendor (OEM) shall have a minimum of TEN Years of Continuous Experience in the field of Design, Manufacture and Supply of CNC Tube Bending Machine	
2	Only those vendors (OEMs), who have supplied and commissioned at least ONE CNC Tube Bending Machine of suitable size in the past ten years (on the date of opening of Tender) and such machine is presently working satisfactorily for more than one year after commissioning (on the date of opening of Tender), should quote. However, if such equipment has been supplied to BHEL, then the same must be currently working satisfactorily for not less than six months (as on date of Tender Opening) from the date of commissioning and acceptance **Performance certificate from the customers regarding satisfactory performance of such equipment supplied to them in attached format should ~~to~~ be enclosed along with technical offer.**	
2.1	BHEL reserves the right to verify the information provided by vendor. In case the information provided by vendor is found to be false/ incorrect, the offer shall be rejected.	

SECTION – II

The BIDDER/ VENDOR (OEM) is requested to furnish the following information:

S. No.	PARTICULARS	VENDOR's RESPONSE
3	Profile of the Company bringing-out the years of Experience of the BIDDER in the field of design, manufacture and supply of Induction heating equipment.	

4	Number of CNC Tube Bending Machine supplied, installed and commissioned till date (with details on equipment type / model, configuration, customer and quantity)	
5	Details on International Standards / Design Process Codes followed in Design and Manufacture of the Equipment.	
6	Details on SERVICE-AFTER-SALES Set-Up in India including the Addresses of Agents / Service Centers in India. Competency & Experience of the Local Service Agency are to be provided.	
7	Any Additional Data to supplement the manufacturing capability of the BIDDER for the subject equipment.	

SECTION – III

The BIDDER/ VENDOR (OEM) to note the following:

S.No.	REQUIREMENTS	VENDOR's COMPLIANCE
8	The BIDDER / VENDOR (OEM) shall submit the offer in TWO PARTS -Technical **[with PART A & PART B]** & Commercial and Price Bid.	
9	The Technical Offer shall be supported by Product Catalogues & description.	
10	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 mere 'CONFIRMED' or 'COMPLIES' or 'YES' or 'NO-DEVIATION' or similar words in the technical comparative statement (without any supporting technical write-ups, photos and datasheets] may lead to disqualification of the Technical Offer.	
11	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.	
12	BIDDER / VENDOR (OEM) has to indicate the Country of Origin for the supply of equipment.	

PERFORMANCE CERTIFICATE

(On Customer's Letter Head)

1. Supplier of the machine :

2. Make & Model of the Equipment :

3. Month & Year of Commissioning :

4. Application :

5. Sizes / Specification of Jobs Performed in the machine : (CNC Tube bending machine dia 88.9mm,12.5mm thick carbon/alloy Steel)

6. Performance of the Machine : (Strike off whichever is not applicable)
   Best in the market /
   Satisfactory /
   Good /
   Average /
   Not Satisfactory

7. Any other remarks:

Date:

Signature & Seal of the Authority
Issuing the Performance Certificate

TECHNICAL SPECIFICATIONS for CNC TUBE BENDING MACHINE

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
1.	Area of Application	The machine is meant for the cold bending of seamless steel tubes in multi-plane axes to form high-pressure components for Power Boilers and Industrial boilers for Process Industries. The bending system shall be Draw-Bending type by Electro-Hydraulic means and with CNC mode of operation.	

2.TUBE SIZES: All are OD (outer diameter) Controlled tubes with thickness tolerance of Maximum +12½ %

Sl.No	OUTER-DIAMETER in mm	WALL THICKNESS RANGE in mm (Tolerance: Max. +12½ %)
1	**31.8**	3.2 / 3.6 / 4.0 / 5.0
2	**38.1**	3.2 / 4.0 / 5.0 / 6.3
3	**44.5**	4.0 / 4.5 / 5 / 6.3 / 8 / 9 / 10
4	**47.63**	5 / 6.3 / 8 / 10
5	**51.0**	3.6 / 4 / 4.5 / 5 / 6.3 / 8 / 10 / 12
6	**54.0**	3.6 / 4 / 4.5 / 5 / 6.3 / 8 / 10 / 12
7	**57.0**	4 / 5 / 6.3 / 8 / 10
8	**60.3**	4 / 5 / 6.3 / 8 / 10 / 12.5
9	**63.5**	4.8 / 5.6 / 6.3 / 10 / 12.5
10	**76.1**	7.1 / 10 / 12.5
11	**88.9**	4 / 5.5 / 6.3 / 12

3. MATERIALS:

a CARBON STEEL : SA 192, SA 209 Gr. T1, SA 210 Gr.A1/Gr.C (ASTM)
b ALLOY STEEL : SA 213 Gr.T2, T11, T12, T22, T91 (ASTM)
c STAINLESS STEEL : SA 213 304H, 316L, 347H (ASTM)
d. GOST Standards: 12X1Mϕ / Steel 20

4. RADII OF BENDS:

Sl.No	TUBE OUTER DIAMETER in mm	RADIUS OF BENDS in mm
1	**31.8**	R 48, 60, 65, 100
2	**38.1**	R 65, 80, 100, 114, 125, 151
3	**44.5**	R 65, 75, 80, 90, 100, 114, 143
4	**47.63**	R 71.5, 76.5, 80, 114, 152
5	**51.0**	R 76.2, 90,100, 114, 121, 151
6	**54.0**	R 65, 114, 165
7	**57.0**	R 100, 151
8	**60.3**	R 160, 200
9	**63.5**	R 160, 200
10	**76.1**	R 160, 200, 225, 300
11	**88.9**	R 240

