



Bharat Heavy Electricals Limited

High Pressure Boiler Plant

Tiruchirappalli 620 014

Phone : 0431-2577454, Fax: 0431-2520719

e-mail : rn@bheltry.co.in

AN
ISO 9000
COMPANY

INVITATION FOR QUOTATIONS TOWARDS PROCUREMENT OF SS FORGINGS TO SPECN SA336F321 AND TDC:D125:002/02

BHEL ENQUIRY NUMBER: 1401000116	ENQUIRY DATE: 11.06.2010	DUE DATE FOR SUBMISSION OF QUOTATION: 21.07.2010
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BHEL invites bids for the supply of 21.28 MT of Forgings to the material specification SA336F321 and TDC D125:002/02.

Kindly note that the materials originating in or exported from CHINA PR or USA is not acceptable.

BHEL will finalize all the 22 items as a package and will procure all the 22 items from a single source only. Hence Vendors who are not capable to quote and supply all the 22 items may refrain from submitting Offers.

You are requested to quote the above enquiry Number, date and due date in all your correspondences. Please note that this is only a request for quotation and not an order.

BHEL Commercial Terms and Conditions, Other Special Conditions for submission of offers, Drawings, TDC etc can be downloaded from BHEL Website, <http://www.bhel.com> (Tender Notifications page) and in Government of India tenders Website, <http://tenders.gov.in> (Public sector units, Bharat Heavy Electrical Limited page) under Enquiry reference "1401000116 DT.11.06.2010 DUE ON:21.07.2010".

Tenders should reach us before 14.00 Hrs on the abovementioned due date and the Technical Bid will be opened at 14.30 Hrs on the due date in BHEL Office Premises in the presence of the Vendors who have submitted their offers and who may be like to be present.

Important Note: LATE OFFERS will not be considered for evaluation. No extension of due date is possible.

yours faithfully
for Bharat Heavy Electricals Limited

-SD-

Manager/Purchase/MM/MFG



ENQUIRY

BHARAT HEAVY ELECTRICALS LIMITED

(A Government of India Undertaking)
HIGH PRESSURE BOILER PLANT
PURCHASE DEPARTMENT - FOSSIL BOILERS
THIRUCHIRAPALLI - 620014
TAMILNADU (INDIA)

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PHONE : 2577454
GRAMS : BHARATELEC
FAX NO: 2520719
E-mail : rn@bheltry.co.in
Web :

Enquiry No.	Enquiry Date	Due Date For Quotation
1401000116	11.06.2010	21.07.2010Enq
Please quote Enquiry No, Date and due date in all correspondences. This is only a request for quotation and not an order		

Item	Description	Unit	Quantity	Delivery Quantity	Schedule Date
10	D12530101003 TDH AS PER DRG.3-90-628-00934/02	NO	5.000	5.00	31.03.11
20	D12530101022 F.PL.20MMX160MMX1200MM L (SAME MELT FOR SL.NO.10)	NO	5.000	5.00	31.03.11
30	D12530101029 F.PL.57MMX160MMX750MM L (SAME MELT FOR SL.NO.10)	NO	1.000	1.00	31.03.11
40	D12530101031 F.PL.57MMX160MMX1000MM L (SAME MELT FOR SL.NO.10)	NO	10.000	10.00	31.03.11
50	D12530101030 F.PL.57MMX300MMX300MM L (SAME MELT FOR SL.NO.10)	NO	58.000	58.00	31.03.11
60	D12530101024 F.PL.57MMX550MMX550MM L (SAME MELT FOR SL.NO.10)	NO	9.000	9.00	31.03.11
70	D12530101007 GUIDE BUSH AS PER DRG.3-90-628-00935 /01	NO	7.000	7.00	31.03.11
80	D12530101025 F.PL.55MMX250MMX250MM L (SAME MELT FOR SL.NO.70)	NO	28.000	28.00	31.03.11
90	D12530101008 NECK AS PER DRG.3-90-628-00936 / 01	NO	7.000	7.00	31.03.11
100	D12530101036 F.Rod Dia 280MMX75MM L (SAME MELT FOR SL.NO.90)	NO	5.000	5.00	31.03.11
110	D12530101033 F.PL.75MMX300MMX1500MM L (SAME MELT FOR SL.NO.90)	NO	4.000	4.00	31.03.11

The offers should reach us before the time of opening of tenders.
The offers will be opened at 14:30 hours on the due date in the presence of the tenderers who may like to be present.
Late tenders are liable to be rejected.

