



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
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	Enquiry Number: 2620700062	Enquiry Date: 08.08.2007	Due date for submission of quotation: 10.09.2007
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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 (Item required at BHEL on)
10	Fitting Sizing Machine – Double Column Band Saw for Sizing of Fittings as per the technical specification & commercial conditions applicable (to be downloaded from web site www.bhel.com or http://tenders.gov.in)	2 Nos.	30.03.2008

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 “2620700062”.

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 has to meet the following requirements to get qualified for submitting an offer for the BANDSAW :

[Additional Sheets shall be attached with the OFFER, to provide requisite details]

S.No.	REQUIREMENTS	VENDOR's RESPONSE
1.0	Only those vendors (OEMs), who have supplied and commissioned at least FIVE Numbers of Double Column Bandsaw of Cutting Capacity 600 mm and above (suitable for either square or circular shaped solid jobs in steel) should quote. The Bandsaw Machines should presently be working satisfactorily for more than one year after commissioning. However, if such a Bandsaw has/had been supplied to BHEL, then such machine should be presently working satisfactorily for more than six months after its commissioning and acceptance in BHEL. The following information should be submitted by the vendor about the companies where similar machines have been supplied. This is required from all the vendors for qualification of their offer"	
2.0	Name of the Customer / Company where the machine is installed.	
3.0	Complete Postal Address of the Customer.	
4.0	Year of Commissioning.	
5.0	Parameters of Machine(s) supplied (parameters as mentioned in Clause 1.0 above) and application for which the machine is supplied.	
6.0	Name and designation of the contact person of the Customer.	
7.0	Phone No., FAX No. and e-mail address of the contact person of the Customer.	
8.0	Performance certificate from the customers regarding satisfactory performance of BANDSAW Machine supplied to them (Original Certificate or Through E-mail directly from the customer). The original performance certificate may be returned after verification by BHEL, if required by the vendor.	

SECTION – II : COMPANY PROFILE

The BIDDER is requested to provide details listed in the table given below :

S.No.	PARTICULARS	VENDOR's RESPONSE
9.0	Number of Years of Experience of the BIDDER / VENDOR in the field of Design, Manufacture, Supply and Commissioning of Double Column Bandsaw Machines.	
10.0	Number of Double Column Bandsaw Machines supplied and installed till date in the following category (based on CAPACITY) with details on customers : a) Above 600 mm b) 300 to 600 mm	
11.0	Details on Standards or Codes followed in the Design of Bandsaw Machine	
12.0	Details of Manufacturing Facilities : a) Fabrication Facilities b) Heat Treatment Facilities c) Machining/Grinding Facilities d) Assembly & Testing Facilities	
13.0	Details of Quality System (with Stages of Internal Inspection) followed for the Fabrication / Machining and Testing of Bandsaws	
14.0	Details on AFTER-SALES-SERVICE Set-Up in INDIA for providing timely service support to BHEL	

SECTION – III : BID / OFFER FORMAT

The BIDDER / VENDOR has to note the following :

S.No.	REQUIREMENTS
15.0	The BIDDER shall submit the offer in TWO PARTS - Technical [with PART A & PART B] & Commercial and Price Bid.
16.0	The OFFER shall contain a comparative statement of Technical Specifications given by BHEL and the Offer Details submitted by the Bidder, against each Clause. A just 'YES' or 'CONFIRMED' or 'NO-DEVIATION' or 'COMPLIES' or 'ACCEPTED' or similar words in the technical comparative statement may lead to disqualification of the Technical Offer.
17.0	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
18.0	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 of the inclusion of all the accessories, tooling, attachments, auxiliary parts, spares, consumables, etc. with the main and basic equipment, to meet the technical specification requirements.