S. No.	PARTICULARS	BHEL SPECIFICATIONS		BIDDER's OFFER [with Complete Technical Details]
5	**TOLERANCES FOR BENDS:**			
5.1	VISUAL DEFECTS	It shall be free from harmful surface visual defects, such as scoring marks, wrinkles, tool marks and depressions.		
5.2	PERCENTAGE OVALITY	% Ovality ={(Max. OD - Min. OD)/ nominal OD} x100	To be Less than 10%	
5.3	PERCENTAGE THINNING	% Thinning = {(t1 - t2)/ t1} x 100 Where, t1 – nominal wall thickness before bending t2 – minimum wall thickness after bending	Maximum allowed Thinning is 10%	
5.4	FLATNESS	Cold bending operation	No flatness allowed	
5.5	TUBE OD AFTER BENDING	Min.Actual OD higher than (0.895Xnominal OD+0.233Xminimum Wall thickness)	Vendor to confirm	
5.6	FLOW AREA	>80% %=Actual flow areaX100/Nominal flow area	Vendor to confirm	
5.7.1	STRAIGHT PORTION	Tolerance on straight portion encompassing bends	± 5 mm	
5.7.2		Tolerance on straight portion for end limbs of multiple bends	± 5 mm	
5.7.3		Acceptance limit for Wrinkles	Wrinkles not permitted	

S. No.	PARTICULARS	BHEL SPECIFICATIONS		BIDDER's OFFER [with Complete Technical Details]
5.8	BENDING ANGLE		± 0.5 °	
5.9	BEND RADIUS	For Radius < 300 mm	± 3 mm	
6	**OPERATING PARAMETERS:**			
6.1	Tube Diameter	Minimum: 31.8 mm Maximum: 88.9mm		
6.2	Tube Wall Thickness	As given in the table (refer Sl.No. 2)		
6.3	Reference Tube Size for establishing the machine capacity	**(Diameter x Thickness)** 76.1 x 12mm; 51x3.6mm (Alloy Steel)		
6.4	Tube Clamping Length required	50mm for tubes upto OD 51mm 1D for tubes above OD 51mm		
6.5	End Limb Length	50mm for tubes upto OD 51mm 1D for tubes above OD 51mm		
6.6	Tube length handled	Minimum : 200mm Maximum: 3500mm		
6.7	Bending Radius	Minimum: 48 mm Maximum: 300 mm		
6.8	R/d ratio	Less than or equal to 1.2		
6.9	Bending Angle to be obtained on Job	0° to 180°		
6.10	Multi Plane Turning Angle	360°		
6.11	Bending Direction	Anti - Clockwise		
6.12	Most frequently used Tube sizes	OD 44.5 x 5 / R 143 / SA106 Gr C		

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
6.13	Use of the machine	Each lot will have maximum of 50 tubes for a particular bend configuration.	
6.14	Production Output required	500 bends / shift in OD 44.5 x 5mm tube, Radius - 143mm for lot sizes as given above.	
6.15	'S' bend configuration (zero distance between bends)	Angles as given in Annexure - 2	
6.16	Maximum Bending Speed	Vendor to specify	
6.17	Minimum Reverse Speed	Vendor to specify	
6.18	Clamp & Pressure Slide Stroke	Vendor to specify	
6.19	Follower Slide Stroke	Vendor to specify	
6.20	Traveling Speed of Carriage	Vendor to specify	
6.21	Mandrels	Mandrels not required	
6.22	Tube Working Height	Maximum - 1200mm from ground level	
6.23	Maximum Bending Torque	Vendor to specify	
6.24	Maximum section modulus that can be bent on the machine	Vendor to specify	
6.25	Maximum Operating Pressure	Vendor to specify	
6.26	Main Pump Motor Power in kW	Vendor to specify	
6.27	Total Power Requirement in kVA	Vendor to specify	
6.28	Hydraulic Tank Capacity	Vendor to specify	

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
7	**CNC AXES SPECIFICATIONS:**		
7.1	**SPEEDS:**		
7.1.1	Y-axis: Tube Feed/Transport Speed	Vendor to specify	
7.1.2	B-axis: Tube Rotation Speed (range)	Vendor to specify	
7.1.3	C-axis: Bending Speed (range)	Vendor to specify	
7.2	**RESOLUTION:**		
7.2.1	Y-axis: Tube Feed/Transport	Vendor to specify	
7.2.2	B-axis: Tube Rotation	Vendor to specify	
7.2.3	C-axis: Bending	Vendor to specify	
7.3	**REPEATABILITY:**		
7.3.1	Y-axis: Tube Feed/Transport	Vendor to specify	
7.3.2	B-axis: Tube Rotation	Vendor to specify	
7.3.3	C-axis: Bending	Vendor to specify	

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
8	**GENERAL DESIGN & CONSTRUCTIONAL FEATURES:**	
8.1	**Foundation:**	
8.1.1	Vendor to provide details of the foundation of the machine, if any. If there is no foundation, the machine shall be placed on anti-vibratory pads.	
8.2	**Controls:**	
8.2.1	The three controls viz, bending angle, rotation angle and distance between bends of 3-Axes – shall be CNC programmable type. Collet axis centering, in line with CLR of bend die shall also be through CNC programme.	
8.2.3	Machine shall be operated in three modes viz., Automatic, semi-Automatic and Manual.	
8.2.4	Boosting facility shall be available to control thinning. The extent of boosting shall be set through CNC program by operator	
8.2.5	CNC System operator panel shall be Self Standing - PC Based Touch Screen type control panel with 10m long cable having protective sheathing and plug-in connectors.	
8.2.6	The bending angle encoder shall be suitably placed for easier accessibility.	
8.2.7	All feedback systems & elements shall have easy accessibility for maintenance	
8.2.8	All control logics used in the machine to be detailed out in the manual.	
8.2.9	Carriage movement sensor shall be of non-contact type. Separate Precision position switch to be provided for referencing the machine.	
8.3	**Carriage Construction:**	
8.3.1	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.	