Yours faithfully,
For **BHARAT HEAVY ELECTRICALS LIMITED**

Sd /-

MANAGER / PURCHASE
(FOSSIL BOILERS)



BHARAT HEAVY ELECTRICALS LIMITED

(A Government of India Undertaking)
HIGH PRESSURE BOILER PLANT
PURCHASE DEPARTMENT - FOSSIL BOILERS
THIRUCHIRAPALLI - 620014
TAMILNADU (INDIA)

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1401000116 / 11.06.2010				18255	
120	D10230101034 FORGEDPLATE150MMX150MMX160LENGT H	NO	16.000	16.00	31.03.11
130	D12530101026 FORGEDPLATE20MMX160MMX1500MMLEN GTH	NO	2.000	2.00	31.03.11
140	D12530101012 F.PL.40MM X 130MM X 250MM L	NO	16.000	16.00	31.03.11
150	D12530101027 FORGEDPLATE40MMX160MMX1200MMLEN GTH	NO	4.000	4.00	31.03.11
160	D12530101023 FORGEDPLATE57MMX160MMX1200MMLEN GTH	NO	6.000	6.00	31.03.11
170	D12530101032 FORGEDPLATE57MMX200MMX150MMLENG TH	NO	4.000	4.00	31.03.11
180	D12530101035 F.Rod Dia 60MMX1500MMLENGTH	NO	7.000	7.00	31.03.11
190	D12530101004 F. ROD DIA 80MM X 1600MM L (ALL MATL. SHOULD BE IN SAME MELT)	NO	30.000	30.00	31.03.11
200	D12530101028 FORGEDROUNDS DIA 80MMX1600MM L	NO	7.000	7.00	31.03.11
210	D12530101005 F.ROD DIA 100MM X 1200MM LENGTH (SAME MELT FOR SL.NO.200)	NO	16.000	16.00	31.03.11
220	D12530101006 F.ROD DIA 150MM X 1600MM LENGTH	NO	4.000	4.00	31.03.11
General Note: 1) ALL ATTACHMENTS (BHEL COMMERCIAL TERMS AND CONDITIONS, SPECIAL CONDITIONS, TDC NAD DRAWINGS)FORM PART OF THIS ENQUIRY. 2) PLEASE READ CAREFULLY ALL THE POINTS INDICATED IN THE TERMS AND CONDITIONS AND SUBMIT REQUESTED DETAILS ACCORDINGLY BY CONFIRMING ON POINT TO POINT BASIS.					
Enclosures: "LD clause has to be confirmed without fail."					
The offers should reach us before the time of opening of tenders. The offers will be opened at 14:30 hours on the due date in the presence of the tenderers who may like to be present. Late tenders are liable to be rejected.				Yours faithfully, For BHARAT HEAVY ELECTRICALS LIMITED Sd /- MANAGER / PURCHASE (FOSSIL BOILERS) Yours faithfully,	