PART B**TECHNICAL SPECIFICATIONS for
DOUBLE COLUMN BAND-SAW for SIZING of FITTINGS****1.0 PURPOSE / APPLICATION :**

The equipment is intended for sizing of hot-forged components ("Tee" and "Elbow") by cutting excess portions. A rotary table type work-piece clamping device also shall form part of the supply. Pictures of typical jobs are shown in the **ANNEXURE – 3**. [This ANNEXURE shows the type of fittings after the sizing of extra portion by flame cutting. The proposed band-saw machine is to be used for sizing by cold cutting, instead of flame cutting process].

2.0 OPTIONAL MACHINE UNIT :

In addition to the rotary worktable (mentioned above), regular work holding device for cutting of pipes / rods of same size, is to be quoted as optional, be with suitable work holding devices. In this case, the rotary table will be replaced by the proposed work holding device.

3.0 JOB DETAILS :

3.1 **FORMATION PROCESS**: Raw-material in the form of seamless steel pipes is heated to a temperature of 1000 ° C and hot-forged in various stages by multiple heating cycles. The end forgings have thick inner sections and excess lengths in free ends due to the plastic flow of metal. These forgings are raw forged or heat-treated (viz., normalising and tempering) and/or shot-blasted prior to sizing operation. The excess length varies between 20 mm to 200 mm, and has to be cut by the proposed bandsaw, prior to finish machining operations carried out on the workpieces.

3.2 **MATERIAL SPECIFICATION** :

SA 234 - WPB, WPC, WP 12, WP 22 and WP 91 (as per ASTM Std.)

Hardness : 190 to 350 BHN [varies with the condition of the job material]

3.3 **MATERIAL SIZES** :

The workpieces are available in three forms and the shape and sizes are indicated in the enclosed **ANNEXURE – 1 & 2** .

ANNEXURE - 1 : ELBOWs (90 ° included angle)

ANNEXURE - 2 : THICK-WALLED TEES
THIN-WALLED TEES

4.0 MACHINE SPECIFICATIONS :

SI.No.	PARAMETERS	SPECIFICATIONS	OFFER
4.1.0	BANDSAW MACHINE :		
4.1.1	Type	Horizontal Cut-Off Bandsaw	
4.1.2	Cutting Capacity at 90 ° - SOLID	Maximum Job Diameter 650 mm	
4.1.3	Cutting Saw Speed Range	20 to 120 mtrs. /min. (Steplessly adjustable)	
4.1.4	Cutting Accuracy	Allowable Limit – Taper 0.1 mm for ϕ 300 mm	
4.1.5	Band Saw Drive Motor Power	Bidder to Specify (Not to be less than 7.5 kW) – Bidder to give power calculations .	
4.1.6	Band Saw Dimensions	Bidder to Specify	
4.1.7	Band Wheel Diameter	Bidder to Specify	
4.1.8	(Flood) Coolant Flow Rate	Around 30 to 50 lits. /min. at 3 Bar delivery pressure	
4.1.9	Coolant Pump Motor Capacity	Bidder to Specify	
4.1.10	Coolant Tank Capacity & Dimensions	Bidder to Specify	
4.1.11	Hydraulic Motor Capacity	Bidder to Specify	
4.1.12	Hydraulic Oil Tank Capacity	Bidder to Specify	
4.1.13	Total Power requirement in kVA	Bidder to Specify	
4.2.0	WORK HOLDING DEVICE :		
4.2.1	Type	Rotary Table & Hydraulically Clamped [Bidder to provide technical details on bearing arrangement for the rotary movement]	
4.2.2	Indexing Angle	In steps of 90 °	
4.2.3	Rotation Angle	360 °	
4.2.3	T-Slot Size & Pitch	Bidder To Specify	
4.2.5	Direction of Rotation	Clockwise & Anti-Clockwise	
4.2.6	Job Dimension	Refer to ANNEXURE – 1 & 2 for Types & Sizes	
4.2.7	Maximum Weight of Single Work-piece	2,200 kgs. (2.20 MT)	
4.3.0	OPTIONAL: WORK HANDLING & HOLDING DEVICE:		
4.3.1	Work Holding Type	Right Angle & Hydraulically Clamped	
4.3.2	Technical Details	Bidder to provide details, suitable for a job of size 650 mm (either circular or square jobs)	