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
8.3.2	Vendor to give details of the different collet arrangements and their ranges that will be used for various diameters as per our specification.	
8.3.3	Carriage shall be of rigid construction with capability of handling the entire range of tubes mentioned.	
8.4	**Lubrication**	
8.4.1	Centralised Automatic Lubricating System to be provided with metallic tubings,tank with level indicator.	
8.5	**Bend die construction**	
8.5.1	Size of bend die mounting plate shall be designed such that there is no interference while bending multi-plane bend configurations	
8.5.2	Bend die mounting shall be of quick type with only hand tightening.	
8.5.3	Independent Bend dies for the following tube size and radii shall be quoted item-wise separately in the offer 1. Dia 38.1 X R65 2. Dia 44.5 X R143 3. Dia 63.5 X R160 4. S Bend Dia 63.5 X R160	
8.5.4	Split die actuation to be provided in the machine.	
8.5.5	Design of the DIE-BOSS (Bending Table) on which the BENDING FORMER is mounted has to suit the FORMER Mounting Details given in Annexure – 3. (This is required to enable use of bending formers available with BHEL.)	
8.6	**Follower jaw construction**	
8.6.1	Follower jaw shall be provided in two segments and to be mountable independently. One segment with sufficient length for bending upto 120^0 and the smaller segment with sufficient length for bending 60^0	

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
8.6.2	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.	
8.6.3	Follower jaws shall be easily removable and mountable with least effort by the operator.	
8.7	**Clamping and Clamp Jaw construction**	
8.7.1	The bending machine shall have swing arm type of tube bending arrangement. Note: NO overhead clamping type.	
8.7.2	Clamp jaw shall be easily removable and mountable with least effort by hand tightening by the operator preferably with quick clamping mechanism.	
8.7.3	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. There shall NOT be any pads to change over diameters.	
8.7.4	Clamping shall be of standard Straight movement of clamp jaw	
8.7.5	Height adjustment for adjusting the clamp jaw height to be provided	
8.8	**Sliding surfaces**	
8.8.1	Sliding surfaces shall have metal-to-metal contact. NO pads or Hylam strips in between shall be used	
8.9	**Hydraulics**	
8.9.1	All Hydraulic valves to be of modular construction. All hydraulic operating components to be mounted on the manifold in a centralised place in convenient location for easy approach for Maintenance. Preferably outside the frame, behind and on side of the machine.	
8.9.2	Hydraulic power pack and Oil tank shall be separate from the Machine and positioned behind the machine conveniently to attend to any maintenance problems.	

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
8.9.3	Hydraulic hose end fittings shall be of suitable material female swivel nut with 24^0 cone and o-ring	
8.9.4	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. STAUFF/MINIMESS Pressure Gauge - 1 No with Connecting Hose to be provided.	
8.9.5	The hydraulic oil-cooling unit shall be tropicalized. An Oil-Chiller is preferable to maintain oil temp. below 45 deg C. The machine shall be suitable for an ambient temperature of +45 deg C and relative humidity of 85% respectively, but both do not occur simultaneously. Vendor to provide details of Oil chiller such as capacity and type.	
8.9.6	All hydraulic pipelines to be neatly laid out.	
8.10	**CNC SYSTEM FEATURES:**	
8.10.1	To provide latest CNC System - Details to be specified in the offer clearly. (with PC Based Touch Screen Control) NOTE: The offered system shall not become obsolete in the next seven years.	
8.10.2	System Software to be stored in EPROM along with Flash Memory	
8.10.3	Software back up shall be given by the supplier.	
8.10.4	A standard RS 232 C (V 24) interface to connect IBM compatible computer.	
8.10.5	USB Ports for connectivity to be provided	
8.10.6	Remote access through network - internet, for remote diagnosis shall be provided.	
8.10.7	Additional external standard 104key Keyboard and Optical Mouse.	
8.10.8	Pen-drive of 512MB capacity of reputed make shall be provided with the machine for storing programs	

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
8.10.9	The computer shall have CD drive	
8.10.10	Real time bending data to be displayed on the screen with details such as bending angle, distance of carriage movement, rotation angle etc.	
8.10.11	Input shall be through either manual data feed or through an external computer.	
8.10.12	Recognition of collision point of the tube rotation device and counter pressure rail	
8.10.13	Auto-Display of machine positions on the screen during manual operation	
8.10.14	Auto calculation of co-ordinate conversion from Cartesian co-ordinates into bending machine co-ordinates and vice-versa	
8.10.15	Spring back and Stretch automatic calculation facility.	
8.10.16	Spring back and Stretch automatic compensation facility	
8.10.17	Vendor to provide details of how the stretch compensation is done and the intermediate distance between bends is controlled.	
8.10.18	Pre-programming and storage of number of different bending tool-data	
8.10.19	Counter for recording no. of bends produced - data logging of no. of bends per shift	
8.10.20	Automatic diagnostic alarm feature with error display	
8.10.21	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.	
8.10.22	System shall have the facility to display Memory details.	
8.11	**PAINTING:**	
8.11.1	Painting of machine / electrical panel	RAL6011Apple Green (Polyurethane paint)

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
9	**OPTIONAL ACCESSORIES:**	
9.1	Automatic clamping jaw changing device - interchanging between Straight clamp jaw and Curved clamp jaw for making 'S' bends	
9.2	Bending Tool Changing Device	
9.3	AUTOCAD integration - Facility to download AutoCAD drawings of tube bends and convert to operating programs.	
9.4	CAD / CAM interface / Compatibility	
9.5	Any Other Optional Accessories: Additional Optional Accessories which enhance the productivity of the machine to be described by the supplier with the offer	
10	**GENERAL POINTS**	
10 a	Make and Model of the machine to be mentioned. Detailed catalogs of the machine to be sent with the offer	
10 b	List of tooling (Standard Clamp jaws, Bending formers, Follower jaw, 'S' Bend clamp jaw s, Mandrels etc) for the sizes mentioned in specification and any optional tooling should be listed and quoted out item wise separately.	
10.1	**Components used:**	
10.1.1	All motors shall be from reputed makers like SIEMENS, ABB, and Allen Bradley conforming to IEC Standards.	
10.1.2	All hydraulic elements shall be of VICKERS / REXROTH or any other reputed make	
10.1.3	All hydraulic hoses shall be preferably of GATES/Aeroquip/Parker hannifin make	
10.1.4	All electrics shall be of reputed make like Siemens / SEW / ROCKWELL Allen Bradley/ Telemechanique/ Delta.	
10.1.5	All components/devices/terminals are to be incorporated with ferrules.	

