An ISO 9001 Company

Bharat Heavy Electricals Limited

(High Pressure Boiler Plant**)**
Tiruchirappalli – 620014, TAMIL NADU, INDIA
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:**
	2620600075	**16.10.2006**	**21.11.2006**
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	System Bender for Tube Coil Formation with 72 meters long built up tubes as per the technical specification & commercial conditions applicable (to be downloaded from web site **www.bhel.com**)	1 No.	31.08.2007

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 "2620600075". 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 Sr. Dy. Genl. Manager / Capital Purchase / MM / Manufacturing

CNC SYSTEM BENDER FOR TUBE COIL FORMATION

PART A

SECTION-I:

QUALIFYING CRITERIA FOR THE SUPPLY OF CNC SYSTEM BENDER FOR TUBE COIL FORMATION

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

SECTION – II

The vendors are requested to provide the following details

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

SECTION – III

The vendor has to comply with the following :

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

PART B

TECHNICAL SPECIFICATION FOR CNC SYSTEM BENDER FOR TUBE COIL FORMATION

S. No.	PARTICULARS	BHEL SPECIFICATIONS	BIDDER's OFFER [With Complete Technical Details]
1.0	**PURPOSE & JOB DETAILS:**		
1.1	**Purpose:**		
1.1.1	The machine is meant for the cold and hot bending (if required) of seamless steel tubes to form serpentine coils for economizer, re-heater, and super-heater of large Power and Industrial Boilers	A few indicative drawings are enclosed	
1.2	**Job Details:**		
1.2.1	Range of diameter, thickness of tube and radii of bends	**Annexure I**	
1.2.2	Tube Outside Diameter (OD):	31.8 mm to 63.5 mm	
1.2.3	Wall thickness:	2.9 mm to 12 mm	
1.2.4	Tube length:	3000 mm to 72000 mm.	
1.2.5	Required Minimum R/D Ratio	1.1	
1.2.6	Bending radii	38 mm to 320 mm	
1.2.7	Bending Direction	Right bending	
1.2.8	The bends will be serpentine, forming coils having more than one radius	Vendor to confirm	
1.2.9	Most coils (for economizers of boilers) will have terminal straight tube portion at 90 deg to the coil in the same plane as the plane of bend		
1.2.10	Max length of coil	21.5 meters	

1.2.11	Max width (height) of coils	3.35 meters	
1.2.12	Max Weight of finished coil	1500 kg	
1.3	**Tube Material:**	a. Carbon Steel: SA192, SA210A1, SA210C b. Alloy Steel: SA209T1, SA213T11, SA213T22, SA213T91, T-23, T-93 c. Stainless Steel SA 213 TP304H, SA 213 TP321H, SA 213 TP347H	
1.4	**TOLERANCES FOR BENDS**		
1.4.1	**Visual Defects:** It shall be free from harmful surface visual defects, such as scoring marks, wrinkles, tool marks and depressions.	Vendor to Confirm	
1.4.2	**Percentage Ovality:** % Ovality ={(Max. OD - Min. OD)/ Nominal OD} x100	To be Less than 10%	
1.4.3	**Percentage Thinning:** % Thinning = $\{(t_{nom} - t_{min})/ t_{nom}\}$ X100 Where, t_{nom} – is the nominal thickness before bending t_{min} – min wall thickness after bending	Maximum allowed Thinning is 10%	
1.4.4	Bending angle	± 0.5 °	
1.4.5	Bend Radius:		
1.4.6	a) For Radius < 250 mm	± 3 mm	
	b) For Radius 300 to 600 mm	± 6 mm	
2.0	**MACHINE SPECIFICATION:**		
2.1	**CONFIGURATION:**		

2.1.1	The bending system shall be Draw-Bending type by Electro-Hydraulic means and with CNC mode of operation.	Vendor to confirm	
2.1.2	The machine will have TWO main benders with induction heating facility (if required) and ONE (optional, to be quoted) terminal bender	Vendor to confirm	
2.1.3	Booster Bending System should also be provided	Vendor to confirm	
2.1.4	The machine shall also be provided with the following: a) Loading Stand and Kick-off arrangement b) Tube In-feed Roller Conveyor c) Pinch roll drive units for tube feeding d) Machine Platform for coil formation with transport arrangement for finished coil e) Radial supports for coil f) Flipping Arms for formed coils g) Discharge Table for finished coil h) Coil unloading arrangement		
2.1.5	Number of axes and description	Vendor to Specify	
2.2	**OPERATING PARAMETERS:**		
2.2.1	Tube Outside Diameter (OD) Range:	**Annexure I**	
2.2.2	Tube Wall Thickness Range	**Annexure I**	
2.2.3	Straight Tube length	Minimum: 3000mm Maximum: 72000mm	
2.2.4	Bending Radius	Minimum: 38 mm Maximum: 320mm	

2.2.5	Bending Capacity (with tube of 347H Stainless Steel Material)	63.5mm x 12.5mm x 320mm (OD x T x R) 63.5mm x 12.5T x 100mm (OD x T x R)	
2.2.6	Max D/t at R/D of 1.1	Vendor to Specify	
2.2.7	Max D/t at R/D of 5	Vendor to Specify	
2.2.8	Bending Angle in Job	0° to 190°	
2.2.9	Bending Direction	Clockwise	
2.2.10	Tube Working Height	Vendor to Specify	
2.2.11	Max length of coil	21.5 m	
2.2.12	Max Width (height) of coil	3350 mm	
2.2.13	Minimum End Limb Length	150mm	
2.2.14	Programmable Bending steps	Max 20 Steps	
2.2.15	Max Number of Bending Programs that can be stored and recalled	Vendor to Specify	
2.2.16	Min. speed of bending	Vendor to specify	
2.2.17	Max. Speed of bending	Vendor to specify	
2.2.18	Return Speed	Vendor to specify	
2.2.19	Maximum Bending Torque	Vendor to specify	
2.2.20	Clamp & Pressure Slide Stroke	Vendor to specify	
2.2.21	Follower Slide Stroke	Vendor to specify	
2.3	**LOADING STAND:**		
2.3.1	Stand for loading 30 tubes of length 72 meters to feed the kick off stand for ensuring continuous bending operation on the machine	Vendor to Specify	
2.3.2	The stand should have provision for keeping the tubes as bundles and as loose tubes for stock and instant feeding.	Vendor to Confirm	
2.3.3	The tube loading stands should be lined with non-metallic lining like nylon / Teflon or equivalent to absorb the hammering noise of tubes.	Vendor to Specify	

2.3.4	The structure should be rigid enough to withstand impact loading of tubes	Vendor to confirm	
2.3.5	The flat portion in the loading stand should be approx 1.5 meter wide and the sloping portion approx 2 m wide	Vendor to Specify	
2.4	**KICK-OFF STAND:**		
2.4.1	This stand is meant for picking and placing the above tubes for bends one by one on to the tune in-feed roller stand as per the requirement of the machine. (The type and arrangement of the system to be explained in detail in the offer)	Vendor to Specify	
2.4.2	Operation	Pneumatic	
2.4.3	Span between the kick-off arms (approx 2000mm).	Vendor to Specify	
2.5	**TUBE INFEED ROLLER CONVEYOR:**		
2.5.1	The kick off arrangement places the tube onto the Tube In-feed roller stand from which the pinch rollers feed the tube to the tube stopper (Complete description of the infeed conveyor should be furnished with the offer)	Vendor to confirm	
2.5.2	Length of the tube in-feed conveyor	Vendor to Specify	
2.6	**PINCH ROLLER & TUBE FEEDING UNIT:**		
2.6.1	Number of Pinch Roller Drive Units along the length of the tube to feed the tube to the carriage without slack and without over loading the pinch roller unit.	3	