SI.No.	PARAMETERS	SPECIFICATIONS	OFFER
4.4.0	DESIGN & CONSTRUCTIONAL FEATURES :		
4.4.1	Double column, horizontal feed frame, guidance by two large-section solid chromium plated columns and maintenance free sleeve bearings	Bidder to give details	
4.4.2	Sturdy Base / Heavy Bed (Cast Iron is preferable) to provide rigid base to saw components	Bidder to give details	
4.4.3	Inclined band travel feature. designed to shorten the effective cutting length	Bidder to give details	
4.4.4	Automatic hydraulic band tension, monitored electrically, to ensure correct band tension with system for automatic switch-off of drive	Bidder to give details	
4.4.5	Mechanism and arrangement for accurate band/blade guidance	Bidder to give details	
4.4.6	Guide arm setting is to be synchronised with the adjustment of the movable vice jaw	Bidder to give details	
4.4.7	Provision to protect the saw band from overloading.	Bidder to give details	
4.4.8	Work height selector to allow raising of the band, to just clear the material stock	Bidder to give details	
4.4.9	Central guide to provide a third guide to stabilise the band at the start of the cut	Bidder to give details	
4.4.10	An electric motor driven brush on either side of the blade for blade cleaning (to remove the chips from the gullets of the blade teeth)	Bidder to give details	
4.4.11	Automatic load controlled feed regulation to provide constant cutting force	Bidder to give details	
4.4.12	Band speed control is to be monitored, to ensure the saw frame feed is inhibited / stopped automatically once the saw band stops running	Bidder to give details	
4.4.13	Flood coolant system through an electrically driven pump. Separate pump units for flood coolant and flushing of chips preferred. Chip cleaning gun for flushing to be provided.	Bidder to give details	

SI.No.	PARAMETERS	SPECIFICATIONS	OFFER
4.4.14	Movable discharge tray with wheels to secure off-cut material, as an optional item.	Bidder to give details	
4.4.15	The method of changing the saw band/blade should be easy and quick.	Bidder to give details	
4.4.16	The equipment shall have a centralised control panel so that all cutting parameters can be set from one position.	Bidder to give details	
4.4.17	Provision to move the rotary work-holding table out of the bandsaw cutting range, for loading and unloading the job on & from the table	Bidder to give details	
4.4.18	Solid state circuitry for control panel	Bidder to give details	
4.4.19	Indicators to display the blade speed and the blade cutting force	Bidder to give details	
4.4.20	A fluorescent machine lamp with protective cover to be provided for cutting area visibility.	Bidder to give details	
4.4.21	List of band saw blades to suit the various sizes (diameter and thickness) of the job, shall be indicated through a chart.	Bidder to give details	
4.5.0	SAFETY FEATURES :		
4.5.1	To stop the machine immediately, if the saw blade breaks or any slip during operation, due to jamming of blade into the work-piece.	Bidder to give details	
4.5.2	The machine is to be equipped with saw blade safety covers, which completely covers the blade except for the actual cutting area.	Bidder to give details	
4.5.3	A safety interlock to stop the machine automatically if a wheel cover is opened during operation	Bidder to give details	
4.5.4	Saw frame lift and lowering with safety limit switch	Bidder to give details	
4.5.5	For operator safety the machine vice control is to be interlocked with blade drive system (i.e, blade drive will not operate unless machine vice is clamped).	Bidder to give details	