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
10.2	**Electrical Points:**	
10.2.1	Control Voltage for all Solenoid Valves shall be 24V	
10.2.2	Control panel shall have built in 230V, 5 amps, 3-pin plug.	
10.2.3	Machine panel shall be adequately illuminated for maintenance purpose.	
10.2.4	Control Panels and Operating Panel shall be air-conditioned	
10.2.5	Type of drives used for motors to be indicated	
10.2.6	The machine shall be suitable for 415V with voltage fluctuation of ± 10%, 50±3% Hz, 3 Phase, 3 wire system	
10.2.7	Electrics shall be tropicalised & shall have IP 54 protection	
10.2.8	All cables should be of copper core	
10.3	**Safety**	
10.3.1	SICK laser mechanism to be provided for safety	
10.3.2	All other safety features provided in the machine shall be specified by the vendor	
10.4	**Ambient Conditions at the Factory location:**	
10.4.1	The machine shall be suitable for an ambient temperature of +45 ° C and relative humidity of 85 % respectively, but both do not occur simultaneously.	
10.4.2	The offered equipment, CNC System and Hydraulic system has to work in a normal fabrication shop environment in ambient conditions.	

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
10.5	**Manuals in English:**	
10.5.1	a) Operation & Maintenance (Operation manual shall include all operations of the machines and its accessories with full details and safety instructions. All the features of the machine and how to operate them shall be explained in detail. All CNC functions shall be elaborated in the manual in a user-friendly manner.) (Maintenance manual shall include all machine construction drawing, Component Drawings, assembly drawings, explanation and details about the sequence of operations of Electrical, Electronic & Hydraulic circuits) Hard copy Original: 3 Nos, CD Media: 1 No	
10.5.2	b) Detailed spare parts specification for the electrical, electronics, mechanical, hydraulics, bearings, seals , (and pneumatic if any) to be furnished for items made by the supplier and for the items bought out and assembled by the supplier. Hard copy Original: 3 Nos.	
10.5.3	c) Electronic and electrical interconnecting drawings (i.e. between machine, control panel and drives) Hard copy Original: 3 Nos.	
10.5.4	d) Machine data / Commissioning data to be provided	
11	**Spares:**	
11.1	Spares for two years of trouble free operation including Hydraulic, Electrical and Electronic components shall be quoted separately with price list item-wise.	
12	**Inspection:**	
12.1	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.	

S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
13	**Acceptance criteria:**	
13.1	All the features of the machines shall be operated and shown as per the given specifications, both at supplier's works during inspection and at BHEL work's during commissioning.	
13.2	The prove-out trials shall be for the tube sizes, bend pattern as given by BHEL during the technical discussions or at the time of releasing the Purchase Order. The tubes supply will be indicated 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. Material for trial will be supplied by BHEL.	
13.3	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. (Sl.No. 6.14)	
13.4	Bending on all thin walled tubes (as per our specification) shall be proved out during commissioning.	
14	**Erection and Commissioning:**	
14.1	The supplier shall depute his engineer(s) for supervising the erection and commissioning of the machine at BHEL and prove-out trials.	
15	**Training:**	
15.1	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.	
15.2	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.	