	(Complete description including drive details should be submitted with the offer)		
2.6.2	Number of pinch rollers per unit per location	4	
2.6.3	Clamping of tube by the pinch rollers	Hydraulic	
2.6.4	Drive for the Pinch Rollers (Motor Type, Make and rating should be furnished with the offer)	Electric	
2.6.5	Variable Feed Speed (m / min)	Vendor to Specify	
2.6.6	Creep Speed (mm / min)	Vendor to Specify	
2.6.7	The hydraulic power required has to be met separately from a power pack unit of the required capacity. (Complete details of the power pack should be submitted with the offer)	Vendor to Confirm	
2.7	**TUBE STOPPER:**		
2.7.1	The tube stop assembly is to enable the tube fed by pinch rollers to stop at a reference position.		
2.7.2	Accuracy of positioning	± 0.2 mm	
2.7.3	Position feedback	Electronic	
2.7.4	Tube stopper should be of robust design	Vendor to Confirm	
2.8	**CARRIAGE DRIVE UNIT FOR TUBE FEEDING:**		
2.8.1	The tube carriage should serve to take the tube to the bender by a measured accurate length and positioning at the bender die for bending operation.	Vendor to Confirm	
2.8.2	Carriage to be provided with a Hydraulic Collet Type Tube Gripping Device for feeding Tubes into the machine	Vendor to Confirm	
2.8.3	The collet should be capable of allowing	Vendor to Confirm	

	weld reinforcement of max 8mm to 10mm on the tube diameter at the tube-to-tube joints		
2.8.4	It is possible that the collet may close over the weld bead. However it should be ensured that effective clamping force is available by suitable means. Provision on the machine to achieve this should be clearly explained in the offer	Vendor to Specify	
2.8.5	Vendor to give details of the different collet ranges that will be used to for various diameters specified	Vendor to Specify	
2.8.6	Carriage Drive (Complete details of the make, rating etc of the drive should be provided along with the offer)	AC Servo Motor	
2.8.7	Drive arrangement (Details of rack pitch, rack length and rack width should be furnished with the offer)	Rack and pinion with Braking arrangement	
2.8.8	Method of Backlash elimination in carriage drive	Vendor to Specify	
2.8.9	Traveling Speed of Carriage	Vendor to specify	
2.8.10	Final positioning speed	Vendor to specify	
2.8.11	Accuracy of tube positioning	± 0.2mm	
2.8.12	Carriage Bed length	Vendor to Specify	
2.8.13	Max Carriage Feed Stroke (approx 15m)	Vendor to Specify	
2.8.14	Tube Rotation (Twisting)	360°	
2.8.15	Tube Rotation drive (Complete Drive Details including make and rating of drive should be furnished with the offer)	AC Servo Motor	
2.8.16	Rotation speed	Vendor to Specify	
2.8.17	Rotation Torque	Vendor to specify	

2.8.18	Carriage shall be of rigid construction with capability of handling the entire range of Tubes mentioned and with anti-slip gripping of Tubes during bending operations.	Vendor to confirm	
2.8.19	Suitable measuring system for measuring the actual length of the tube prior to bending shall be offered as an option. The length should be displayed. (Complete details of the system shall be furnished with the offer)	Vendor to Specify	
2.8.20	Carriage drive motor power rating	Vendor to specify	
2.8.21	Tube rotation drive motor rating	Vendor to specify	
2.8.22	Support rollers to prevent sagging of tube between collet and bender, and prevent loading of tube carriage and collet during hitch feed (Vendor to give complete description)	Vendor to Specify	
2.9	**TUBE BENDERS:**		
2.9.1	Bender operation	Hydraulic	
2.9.2	Number of Benders	Two (2)	
2.9.3	Bending Torque	Vendor to Specify	
2.9.4	While one bender is in operation, the other bender is positioned out of the way to prevent it from interfering with the bending operation (Arrangement should be clearly detailed in the offer)	Vendor to Confirm	
2.9.5	Movement of the benders in the vertical and / or horizontal direction shall be through suitable drive arrangement and properly guided without any slackness in robust guide	Vendor to specify	

	ways (Complete details should be furnished with the offer)		
2.9.6	The selection of bender should be automatically from the program	Vendor to Confirm	
2.9.7	Bending dies	1 stage bending die at each bender	
2.9.8	Type of Bending Die	Split Die	
2.9.9	The upper and lower die should be hydraulically clamped together during bending. (Detailed description should be furnished with the offer)	Vendor to Confirm	
2.9.10	The tube clamping arrangement (Vendor to furnish complete description of the clamping arrangement in the offer)	Vendor to Specify	
2.9.11	Tube Clamping Length	Max 100mm	
2.9.12	Upper and lower die shall be easily removable and mountable with least effort by the operator.	Vendor to Confirm	
2.9.13	Independent upper and lower die for each diameter shall be quoted, for all diameters as given in the specification. There shall NOT be any pads to change over diameters.	Vendor to Confirm	
2.9.14	Height adjustment for adjusting the height in clamping die to be provided	Vendor to Confirm	
2.9.15	Programmable spring back compensation should be provided.	Vendor to Confirm	
2.9.16	Suitable software for calculation of spring back compensation has to be supplied as an option. (Complete details of the software and its application should be furnished with the offer)	Vendor to Confirm	
2.9.17	The bending angle encoder shall be suitably	Vendor to Confirm	

	placed for easy accessibility for maintenance		
2.10	**PRESSURE DIE:**		
2.10.1	The pressure die shall be suitable for diameters and radius range specified	Vendor to confirm	
2.10.2	Length of pressure die	Vendor to Specify	
2.10.3	Pressure Die Hydraulic Pressure	Vendor to Specify	
2.10.4	Pressure Die force	Vendor to Specify	
2.10.5	Individual pressure dies shall be offered for each tube diameter. There shall NOT be any pads to change over diameters.	Vendor to Confirm	
2.11	**BOOSTER UNIT:** (Complete description of boosting arrangement should be furnished with the offer)		
2.11.1	Booster arrangement shall be provided to reduce tube thinning during bending, especially in case of bends with R < 1.5 D	Vendor to confirm	
2.11.2	Booster force	Vendor to specify	
2.11.3	It should be possible to set the required boosting power in the CNC control (Complete description shall be furnished with the offer)	Vendor to Confirm	
2.12	**INDUCTION HEATING UNIT:** **(If vendor is confident of achieving the bend quality requirements without the use of Induction Heating unit, sufficient proof by way of results from already supplied Machines of this capacity should be furnished to establish that bends of**		

	required quality could be achieved.		
2.12.1	The induction heating system is used to heat a band of tube to increase the ductility of the metal when a bend is to be made on a tight centerline radius (Complete details of the induction heating system shall be furnished with the offer)		
2.12.2	The induction heating system shall consist of a thyristor based inverter unit, control unit, HF Transformer, cables and inductor arrangement	Vendor to Confirm	
2.12.3	The inductor unit shall be suitable for strip (band) heating of the entire range of tube diameters and radii	Vendor to Confirm	
2.12.4	Tube Heating Temperature Range (continuously adjustable)	Up to 850 °C	
2.12.5	Temperature Indicator to indicate set and actual temperature should be provided	Vendor to Confirm	
2.12.6	Heating Time to reach set temperature (in seconds)	Vendor to specify	
2.12.7	Temperature shall be settable preferably through the main CNC control or (Complete details should be furnished with the offer)	Vendor to Specify	
2.12.8	Tube heating unit raising / lowering arrangement	Vendor to Specify	
2.12.9	Display of Power, Frequency and Current of induction heating unit	Vendor to specify	
2.12.10	Fume extraction and filter system should be provided to exhaust the fumes from the vicinity of the heating zone and let it out into the atmosphere after filtering	Vendor to Specify	

	(Complete description should be furnished with the offer)		
2.12.11	Cooling of inductor shall be through a closed-circuit chilled water cooling system with suitable capacity refrigerated water chilling unit (Complete description of chilling unit should be submitted with the offer)	Vendor to confirm	
2.13	**TERMINAL TUBE BENDER:** **(To be quoted as an optional item)**		
2.13.1	This is required for making the terminal bend in an economizer coil (Complete description should be furnished in the offer)	Vendor to specify	
2.13.2	Min / Max length of terminal tube	150mm / 1000 mm	
2.13.3	Angle of Bend	Max 90 deg	
2.14	**RADIAL GRIPPER:**		
2.14.1	The scissor type radial gripper with rollers is used to maintain tube in position when the carriage collet is open The radial griper is closed to hold the tube (a) when the carriage makes a hitch move to a new feed position with the collet open, (b) when the tube flipping is accomplished between bends or (c) when the induction heater heats the tube for a hot bend.	Vendor to Specify	
2.14.2	The radial gripper is to be located beyond the bender. It should remain below the tube level when not in operation and come up by scissor	Vendor to confirm	

	action to grip the tube		
2.14.3	Operation should be automatic through program control	Vendor to confirm	
2.14.4	Operation	Hydraulic	
2.14.5	Alternate arrangement for the above can also be offered	Vendor to Specify	
2.15	**MACHINE PLATFORM WITH ROLLER ARRANGEMENT:**		
2.15.1	During and after bending the coil has to be supported on a platform provided with rollers (Complete description of the machine platform and roller arrangement has to be submitted with the offer)	Vendor to Confirm	
2.15.2	Roller Span	Approx 1 m	
2.15.3	Length of each roller	Vendor to Specify	
2.15.4	Number of rollers	Vendor to Specify	
2.15.5	The rollers are to be driven to transport the finished coil to the discharge table. (Vendor to provide complete description of the drive arrangement in the offer)	Vendor to confirm	
2.15.6	Electrically operated clutch arrangement may be provided to engage the rollers during transportation of finished coil to discharge table	Vendor to Specify	
2.15.7	Width of platform (Sufficient enough to support the coil without sag)	Vendor to Specify	
2.15.8	The platform top shall be provided with mild steel plate of suitable thickness	Vendor to Specify	