SI.No.	PARAMETERS	SPECIFICATIONS	OFFER
4.6.0	OPTIONAL ACCESSORIES:		
4.6.1	Electric piece counter with display unit	Bidder to give details	
4.6.2	Chip conveyor system with disposal bucket	Bidder to give details	
4.6.3	Cutting Depth Control Unit: To stop the machine automatically as soon as the blade reaches the required depth of cutting	Bidder to give details	
4.6.4	Overload Indicator :- to indicate the overloading applied to the bandsaw blade	Bidder to give details	
4.6.5	Blade Run-Out Detector : - To stop the machine automatically when the cutting goes taper (i.e., deviation of cutting from vertical direction).	Bidder to give details	
4.6.6	Remote Control Unit with 10 mtr. Long interconnecting cable provided with protective sheath, connected to the machine main panel for machine operations.	Bidder to give details	
4.6.7	Any Other Optional Accessories: Additional Optional Accessories which enhance the productivity of the machine to be described by the Bidder with the offer	Bidder to give details	

5.0 IMPORTANT POINTS :

SI.No.	DESCRIPTION	OFFER
5.1.0	415V + 10% / -10%, 50HZ +/-1.5 HZ, 3 Phase AC (3 wire system with out neutral) Power Supply Source will be provided by BHEL at a single point near the machine, as per layout recommended by Vendor. All types of cables, connections, circuit breakers etc. required for connecting BHEL's power supply point to different parts of the machine/control cabinets, shall be the responsibility of vendor.	
5.2.0	All electrical equipment shall be Tropicalized and shall have IP 54 degree of protection	
5.3.0	All electrical control cabinets & panels should be dust and vermin proof	
5.4.0	All electrical components in the cabinets should be mounted on DIN Rail	

SI.No.	DESCRIPTIONS	OFFER
5.5.0	All electrical panels should be provided with CFL lamps for sufficient illumination and electric power receptacles of 220 Volts, 5/15 Amp. AC. All adapters/receptacles should have compatibility with Indian equivalents.	
5.6.0	Motors shall be from M/s Siemens / ABB or other reputed make conforming to IEC and acceptable to BHEL	
5.7.0	All electrics shall be of reputed make like Siemens, L&T, BCH, Tele-mechanique.	
5.8.0	Electrical drives shall be of Siemens / ABB / L&T / Eurotherm and PLC of SEW / Allen Bradley / Siemens / Messung	
5.9.0	All components / devices / terminals are to be incorporated with ferrules.	
5.10.0	All cables moving with traversing axes should be installed in metallic cable drag chain. Additionally, all the cable trays required for laying of cables should be included in the offer.	
5.11.0	Vendor should ensure the proper earthing for the machine and its accessories.	
5.12.0	Centralized Automatic Lubricating System to be provided with metallic tubings.	
5.13.0	All hydraulic elements used shall be of standard ones and shall be of Vickers / Rexroth or any other reputed make acceptable to BHEL.	
5.14.0	All hydraulic operating components to be mounted on the manifold in a centralised place .	
5.15.0	Hydraulic circuits shall be designed with minimum number of control valves and to suit oil of ISO VG 46 or 68 only. Also MINIMESS checkpoints to be provided wherever pressure is required to be read for setting and troubleshooting. One number of MINIMESS Pressure Gauge and Connecting Hose to be provided.	
5.16.0	The equipment has to be guaranteed for its performance and also of the sub-assemblies / bought-out items, for a minimum period of 24 months from the date of commissioning at BHEL Works.	
5.17.0	ENVIRONMENTAL PERFORMANCE OF THE MACHINE: [The Machine shall conform to following factors related to environment]	
5.17.1	Maximum noise level shall be 85 dB (A) at normal load condition, 1 M away from the machine with correction factor for back ground noise, if necessary. This will be measured as per international standards like DIN 45635-16. Vendor to demonstrate compliance to noise level, if so required.	