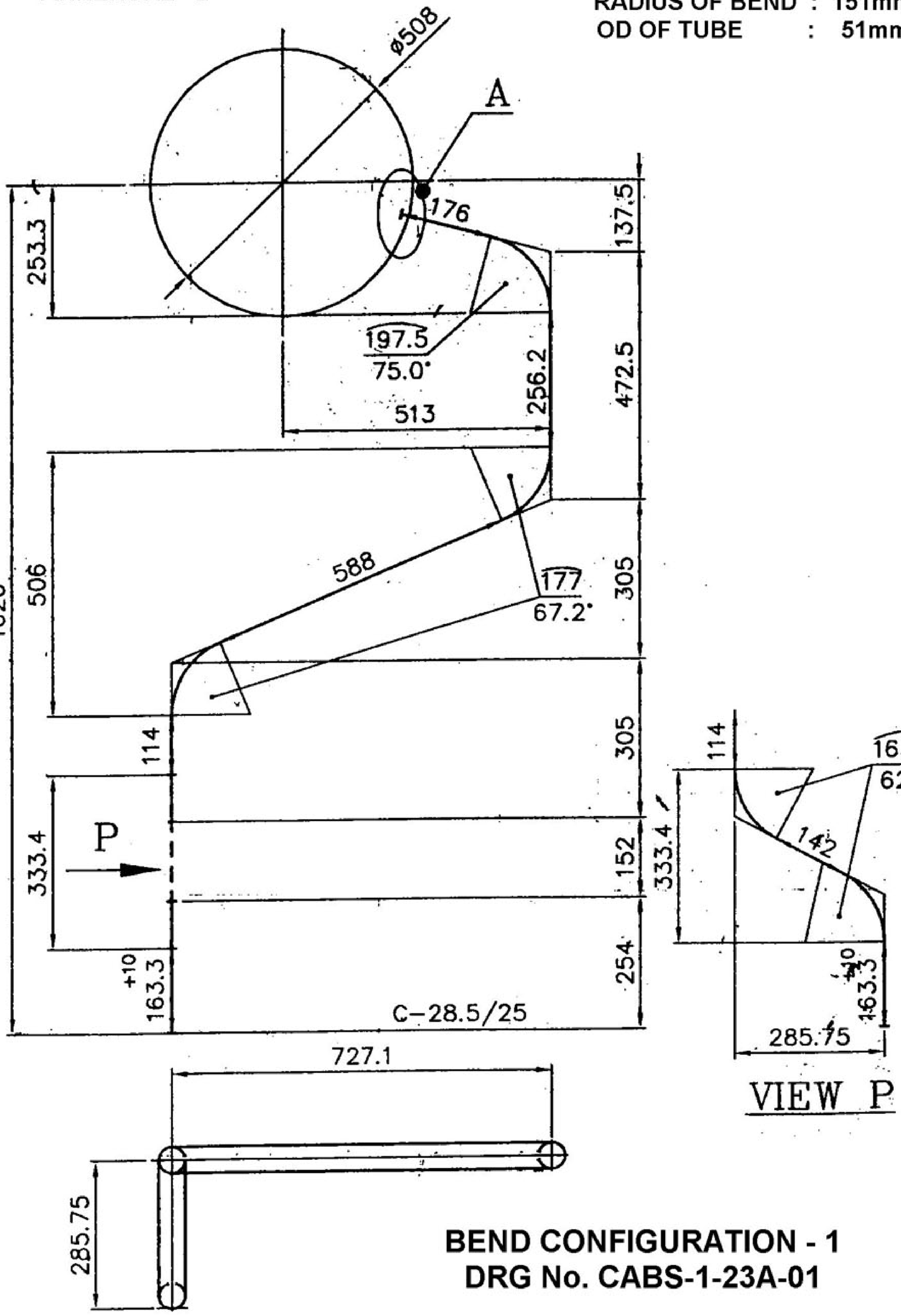
S. No.	PARTICULARS & BHEL SPECIFICATIONS	BIDDER's OFFER [with Complete Technical Details]
15.3	The training shall include specialised coaching in a) Safety b) Operation of the machine c) CNC System Operation, d) Trouble-Shooting, e) Software Application f) All special features of the machine including hydraulics g) Electrical / Mechanical / Electronics systems installed on the machine	
15.4	Co-ordination for a visit of BHEL Personnel to an industry having similar/identical machine & system, in case of order realisation, for system acquaintance & performance feedback	
16	**Guarantee:**	
16.1	Equipment has to be guaranteed for its performance, for a minimum of 24 months from the date of commissioning.	

Enclosures:

a) **Annexure-2 with drawings of 3 different bend configurations.**
b) **Annexure-3 with typical drawings of bends dies.**