2.15.9	Suitable arrangement should be provided on the platform to facilitate smooth travel of the coil on the platform during bending with minimum friction	Vendor to Specify	
2.15.10	Since, during bending, the coil will travel in an arc with max 21.5 m radius, it has to be supported on suitable supports placed in semicircles radially beyond the machine platform. The span between the supports should not exceed 2 meters. Suitable arrangement is to be provided for a smooth travel of the coil on these supports during bending with minimum friction (Complete description should be furnished in the offer)	Vendor to specify	
2.15.11	Suitable mechanical stoppers should be provided to ensure that the bends of the coil do not foul with the carriage during bending	Vendor to specify	
2.16	**FLIPPING UNIT FOR COILS:-**		
2.16.1	The flipping unit is required to flip the coil after each bend so that right and left bends can be carried out. (Complete description of the flipping unit should be furnished with the offer)	Vendor to Specify	
2.16.2	Number of pairs of flipping arms to handle coils of specified length and width (height)	Vendor to Specify	
2.16.3	Each pair of flipping arms should be so designed that the tube does not get pinched when the arms close over the coil for flipping	Vendor to confirm	

2.16.4	Provision has to be made in each pair of flipping arm to ensure that individual bends of the coil are held in position without collapsing during the flipping operation (Complete description of the arrangement should be furnished in the offer)	Vendor to specify	
2.16.5	Length of each arm	Vendor to Specify	
2.16.6	Operation of the flipping unit	Hydraulic	
2.16.7	Speed of flipping	Vendor to Specify	
2.16.8	Flipping operation should be quick and smooth without jerks	Vendor to confirm	
2.17	**DISCHARGE TABLE:**		
2.17.1	A discharge table with roller arrangement has to be provided to move the finished coil out of the machine area	Vendor to confirm	
2.17.2	Length of Discharge Table	Vendor to Specify	
2.17.3	Number of rollers	Vendor to Specify	
2.17.4	Spacing between the rollers	Vendor to Specify	
2.17.5	Conveyor Speed	Vendor to Specify	
2.17.6	Drive description	Vendor to Specify	
2.18	**COIL UNLOADING SYSTEM:**		
2.18.1	Suitable system should be provided for unloading the finished coil from the discharge table. (Vendor should provided detailed description of the system in their offer)	Vendor to Specify	
2.19	**OPERATOR'S PLATFORM:**		
2.19.1	If required, an independent operator's platform should be provided so that the	Vendor to specify	

	machine operation can be observed and controlled. The platform should have sufficient space for movement without any obstruction for convenient and safe operation. A 15 Amp. Plug Point with ON/ OFF switch is also to be provided on the Platform.		
2.20	**OPERATION AND CONTROL SYSTEM:**		
2.20.1	**OPERATOR'S PANEL:**		
2.20.1.1	Operator's panel having complete CNC / PC based controller and machine control system with display of required configuration shall be provided for convenient and efficient operation. All switches should be within reach of operator. All displays/indications should also be conveniently placed (Layout showing complete details should be submitted with the offer)	Vendor to Confirm	
2.20.2	**CNC SYSTEM & FEATURES:**		
2.20.2.1	Make: Fanuc / Siemens / Other dedicated CNC system / Industrial PC Based System.	Vendor to specify	
2.20.2.2	Type: PC based latest version	Vendor to specify	
2.20.2.3	Model (Suitable and Latest version, as available at the time of ordering, should be supplied).	Vendor to specify	
2.20.2.4	The system should have full alphanumeric keyboard, TFT colour display (10.4" or more), additional draw-out type Qwerty Key Board and optical mouse, in suitable dust-proof enclosure, RS232C serial interfaces, parallel interface for printer, COM port for	Vendor to Confirm	

	on-line tele diagnostics, USB Port, electronic hand wheels for all axes (MPG), compact disc R/W drive unit for data input/output, hard disk of sufficient capacity **(Largest size available at the time of order shall be supplied)**, graphic simulation and preinstalled system software & other required soft wares etc (Details should be furnished by the Vendor in the offer)		
2.20.2.5	Details of Standard features	Vendor to specify	
2.20.2.6	Details of optional features, recommended by vendor.	Vendor to specify	
2.20.2.7	Details of other features	Vendor to Confirm	
a)	Number of axes and axes description	Vendor to specify	
b)	XYZ and YBC Programming	Vendor to Confirm	
c)	Operating Modes: Automatic, Semi-automatic, and Manual (Brief description of operation in these modes should be furnished with the offer)	Vendor to Confirm	
d)	Auto calculation of co-ordinate conversion from Cartesian co-ordinates into bending machine co-ordinates and vice-versa	Vendor to Confirm	
e)	Pre-programming and storage of number of different bending tool-data.	Vendor to Confirm	
f)	Storing and retrieval of all machine operating parameters including spring back applied, stretch compensation applied, bending speed, boosting parameters, tooling data etc with Program search facility sorted on various criteria of bending.	Vendor to Confirm	
g)	No. of bends produced counter - data logging of no. of bends per shift produced.	Vendor to Confirm	

h)	Spring back and Stretch automatic calculation facility.	Vendor to Confirm	
i)	Spring back and Stretch compensation facility (Vendor to provide details of how the stretch compensation is done and the intermediate distance between bends is controlled)	Vendor to Confirm	
i)	Automatic diagnostic alarm feature with error display.	Vendor to Confirm	
2.20.3	**MANUAL CONTROL:**		
2.20.3.1	Complete manual control of machine with required switches / keys should be provided on operator's panel for selection of required axis, axis direction, feed on/off, display of axis position values etc, for manual operation without using CNC program, Diagram / Sketches for switches / keys provided on operators pendant should be submitted.	Vendor to specify	
2.20.4	**HAND HELD UNIT:**		
2.20.4.1	Hand Held unit, Type B-MPI of Siemens make or equivalent along with sufficient length of interfacing cable for job setting and similar other purposes, is to be offered with complete details.	Vendor to specify	
2.20.5	**UPS FOR CNC SYSTEM:**		
2.20.5.1	UPS of 30 minutes for CNC system with inbuilt cooling and charge status display Battery charging /discharging time should be specified by Vendor.	Vendor to Specify	