SI.No.	DESCRIPTIONS	OFFER
5.17.2	If any safety / environmental protection enclosure is required it shall be built in the machine by the vendor.	
5.17.3	Paint of the machine should be oil / coolant resistant and should not peel off and mix up with coolant.	
5.18.0 LEVELLING & ANCHORING SYSTEM		
5.18.1	Complete anchoring system including foundation bolts, anchoring materials, fixtures, leveling shoes etc shall be supplied for the Machine etc.	
5.19.0 TOOLS FOR ERECTION, OPERATION & MAINTENANCE		
5.19.1	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 & Maintenance of the machine should be supplied. List of such tools shall be submitted with offer	

6.0 MACHINE SPARES :

SI. No.	DESCRIPTION	OFFER
6.1.0	Itemised break-up of mechanical, hydraulic, electrical spares used on the machine in sufficient quantity as per recommendation of Vendor for 2 years of trouble free operation on three shifts continuous running basis should be offered by vendor. The list to include following, in addition to other recommended spares: (Unit Price of each item of spare shall be offered)	
6.2.0	Mechanical & Hydraulic Spares: Bearings, clutches, gears and all types of pumps, Valves, pressure switches / transducers, filters, seals, O rings, Hydraulic Hoses, etc.	
6.3.0	Electrical: All types of Relays, Contactors, Proximity Switches, Push Buttons, Indicating Lamps, Semiconductor Fuses, Special Fuses, Circuit Breakers, Main Power Switch.	
6.4.0	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 & Vendors to enable BHEL to procure these in advance, if required.	
6.5.0	Vendor to confirm that complete list of spares for machine and accessories, along with specification / type / model, and name & address of the spare Vendor shall be furnished along with documentation to be supplied with the machine.	

7.0 INSPECTION & MACHINE ACCEPTANCE :

SI. No.	DESCRIPTION	OFFER
7.1.0	The Machine shall be offered for inspection and performance prove-out trials, for the design capabilities of the machine, at Vendor's Works by BHEL Engineers, before dispatch.	
7.2.0	The Bidder shall train BHEL Personnel in Operation and Maintenance (Mechanical and Electrical / Electronics) of the Machine at Vendor's works. The prove-out trials (at Vendor's Works and at BHEL Works) shall be for the job sizes given at the time of technical discussions / order release.	
7.3.0	The Bidder shall depute his engineer(s) for supervising the erection and commissioning of the machine at BHEL Works and further prove-out trials. 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.	

8.0 DOCUMENTATION :

SI. No.	DESCRIPTION	OFFER
8.1.0	THREE sets of following documents (Hard copies) in English language should be supplied along with the machine	
8.1.1	Detailed Operation and Maintenance manual of machine with all drawings of machine assemblies / sub-assemblies /parts including Electrical / Pneumatic/ Coolant / Hydraulic circuit diagrams. All Assembly/ Sub Assembly Drawings shall be supplied with the part list with component specification / BOM also. Component drawings for all wearing parts to be provided.	
8.1.2	Catalogues, O&M Manuals and drawings of all bought out items, bearings wherever applicable.	
8.1.3	Electronic and electrical interconnecting drawings (i.e. Between machine, control panel and drives). Hard Copy in Original : 3 Nos.	
8.1.4	Hydraulic, coolant, lubrication and Electrical circuits with Bill Of Materials	
8.2.0	Detailed specification of all rubber items and hydraulic/lube fittings	
8.3.0	The vendor shall submit complete Master List of parts used in the machine.	
8.4.0	One additional set of all the above documentation on CD ROM, wherever possible.	

9.0 FOUNDATION :

Sl. No.	DESCRIPTION	OFFER
9.1.0	BHEL shall construct complete foundation for the machine. Vendor shall furnish the foundation details.	Bidder to confirm

10.0 SCOPE OF SUPPLY:

[The Un-Priced Commercial Offer shall contain the following details]