ANNEXURE - 2

RADIUS OF BEND : 151mm
OD OF TUBE : 51mm

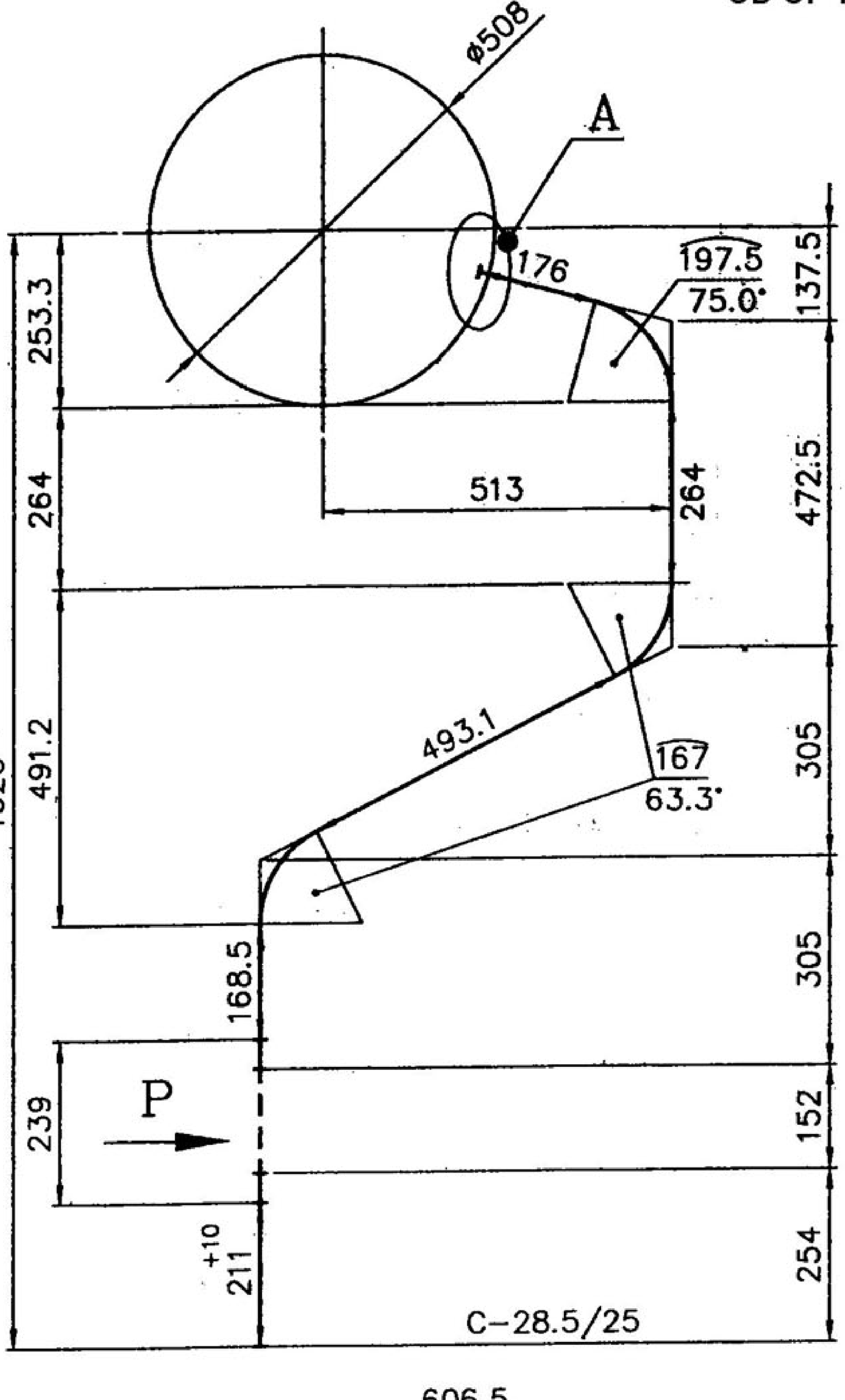


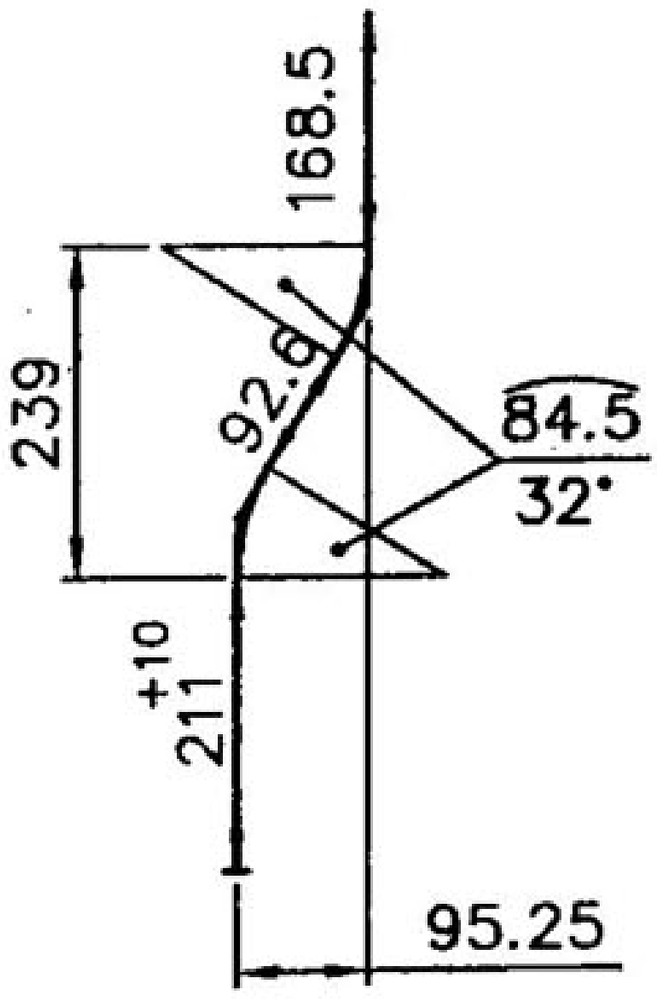
BEND CONFIGURATION - 1
DRG No. CABS-1-23A-01