2.20.6	**PLC PROGRAMMING TOOL:**		
2.20.6.1	If PLC is used, a PLC Programming Tool with complete software should be supplied for on-line trouble shooting, software modification, upload and download of programs	Vendor to Confirm	
2.21	**MACHINE LIGHTS:**		
2.21.1	Machine Lights for sufficient illumination of complete working area should be provided for clear visibility. (Details should be furnished in the offer)	Vendor to Confirm	
2.21.2	A spot light with sufficiently long cable should also be provided.	Vendor to Confirm	
2.21.3	All light fittings, consumables, adapters/receptacles should have compatibility with Indian equivalents	Vendor to Confirm	
2.21.4	Flashing / rotary type signal lamp to indicate that machine is in operation	Vendor to confirm	
2.22	**AIR CONDITIONERS:**		
2.22.1	Air Conditioners with Dehumidifiers of suitable / sufficient capacity to be provided for all Electrical / Electronic Panels / Cabinets including Operator's Panel considering specified ambient conditions. Detailed specifications of the same are to be submitted.	Vendor to submit	
2.23	**HYDRAULICS**		
2.23.1	Hydraulic system should be centralized and separate from the machine. Hydraulic Tank	Vendor to Confirm	

	shall preferably be located at floor level All hydraulic pipelines to be neatly laid out (Details should be furnished in the offer)		
2.23.2	Make Bosch Rexroth / Vickers Sperry / Denison / Parker Hannfin (Details to be submitted)	Vendor to specify	
2.23.3	Hydraulic hose end fittings shall be of suitable material with female swivel nut and 24^0 cones. Hoses shall preferably be of GATES make	Vendor to specify	
2.23.4	Hydraulic circuits shall be designed with minimum number of control valves and to suit oil of ISO VG 46 or 68 only. Also minimum number of check-points to be provided wherever pressure is required to be read for setting and trouble shooting. MINIMESS Pressure Gauge - 1 No with Connecting Hose to be provided.	Vendor to confirm	
2.23.5	The control voltage for all solenoid operated valves. Solenoids shall be provided with indication lamp / LED	24 V DC	
2.23.6	Filtration System, Details should be submitted.	Vendor to specify	
2.23.7	Hydraulic Failure indication	Vendor to specify	
2.23.8	Automatic shut off provision, Details should be submitted.	Vendor to specify	
2.23.9	Refrigerated type cooling system of sufficient capacity to maintain Hydraulic oil at a temperature not exceeding 40 deg C irrespective of the ambient conditions. Complete details should be submitted with the offer	Vendor to specify	
2.23.10	Hydraulic pump capacity (flow / pressure)	Vendor to specify	

2.23.11	Pump Motor Power in kW	Vendor to specify	
2.23.12	Hydraulic Tank Capacity	Vendor to specify	
2.23.13	Each pump should have an independent motor. Tandem pumps should not be used	Vendor to Confirm	
2.23.14	**First filling of all required Oils & Grease etc**. should be supplied by vendor. Indigenous (Indian) source or Indian equivalent and specifications of oils/ greases are also to be provided by the vendor.	Vendor to specify	
2.23.15	All hydraulic pump for the power pack should be loaded only during requirement and should run unloaded during idle running.	Vendor to Confirm	
2.23.16	Hyd oil level indicator and temperature indicator shall be provided in the Hydraulic power pack	Vendor to confirm	
2.24	**ELECTRICAL:**		
2.24.1	415V + 10% / -10%), 50HZ +/-3 Hz, 3 Phase AC (3 wire system without neutral) power supply will be provided by BHEL at a single point near the machine, as per layout recommended by Vendor. All cables, connections, circuit breakers etc. required for connecting BHEL's power supply point to different parts of the machine/control cabinets, shall be the responsibility of vendor. Requirement of grounding/earthing with required material details should be informed by vendor well in advance so that it could be incorporated during construction of foundation.	Vendor to confirm	
2.24.2	Tropicalization**:** All electrical / electronic equipment shall be tropicalized.	Vendor to confirm	

2.24.3	All electrical & electronic control cabinets & panels should be dust and vermin proof	Vendor to confirm	
2.24.4	All electrical components in the cabinets should be mounted on DIN Rail	Vendor to confirm	
2.24.5	All electrical and electronic panels including operator's panel should be provided with fluorescent lamps for sufficient illumination and power receptacles of 220Volts, 5/15 Amp AC. All adapters /receptacles should have compatibility with Indian equivalents.	Vendor to confirm	
2.24.6	Motors & other electrical components shall conform to IEC or Indian Standards	Vendor to confirm	
2.24.7	All cables moving with traversing axes should be installed in caterpillar / Drag chain. Additionally, all the cable trays required for laying of cables should be included in the offer.	Vendor to confirm	
2.24.8	Vendor should ensure the proper earthing for the machine and its peripherals.	Vendor to confirm	
2.24.9	In-cycle hour counter with reset facility should be provided.	Vendor to confirm	
2.24.10	All Electric enclosures shall have IP 54 protection	Vendor to confirm	
2.24.11	Motors and drives shall be of Fanuc / Siemens / Allen Bradley / ABB / Indramat / SEW or such reputed makes only conforming to IS / IEC Standards (Vendor should indicate make and type in the offer)	Vendor to confirm	
2.25	**SAFETY ARRANGEMENTS:**		
2.25.1	Following safety features in addition to other standard safety features should be provided		

	on the machine:		
2.25.2	Machine should have adequate and reliable safety interlocks / devices to avoid damage to the machine, work piece and the operator due to the malfunctioning or mistakes. Machine functions should be continuously monitored and alarm / warning indications through lights/ alarm number with messages (on CNC display and panels) should be available.	Vendor to specify	
2.25.3	A detailed list of all alarms / indications provided on machine should be submitted by the Vendor.	Vendor to specify	
2.25.4	All the pipes, cables etc. on the machine should be well supported and protected. These should not create any hindrance to machine operator's movement for effective use of machine.	Vendor to Confirm	
2.25.5	All the rotating parts used on machine should be statically & dynamically balanced to avoid undue vibrations and suitably guarded.	Vendor to Confirm	
2.25.6	Emergency Switches at suitable locations as per International Norms should be provided.	Vendor to Confirm	
2.25.7	All lubricated parts like Bed, guide ways shall have provision for collecting the used Lubrication oil from machine guide ways and preventing them from spilling over on to the ground.	Vendor to Confirm	
2.25.8	Cable and hoses of the traveling axes should be well supported on suitable cable drag chains / cable carriers	Vendor to Confirm	
2.25.9	Excess pressure safety relief valve in hydraulic circuit	Vendor to Confirm	

2.25.10	Oil high temperature and oil low level alarm and safety interlock	Vendor to Confirm	
2.26	**ENVIRONMENTAL PERFORMANCE OF THE MACHINE:** The Machine should confirm to following factors related to environment:		
2.26.1	Maximum noise level shall be 85 dB(A) at normal load condition, 1meter away from the machine with correction factor for back ground noise. This will be measured as per international standards like DIN 45635-16. Supplier to demonstrate compliance to noise level, if asked for.	Vendor to Confirm	
2.26.2	If any safety / environmental protection enclosure is required it should be built in the machine by the vendor.	Vendor to confirm	
3.0	**SERVO VOLATGE STABILIZER:**		
3.1	Indian make Oil / **Air** Cooled servo Controlled Voltage Stabilizer suitable for complete machine, its drives, controls, PLC etc with no undesirable Harmonics in the stabilizer output.	Vendor to confirm	
3.2	Make.	NEEL / DELTA / AEI / POWER AID	
3.3	Model & Rating (Suitable for the machine load. Vendor to specify the noise level also)	Vendor to Specify	
3.4	Spares Package for the Voltage Stabilizer for 2 years working should also be offered.	Vendor to submit	
3.5	Catalogue of the Voltage Stabilizer shall be submitted with the offer.	Vendor to submit	
4.0	**ULTRA ISOLATION TRANSFORMER**		

4.1	Indian make Ultra Isolation Transformer suitable for complete machine, its drives, controls, PLC etc. shall be supplied	Vendor to confirm	
4.2	Make	NEEL / DELTA / AEI / POWER AID	
4.3	Model and Rating	Vendor to specify and noise level also	
4.4	Spares Package for the Ultra Isolation Transformer for 2 years working should also be offered.	Vendor to submit	
4.5	Catalogue of the Ultra Isolation Transformer shall be submitted with the offer.	Vendor to submit	
5.0	**PNEUMATIC SYSTEM:**		
5.1	The pneumatic operated elements of the machine shall work efficiently with BHEL compressed air supply at a pressure of **3 to 4 Kg / cm^2**	Vendor to confirm	
5.2	BHEL will provide compressed air at only one point near / on the machine. Vendor shall provide suitable filter-regulator-lubrication (FRL) unit at this point	Vendor to confirm	
5.3	If air pressure required for the machine is more than that specified in clause 5.1, the supplier should supply an air pressure booster or air compressor of suitable capacity. Complete details of the booster / air compressor should be furnished with the offer	Vendor to Specify	
5.4	Volume (flow) of compressed air required for the machine	Vendor to Specify	
6.0	**TOOLING:**		
	List of tooling (Clamp jaws, Bending formers, Follower jaw, etc) for the tube sizes	Vendor to Specify	

	and radii mentioned in specification and any other optional tooling should be listed and quoted item wise separately.		
7.0	**DIAGNOSTIC SYSTEM**		
7.1	**TELE-DIAGNOSTIC SERVICE:**		
7.1.1	Tele-diagnostic service should be provided through International telephone lines along with required Hardware / Software package for the supplied CNC system for remote diagnosis and correction of the problems in both CNC System and PLC of the machine. This should be provided free of charge for the guarantee period. The Vendor should inform terms and conditions for the service after guarantee period. Subsequently, it should be possible to use other platforms, such as Internet or ISDN, subject to their availability in future. BHEL will provide the necessary telephone line near the machine.	Vendor to confirm	
7.2	**FAULT DIAGNOSTIC SYSTEM:**		
7.2.1	Vendor's own diagnostic system with required hardware and software should be supplied and installed on the CNC system. This should include customized auto-diagnostic system with supporting hardware and software, which shows detailed cause, and remedy for the fault on the display for faults related to mechanical and electrical maintenance.	Vendor to confirm	
7.3	Help guide should be provided to use both diagnostic systems	Vendor to confirm	