S. No.	DESCRIPTION	OFFER
10.1.0	Basic Band-saw Machine with Standard Accessories	
10.2.0	Hydraulic Power Pack and Connected Circuitry with Tank	
10.3.0	Electrically run Flood Coolant Circulation System and Tank	
10.4.0	Rotary table and complete set of work holding devices like "V" blocks, adapters, screw-clamps, tightening nuts, carbide guides, etc. shall form part of the supply to cover all sizes of the work-pieces specified	
10.5.0	Remote Control & Optional Accessories as recommended by the Bidder	
10.6.0	Inter-connecting Cables (with Plug-In connectors) and Hoses (with Quick-Fix couplings)	
10.7.0	Complete range of Band-saw Blades in packs of five numbers for the sizes of jobs specified in ANNEXURES	
10.8.0	Complete set of Spares for Mechanical, Hydraulic, Electric and Electronic elements as per Clause 6.0	
10.9.0	Set of Operating and Maintenance Tools	
10.10.0	Inspection and Performance Prove-Out at Vendor's Works	
10.11.0	Training in Operation & Maintenance of the total system for BHEL Personnel	
10.12.0	Complete set of Documents as per Clause 8.0	
10.13.0	Erection & Commissioning at BHEL Works and Machine Prove-out Trials for various sizes of jobs	

ENCLOSURES : ANNEXURE – 1, 2 & 3

ANNEXURE - 1

SIZES OF 'ELL's (ELBOWS)

SI. No.	OUTER DIAMETER (O.D. in mm)	BEND RADIUS (‘R’ in mm)	WALL THICKNESS (‘t’ in mm)	
			Minimum	Maximum
1.	219.1	203.2	18	35
2.	219.1	305.0	20	50
3.	273.0	254.0	28	45
4.	273.0	381.0	25	55
5.	323.9	304.8	30	56
6.	323.9	457.0	15	60
7.	356.0	533.0	20	75
8.	368.0	368.0	30	70
9.	368.0	533.0	30	80
10.	377.0	533.0	50	70
11.	406.4	406.4	40	85
12.	406.4	610.0	20	50
13.	457.2	457.2	40	85
14.	457.2	686.0	20	35
15.	508.0	508.0	45	90
16.	508.0	762.0	25	35
17.	558.8	558.8	40	90
18.	558.8	838.0	30	105
19.	609.6	609.6	40	90
20.	609.6	914.0	30	45

**(NOTE : EXCESS LENGTH TO BE CUT ON EITHER SIDE
VARIES FROM 10 TO 200 MILLIMETERS)**

ANNEXURE - 2**SIZES OF THICKWALLED TEEs**

Sl.No.	OUTER DIAMETER (O.D. IN mm)	ARM LENGTH (A/2 IN mm)		BODY LENGTH (A IN mm)		BRANCH HEIGHT (B IN mm)		NOSE RADIUS (R in mm)	WALL THICKNESS (T1 IN mm)	BRANCH WALL THICKNESS (T2 IN mm)
1.	159.0	175	143	350	286	159	143	30	40	27
2.	168.3	-	143	-	286	-	143	30	45	30
3.	219.1	170	178	340	356	170	178	40	65	35
4.	273.0	318	216	635	432	215	216	51	80	40
5.	328.9	355	254	710	508	255	254	61	70	37
6.	356.0	380	279	760	558	280	279	62	90	60
7.	368.0	380	279	760	558	280	279	67	90	60
8.	406.4	435	305	870	610	305	305	76	105	55
9.	457.2	545	348	1090	686	338	343	86	105	45
10.	508.0	550	381	1100	762	385	381	95	160	45
11.	558.8	550	419	1100	838	420	419	105	90	45

ANNEXURE - 2**SIZES OF THIN WALLED EQUAL TEEs**

SI.No.	OUTER DIAMETER (O.D. ₁ IN mm)	OUTER DIAMETER (O.D. ₂ IN mm)	BODY LENGTH (IN mm)		BRANCH HEIGHT (B IN mm)	NOSE RADIUS (R in mm)	WALL THICKNESS (T1 IN mm)	BRANCH WALL THICKNESS (T2 IN mm)
			A/2	A				
01	273.0	273.0	216	432	216	27	6.35	13.9
02	273.0	291.1	216	432	203	22	6.35	12.0
03	273.0	168.3	216	432	194	17	6.35	12.0
04	273.0	114.3	216	432	184	11	6.35	12.0
05	323.9	323.9	254	508	241	32	6.35	18.6
06	323.9	273.0	254	508	241	27	6.35	13.0
07	323.9	291.1	254	508	229	22	6.35	9.0
08	323.9	168.3	254	508	219	17	6.35	12.0
09	355.6	355.6	279	558	279	36	6.35	16.4
10	355.6	219.1	279	558	248	22	6.35	16.4
11	406.4	406.4	305	610	305	41	6.35	19.2