BHEL, TIRUCHIRAPPALLI

ANNEXURE - 2

RADIUS OF BEND : 151mm
OD OF TUBE : 51mm





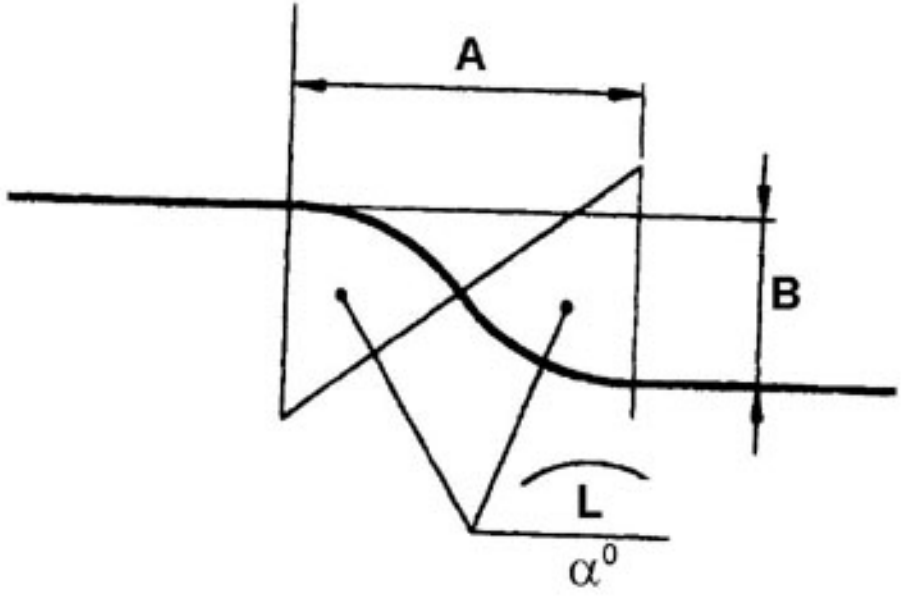
VIEW P

BEND CONFIGURATION - 2
DRG No. CABS-1-23A-02

BHEL, TIRUCHIRAPPALLI

ANNEXURE - 2

'S' BEND CONFIGURATION



VARIANTS

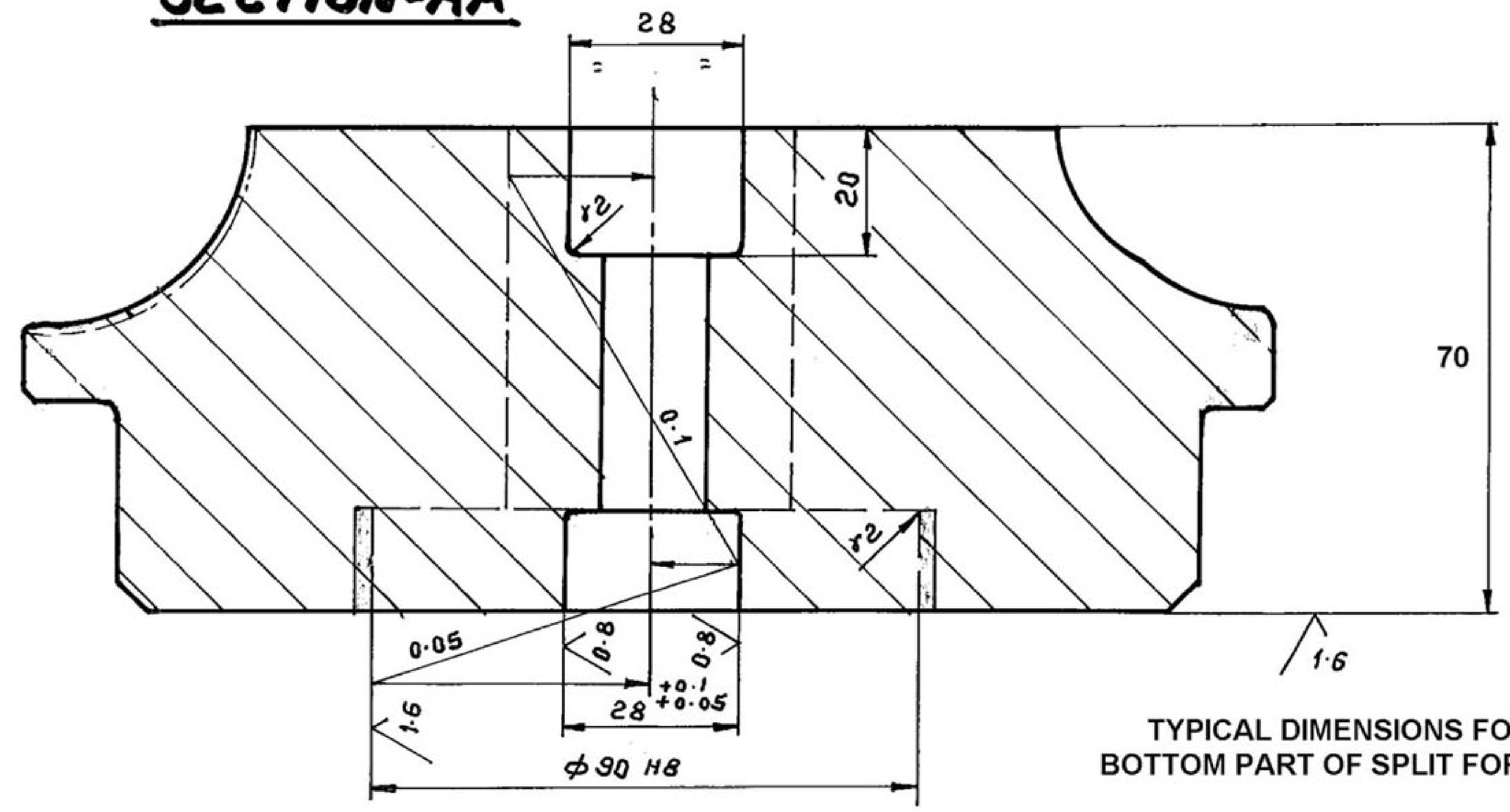
All dimensions are in 'mm'

S.No	Tube OD	Radius of bend	A	B	Arc Length L	Angle α
1	76.1	160	--	233	207	74^0 12′
2	63.5	200	317	156	183	52^0 30′
3	51	151	--	102	128	48^0 30′