8.0	**LEVELING & ANCHORING SYSTEM**		
8.1	Complete anchoring system including foundation bolts, anchoring materials, fixators, leveling shoes etc should be supplied	Vendor to confirm	
9.0	**TOOLS FOR ERECTION, OPERATION & MAINTENANCE:**		
9.1	The Vendor shall bring special tools and equipment required for erection of the machine. Necessary tools like Torque Wrench, Spanners, Keys, grease guns etc. for operation and maintenance of the machine should be supplied. List of such tools should be submitted with offer	Vendor to confirm	
9.2	Any Test mandrel required for checking & alignment of the machine components etc. should be supplied	Vendor to confirm.	
9.3	Laser equipment, if required, for aligning and checking positioning and repeatability should be arranged for by the vendor at his own cost	Vendor to Specify	
10.0	**SPARES:**		
10.1	Itemized breakup of mechanical, hydraulic, electrical and electronic spares used on the machine in sufficient quantity as per recommendation of Vendor for 2 years of trouble free operation on three shifts continuous running basis should be offered by vendor. The list to include following, in addition to other recommended spares: **(Unit Price of each item of spare should be offered)**	Vendor to confirm	

10.2	**a) Mechanical & Hydraulic Spares:** All types of Pumps, Valves, Pressure Switches, Transducers, Flow Switches, Filters, Seals, O-rings, Hydraulic Hoses etc.	Vendor to confirm	
10.3	**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, optical sensors, spares for CNC, PLC spares (I/O card, digital to analogue card, CPU card, power supply board etc.), display unit, HMI, Servo Motors for Feed Drives, Power Module & Control Cards for Main Drive as well as Feed Drives etc.	Vendor to confirm	
10.4	All types of spares for total machine and accessories should be available for at least ten years after supply of the machine. If machine or control is likely to become obsolete in this period, the vendor should inform BHEL sufficiently in advance and provide drawings of parts / details of spares & suppliers to enable BHEL to procure these in advance, if required	Vendor to confirm	
10.5	Vendor to confirm that complete list of spares for machine and accessories, along with item part no / specification / type / model, and name & address of the spare supplier shall be furnished along with documentation to be supplied with the machine	Vendor to confirm	
11.0	**DOCUMENTATION:**		

	Three sets of following documents (3 Hard copies,) in English language should be supplied along with the machine		
11.1	Operating manuals of Machine & CNC system	Vendor to confirm	
11.2	Programming Manuals of Machine & CNC system	Vendor to confirm	
11.3	Detailed Maintenance manual of machine with all drawings of machine assemblies/sub-assemblies/parts including Electrical / Pneumatic/ Hydraulic circuit diagrams. All Assembly/ Sub Assembly Drawings shall be supplied with the part list also	Vendor to confirm	
11.4	Maintenance, Interface & commissioning manuals for CNC system, & feed drives.	Vendor to confirm	
11.5	Manufacturing drawings for all supplied bending dies, pressure dies etc.	Vendor to confirm	
11.6	Catalogues, O&M Manuals of all bought out items including drawings, wherever applicable.	Vendor to confirm	
11.7	Detailed specification of all rubber items and hydraulic/lube fittings	Vendor to confirm	
11.8	Operating Manuals, Maintenance Manuals & Catalogues for supplied Voltage Stabilizer, Isolation Transformer, and all supplied Accessories.	Vendor to confirm	
11.9	PLC program printouts with comments in English.	Vendor to confirm	
11.10	PLC program on CD, NC data & PLC data on CD / Flash Memory card	Vendor to confirm	
11.11	Complete back up of hard disk on GHOST CD and clear written Instructions (3 copies) to take back up and reloading of a new hard	Vendor to confirm	

	disk.		
11.12	The vendor shall submit complete Master List of parts used in the machine.	Vendor to confirm	
11.13	One additional set of all the above documentation on CD	Vendor to confirm	
11.14	GA Drawing – 6 Copies	Vendor to confirm	
11.15	3 Sets of tooling drawings for ordered tooling	Vendor to Confirm	
12.0	**TRAINING:**		
12.1	The Vendor shall train Four BHEL's Engineers in Operation and Maintenance (Mechanical, Electrical/ Electronics and CNC System) of the Machine at Vendor's works for a period not less than 10 working days.	Vendor to confirm	
12.2	The Vendor shall impart training to BHEL's Machine Operators and Maintenance crew in Operation and Maintenance (Mechanical, Electrical/ Electronics and CNC System) after the commissioning of the Machine at BHEL works for not less than 10 working days.	Vendor to confirm	
12.3	The training shall include specialized coaching in i) Safety ii) Operation of the machine iii) CNC System Operation, iv) Trouble-Shooting, v) Software Application vi) All special features of the machine vii) Electrical / Mechanical / Electronics systems	Vendor to Confirm	

12.4	Airfare, boarding & lodging for the trainees shall be borne by BHEL.	Vendor o Confirm	
12.5	Competent, English speaking experts shall be arranged by the vendor during training for satisfactory & effective training of BHEL personnel	Vendor to Confirm	
12.6	Vendor to quote for training on per man per week basis	Vendor to Specify	
13.0	**FOUNDATION:**		
13.1	Vendor shall submit the preliminary layout drawing for getting BHEL's approval within one month from the date of Letter of Intent (LOI) Foundation details viz. static / dynamic load details etc. and Final Layout drawings shall be submitted by the Vendor within three months after getting BHEL's approval. The layout should consist of all requirements pertaining to complete machine including space requirement for Voltage Stabilizer, Isolation Transformer, & any other accessories. BHEL shall design and construct complete foundation for the machine as per the Vendor's recommendation The Vendor shall also indicate detailed specifications of grouting compound and Grouting procedure etc. for foundation bolts of the machine	Vendor to Confirm	
14.0	**ERECTION & COMMISSIONING**		
14.1	Vendor to take full responsibility for Supervision of the erection, and for start up, testing and commissioning of machine, it's		

	control & all types of other supplied equipment. Service requirement like power, air & water shall be provided by BHEL at only one point to be indicated by Vendor in their foundation/layout drawings. Other requirements like crane and helping personnel shall also be provided by BHEL.		
14.2	Commissioning of Voltage stabilizer, Isolation Transformer shall also be responsibility of the Vendor.	Vendor to confirm	
14.3	Successful proving of BHEL components by the Vendor shall be considered as part of commissioning. All tests, as mentioned (Machine Acceptance) shall form part of the commissioning activity.	Vendor to confirm	
14.4	Tools, Test Mandrels, instruments and other necessary equipment including Laser equipment required to carry out all above activities should be brought by the Vendor.	Vendor to confirm	
14.5	Commissioning spares, required for commissioning of the machine within stipulated time, shall be brought by the Vendor on returnable basis.	Vendor to confirm	
14.6	All Cover Plates required for the machine and its peripherals including pits, if any, shall be supplied and installed by the Vendor.	Vendor to confirm	
14.7	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	Vendor to confirm	