ANNEXURE 3

TYPICAL FORMED FITTINGS - PHOTOS



1. Ø219mm Formed 'T' Fittings



2. Ø219mm Formed 'T' Fittings



3. One end of 'T' fitting - Closer View



4. Ø 273mm 'T' fitting

ANNEXURE 3

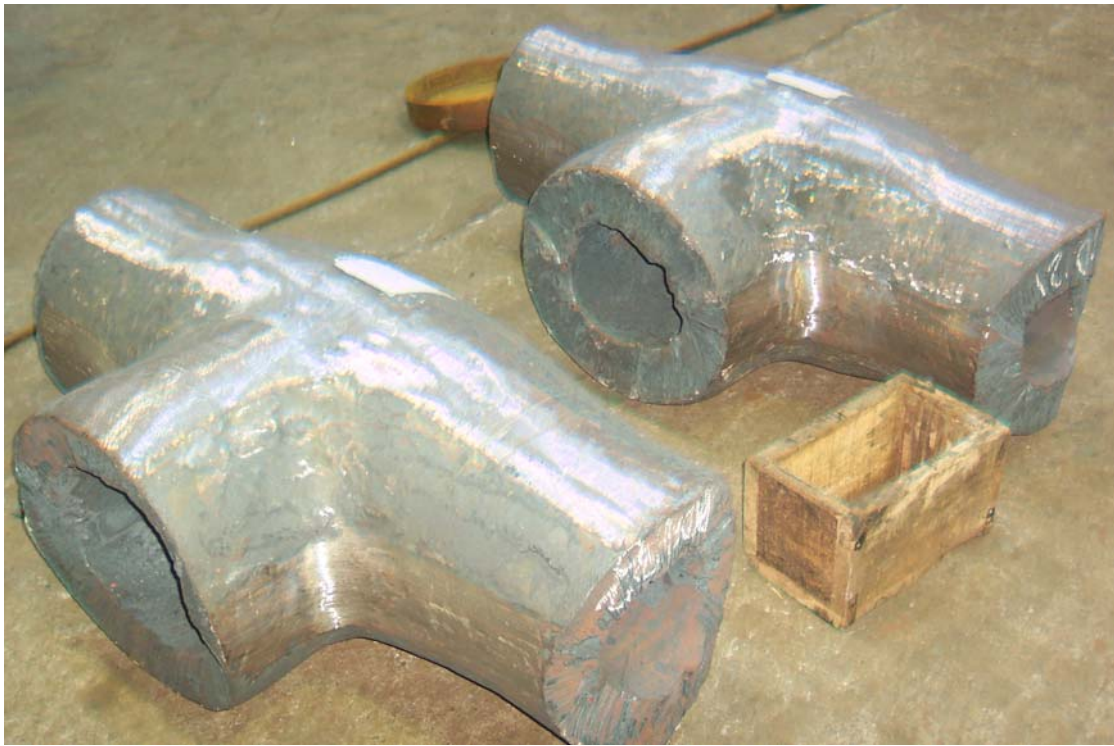
TYPICAL FORMED FITTINGS - PHOTOS



5. \varnothing 219mm 'T' fitting



6. \varnothing 273mm 'T' fitting



7. Unequal 'T' fitting



8. Run end of Unequal 'T' fitting



9. Branch end of Unequal 'T'



10. Typical Elbow Fittings



11. Typical Machined Elbow Fitting