DRG NO. CABS-1-23A-03

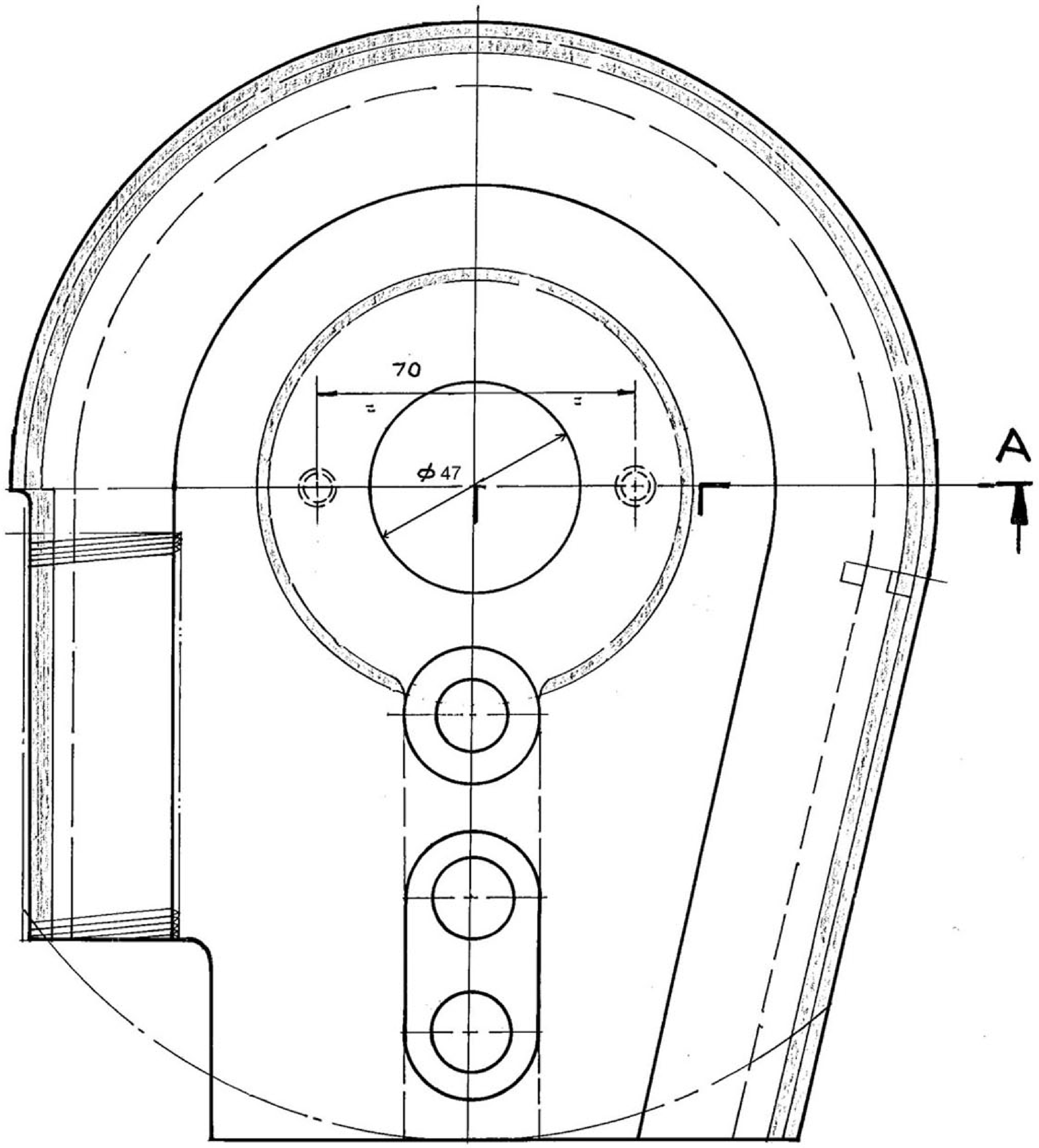
BHEL, TIRUCHIRAPPALLI

ANNEXURE 3



TYPICAL DIMENSIONS FOR
BOTTOM PART OF SPLIT FORMER

DRG NO. CABS-1-23A-04
BHEL, TIRUCHIRAPPALLI

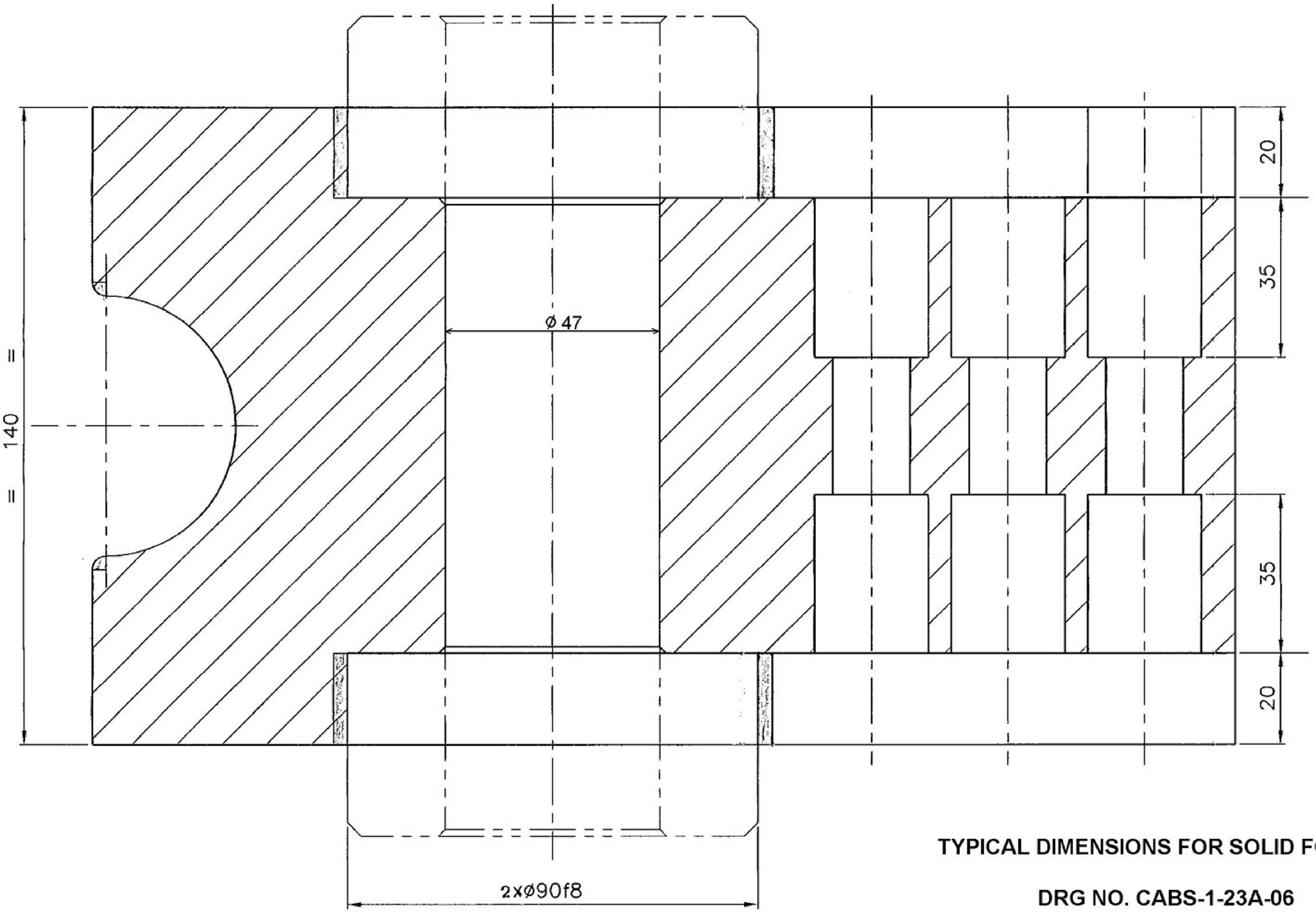


ANNEXURE 3

TYPICAL DIMENSIONS FOR SOLID FORMER

DRG NO. CABS-1-23A-05
BHEL, TIRUCHIRAPPALLI

ANNEXURE 3



TYPICAL DIMENSIONS FOR SOLID FORMER

DRG NO. CABS-1-23A-06
BHEL, TIRUCHIRAPPALLI