	sufficient quantity of touch-up paint of various colours of paint used.		
14.8	Schedule of Erection and Commissioning shall be submitted with the offer.	Vendor to confirm	
14.9	Charges, duration, terms & conditions for E&C should be furnished in detail separately by Vendor along with offer.	Vendor to confirm	
15.0	**ACCURACY TESTS:**		
15.1	**GEOMETRICAL ACCURACY**		
15.1.1	Geometrical Accuracy Tests shall be in accordance with applicable standard recommended by the Vendor. Detailed Test Charts for the same, clearly showing the accuracies to be achieved on the machine, shall be submitted with the offer.	Vendor to confirm	
15.1.2	All other accuracies shall confirm to Vendors Test chart.	Vendor to confirm	
15.1.3	All the above accuracies should be demonstrated to BHEL engineers during pre-acceptance at Vendors works and during Erection & Commissioning at BHEL Works.	Vendor to confirm	
15.2	**RESOLUTION & REPEATABILITY:**		
15.2.1	**REPEATABILITY:**		
a)	Tube Feed/Transport	± 0.10 mm	
b)	Tube Bending Bender-I	± 0.1deg	
c)	Tube Bending Bender-II	± 0.1deg	
d)	Tube Rotation for Orientation.	± 0.1deg	
e)	Booster	Vendor to Specify	
15.2.2	**RESOLUTION:**		

a)	Tube Feed/Transport	Vendor to Specify	
b)	Tube Bending Bender-I	Vendor to Specify	
c)	Tube Bending Bender-II	Vendor to Specify	
d)	Tube Rotation for Orientation.	Vendor to Specify	
e)	Booster	Vendor to Specify	
15.3	All the above accuracies should be demonstrated to BHEL engineers during pre-acceptance at Vendors works and during Erection & Commissioning at BHEL Works	Vendor to confirm	
16.0	**AMBIENT CONDITIONS & THERMAL STABILITY:**		
16.1	Total machine including CNC system and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies. Power Supply: Voltage: 415 V - 10%, +10% Frequency: 50 Hz +3%, - 3% No. of phases = 3 The machine shall be suitable for an ambient temperature of +45 ° C and relative humidity of 90 % respectively, but both do not occur simultaneously	Vendor to confirm	
16.2	Weather conditions are tropical, Atmosphere may be dust laden during some part of the year. Machine shall be kept in the normal shop floor condition.	Vendor to confirm	
16.3	Thermal Stability of the complete machine keeping in view specified Ambient Conditions and accuracy requirements of	Vendor to confirm	

	BHEL components and vendor should ensure trouble free operation of the machine.		
16.4	The machine, including attachments and accessories, should be suitable for 24 hrs. Continuous operation to its full capacity for 24 hour a day and 7 days a week throughout the year.	Vendor to Confirm	
17.0	**PROVEOUT OF BHEL COMPONENTS:**		
17.1	The prove-out trials shall be for the tube sizes, bend pattern that will be given by BHEL during the technical discussions / at the time of release of Purchase Order. The bends have to meet the quality requirements of all parameters (like ovality, thinning, flow area, angle of bend, distance between bends etc) as mentioned in the specification	Vendor to confirm	
17.2	**Productivity:** Vendor shall establish an output of minimum 300 bends / shift in OD 47.63 x 6.3 mm tube with two radii one of which will be close radius	Vendor to specify	
18.0	**MACHINE ACCEPTANCE: (Tests/Activities to be Performed by Vendor)**		
18.1	**Tests/Activities to be carried out on the machine at Vendor's works in the presence of BHEL engineers before dispatch:**		
18.1.1	Geometrical accuracies as per applicable standard test chart recommended by the Vendor	Vendor to confirm	
18.1.2	Resolution and Repeatability as per	Vendor to confirm	

	specification		
18.1.3	Full load test to demonstrate the maximum capacity of the machine.	Vendor to confirm	
18.1.4	Demonstration of all features of the machine, control system & accessories	Vendor to confirm	
18.2	**Tests / Activities to be carried out at BHEL works while commissioning the machine:**	Vendor to confirm	
18.2.1	Geometrical accuracies as per applicable standard test chart recommended by the Vendor	Vendor to confirm	
18.2.2	Resolution and Repeatability as per specification	Vendor to confirm	
18.2.3	Full load test to demonstrate the maximum capacity of the machine.	Vendor to confirm	
18.2.4	Demonstration of all features of the machine, control system & accessories to the satisfaction of BHEL for efficient and effective use of the machine	Vendor to confirm	
18.2.5	Demonstration by actual use of all supplied attachments and accessories to their full capacity.	Vendor to confirm	
18.2.6	The prove-out trials **as per Clause 17.0**	Vendor to confirm	
18.2.7	Two weeks supervision by vendor of independent operation of machine by BHEL after job prove out (to run concurrently with training at BHEL)	Vendor to confirm	
19.0	**PACKING:**		
19.1	Sea worthy & rigid packing for all items of complete machine, CNC System, all accessories and other supplied items to avoid any damage/loss in transit. When machine is	Vendor to confirm	

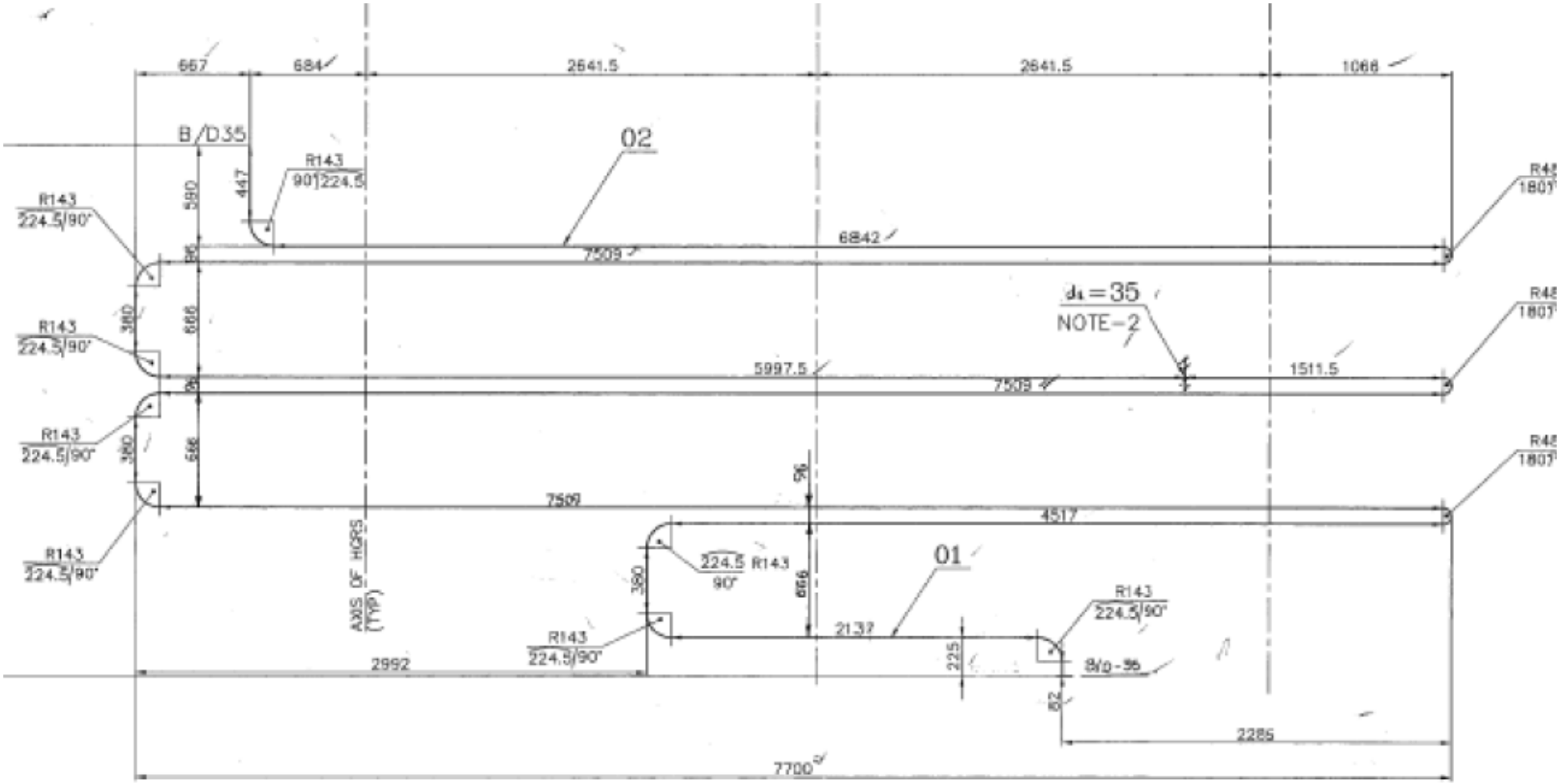
	dispatched in containers, all small loose items shall be suitably packed in boxes		
20.0	**GUARANTEE:**		
20.1	24 months from the date of acceptance of the machine at BHEL Works.	Vendor to confirm	
21.0	**GENERAL:**		
21.1	Machine Model No.	Vendor to specify	
21.2	Total connected load (KVA):	Vendor to specify	
21.3	Floor area required (Length, Width, Height) for complete machine & accessories	Vendor to specify	
21.4	Machine lubrication	Automatic centralized lubrication system.	
21.5	Painting of Machine / Electrical Panels:	RAL 6011 Apple Green (Polyurethane Paint)	
21.6	Total weight of the machine	Vendor to specify	
21.7	Weight of heaviest part of machine	Vendor to specify	
21.8	Weight of the heaviest assembly / sub-assembly of the Machine	Vendor to specify	
21.9	Dimensions of largest part/ sub-assembly/ assembly of the machine	Vendor to specify	
21.10	Vendor to submit, along with offer, reference list of customers where similar machines have been supplied mentioning broad specifications of the supplied machine	Vendor to confirm	
21.11	Detailed catalogues, sketch/ photographs of the m/c and accessories/ attachments should be submitted with the offer.	Vendor to confirm	
21.12	Hydraulic, Pneumatic & oil piping should be preferably metallic except places where flexible piping is essential. All the pipes required for the same shall be included in the standard scope of the machine.	Vendor to confirm	
21.13	All feedback systems & field sensors, limit	Vendor to confirm	

	switches, proximity switches, pressure switches, temperature controllers, should be for heavy duty application and wired up with flexible PVC insulated screened cables. All field elements shall have easy accessibility for maintenance.		
21.14	The general arrangement drawing showing the machine & associated systems with salient dimensions shall be submitted along with the offer. The drawing should be clear and legible	Vendor to Confirm	
21.15	The supplier should describe in the offer any additional optional accessories that are likely to enhance the productivity of the machine.	Vendor to Specify	

ANNEXURE I

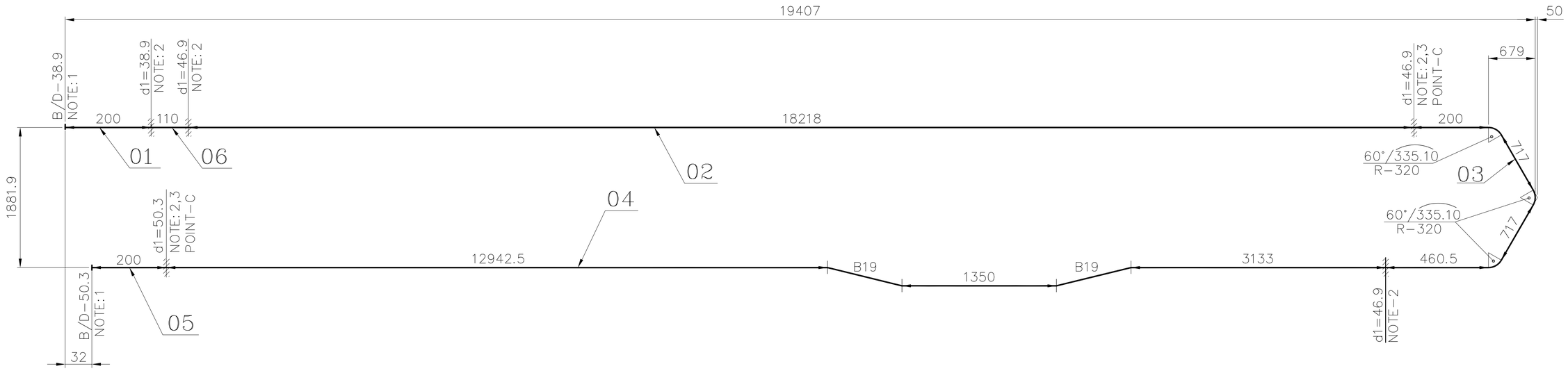
TUBE OUTER DIAMETER AND THICKNESS: All are OD (Outer Diameter) controlled tubes with thickness tolerance of Max +22%		
S.No	OD (mm)	THICKNESS (mm)
1	31.8	3.2 / 3.6 / 4.0 / 5.0
2	38.1	3.2 / 4.0 / 5.0 / 6.3
3	44.5	4.0 / 4.5 / 5.0 / 6.3 / 8 / 9 / 10
4	47.63	5.0 / 6.3 / 8 / 10
5	51.0	3.6 / 4.0 / 4.5 / 5.0 / 6.3 / 8 / 10 / 12
6	54.0	3.6 / 4.0 / 4.5 / 5 / 6.3 / 8 / 10 / 12
7	57.0	4.0 / 5.0 / 6.3 / 8 / 10
8	60.3	4.0 / 5.0 / 6.3 / 8 / 10 / 12.5
9	63.5	4.8 / 5.6 / 6.3 / 10 / 12.5

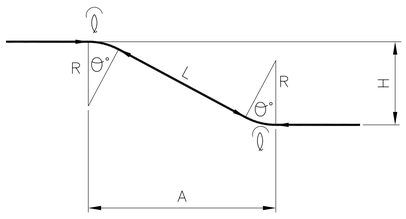
RADIUS OF BENDS:		
S.No	TUBE OD (mm)	RADIUS OF BEND (mm)
1	31.8	R 40, 48
2	38.1	R 48, 51, 65
3	44.5	R 48, 51, R 65, 143
4	47.63	R 51, 114, 152
5	51.0	R 76.5, 151
6	54.0	R 76.5, 165
7	57.0	R 100
8	60.3	R 200
9	63.5	R 100, 160, 200, 320


667
684
2641.5
2641.5
1066
B/D35
02
R143
90°224.5
447
590
R143
224.5/90°
96
7509
6842
R48
180°
380
666
R143
224.5/90°
$d_4 = 35$
NOTE-2
5997.5
7509
1511.5
R48
180°
380
666
R143
224.5/90°
96
7509
4517
R48
180°
R143
224.5/90°
AXIS OF HGRS
(TYP)
224.5 R143
90°
380
666
01
R143
224.5/90°
2137
R143
224.5/90°
2992
225
B/D-35
82
2285
7700

DRAWING NO: 2-11-078-09024

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





	H	R	A	θ°	L		TOTAL LENGTH
B19	51	320	305	12.1	174.2	67.5	309.2

NOTES:

01. BUTT WELD EDGE PREPARATION AS PER BPS: TP 062 05 99
02. EDGE PREPARATION TO SUIT RELEVANT WELDING PROCESS AS PER BPS: TP 062 05 99
03. AFTER FABRICATION ITEM NO.: 03&04 ARE TO BE SOLUTION HEAT TREATED BEFORE WELDING AT POINT 'C'.

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO / VAR NO	MATERIAL CODE / MATERIAL SPECN	A/C/P	UNIT / DI	UNIT WEIGHT / QUANTITY	GS	ZONE
	06	INSERT D63.5X12/ D63.5X8;110LONG		4-11-078-02956/01		15 152 119	A		1.870		
						SA213 TP347H			1		
	05	TUBE D63.5X6.3 200 LONG				15 189 148	A		1.890		
						SA213 T22			1		
	04	TUBE D63.5X8 18044 LONG				15 152 110			215.690		
						SA213 TP347H			1		
	03	TUBE D63.5X12.5 3000 LONG				15 152 119	A		51.000		
						SA213 TP347H			1		
	02	TUBE D63.5X8 18218 LONG				15 152 110	A		217.770		
						SA213 TP347H			1		
	01	TUBE D63.5X12 200 LONG				15 089 139	A		3.200		
						SA213 T22			1		

REV	DATE	ALTERED :
01		CHD & APPD :
ZONE		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-054

	NAME	SIGNATURE	DATE
DRN	R.JAY		
CHD	J.P/R.S.R		
APPD	N.K		

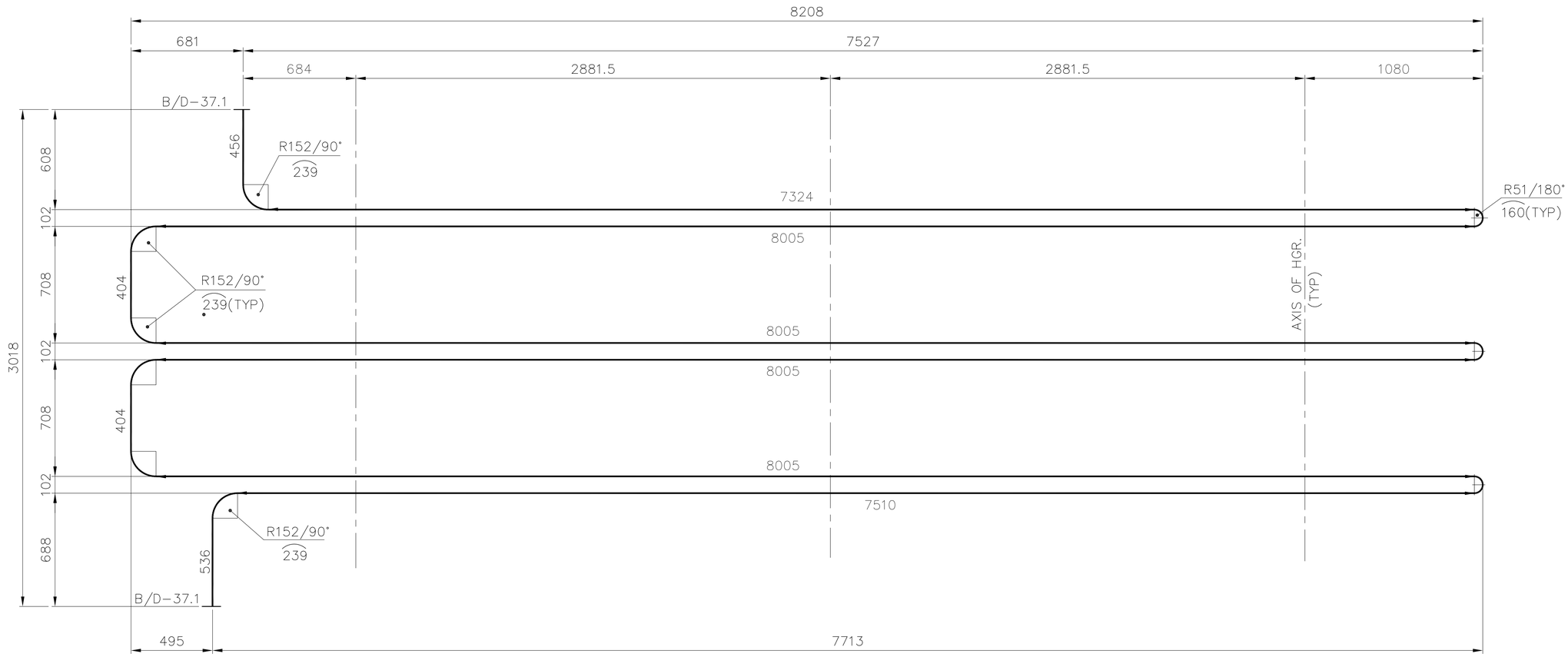
DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
PP			N.T.S	491.420	
CODE 121					

TITLE: SH. VERTICAL PLATEN CIRCUIT-01

DRAWING NO : 2-11-078-09024 REV 00

DRAWING NO: 2-11-236-09325

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



NOTES:

01.BUTT WELD EDGE PREPN. AS PER BPS TP- 062:05:99.

02. BUTT WELD EDGE PREPN. TO SUIT RELEVANT WELDING PROCESS.

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO	MATERIAL CODE	A/C/P	UNIT	UNIT WEIGHT	GS	ZONE
		TUBE D47.63x5.0; 50568 LONG				15-188-089	A		281.700		
					VAR NO	SA213 T11		DI	QUANTITY		

REV	DATE	ALTERED :
01		CHD & APPD :
ZONE		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014
355-054

	NAME	SIGNATURE	DATE
DRN	T.R.K.		18-05-05
CHD	R.NATARAJAN		20-05-05
APPD	R.NATARAJAN		20-05-05

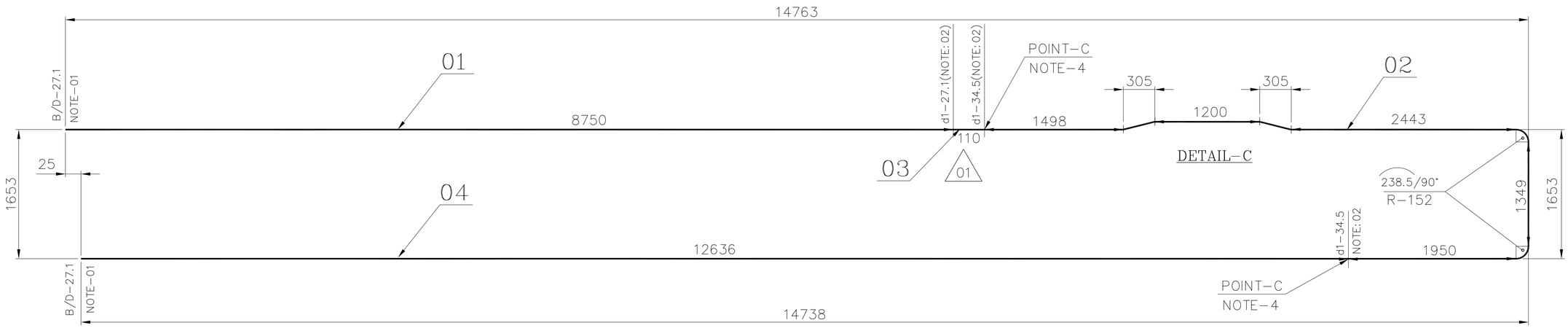
DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
PP			NTS	281.700	
CODE 121					

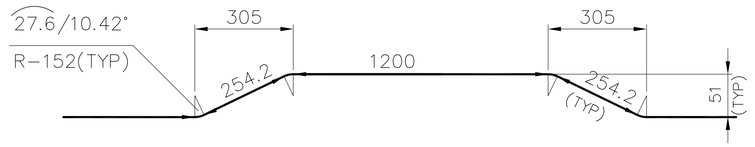
TITLE: CIRCUIT-04

DRAWING NO : 2-11-236-09325 REV 00

DRAWING NO: 2-11-278-09353

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





DETAIL-C

NOTES :-

1. TUBE EDGE PREPN. AS PER BPS TP 062 05 099.
2. EDGE PREPN. TO SUIT RELEVANT WELDING PROCESS FOR COIL BUILD UP AS PER BPS: TP 062 06 99
3. RADIUS OF BENDS R-152
4. AFTER FABRICATION SOLUTION HEAT TREAT ITEM NO:02 BEFORE WELDING AT POINT-C
5. RADIUS OF BEND R-240 IS USED IN PLACE OF R-152 FOR IT.NO:02 TO AVOID SOLUTION HEATTREATMENT FOR CUST NO:0369. (01)

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO / VAR NO	MATERIAL CODE / MATERIAL SPECN	A/C/P	UNIT / DI	UNIT WEIGHT / QUANTITY	GS	ZONE
	04	TUBE D47.63x10 12636 LONG				15 189 082	A		123.100		
						SA 213 T22			1		
	03	TUBE INSERT D47.63x10/D47.63x6.3		4-11-278-03069/01		15-152-116	A		1.330		
						SA213TP347H			1		
	02	TUBE D47.63x6.3 9536.8 LONG				15-152-068	A		64.820		
						SA213 TP347H			1		
	01	TUBE D47.63x10 8750 LONG				15-189-082	A		85.250		
						SA 213 T22			1		

(01)

REV	DATE	ALTERED : R.Sivaraman
01	05.04.06	CHD & APPD :N.Kirubakaran
ZONE	INSERT LENGTH INCREASED FROM 80 TO 110 BASED ON SHOP FABRICATION REQUIREMENT. NOTE NO:5 ADDED.	

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014
355-054

	NAME	SIGNATURE	DATE
DRN	T.M.K		20-05-05
CHD	N.K		21-05-05
APPD	N.K		23-05-05

DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
PP			NTS	274.500	
CODE 121					

TITLE	DRAWING NO :	REV
CIRCUIT-01	2-11-278-09353	01