SPECIAL CONDITIONS

1. All SS forgings should be supplied as per specification SA336F321 and TDC:D125:002/02 . Clause by Clause confirmation is to be given for the TDC alongwith techno-commercial bid.
2. Inspection will be done by third party for Foreign Vendors. For Indigenous Vendors inspection will be done by BHEL/Customer. Inspection charges, if any, shall be quoted separately.
3. Same melt No. to be maintained in following pattern. a) For Enq. Sl.no 10 to 60 same melt no. b) For Enq. Sl.no 70 & 80 same melt no. c) For Enq. Sl.no 90 to 110 Same Melt No. d) For Enq. Sl.no 190 - All 30No's should be in one melt No. e) For Enq. Sl.no 200 & 210 Same Melt No.
4. For Enq. S.No. 10 supply as per drawing No: 3-90-628-00934/02. For Enq. S.No. 70 supply as per drawing No: 3-90-628-00935/01. For Enq. S.No. 90 supply as per drawing No: 3-90-628-00936/01.
5. Raw material inspection reports shall be provided along with supply.
6. The actual production of materials is permitted only after review/approval of Manufacturing/Testing/Inspection Drawing/Documents and Quality Assurance Plans (QAP) by BHEL,Trichy.
7. Five sets of additional Dialets containing Test Certificate ,copies of the approved procedures DCR, Drgs etc apart from contractual requirements are required.
8. End use certificate will not be given by BHEL. Vendors should furnish written confirmation that End Use Certificate will not be demanded.
9. BHEL will finalize all the 22 items as a package and will procure all the 22 items from a single source only. Hence Vendors who are not capable to quote and supply all the 22 items may refrain from submitting Offers.
10. Confirmation is required to BHEL's Commercial Terms and Conditions including Payment terms, LD clause, Risk Purchase Clause and PBG clause. BHEL reserves the right to reject offer of any vendor who do not accept BHEL's Commercial terms and conditions. This confirmation is to be furnished alongwith the Techno-Commercial bid.
11. No charges shall be mentioned as extra at actuals. Indicate the same in figures.
12. Kindly note that the materials originating in or exported from CHINA PR or USA is not acceptable.
13. Tenders should reach us before 14.00 Hrs on the abovementioned due date and the Technical Bid will be opened at 14.30 Hrs on the due date in BHEL Office Premises in the presence of the Vendors who have submitted their offers and who may be like to be present.
14. LATE OFFERS will not be considered for evaluation. No extension of due date is possible.

PURCHASE/C&F/MM/MFG/BHEL/TIRUCHY-14

COMMERCIAL TERMS AND CONDITIONS

1.0 QUOTATIONS

The Bidders shall submit the offer in **TWO INNER ENVELOPES** as indicated below which shall be sealed in one outer envelope.

Envelope I This sealed envelope should contain all the copies of technical bid together with un-priced commercial bid. This envelope should be clearly marked **“Part I - Technical and commercial bid”**, indicating Enquiry No., Due Date and Address & Reference of the Bidder.

Envelope II This sealed envelope should contain **price details**. This envelope should be clearly marked **“Part II - Price bid”**, indicating Enquiry No., Due Date and Address & Reference of the Bidder.

Both the envelopes (Part I & II) shall be put in one cover, duly sealed, superscribing as Part I and Part II of Enquiry No., due date of opening and the address and reference of the Bidder.

The above offer should reach this office on or before the due date by 14.00 Hrs (IST). Late offers will not be considered.

Tender should not be addressed to any Individual's name but only by designation to:

**MANAGER / PURCHASE / MM / MFG
BHARAT HEAVY ELECTRICALS LIMITED
HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620 014
TAMIL NADU, INDIA**

Tenders should be free from **CORRECTION AND ERASURES**, Corrections if any, must be attested. All amount shall be indicated both in words as well as in figures. Where there is difference between amount quoted in words and figures, amount quoted in words shall prevail.

Offers should be in **ENGLISH** and accompanied by detailed technical literature, catalogue and detailed dimensional drawings in **ENGLISH** or otherwise, the offers will not be considered.

2.0 PART I (TECHNICAL & COMMERCIAL BID)

2.1 Technical

This part shall include / indicate the following :

- 2.1.1. Offer should contain complete scope of supply with all technical details, specifications, delivery and other commercial terms and conditions.
- 2.1.2. Point by point confirmation for the Technical Delivery Condition (TDC) enclosed to be provided. if there are any deviation, the same should be clearly specified. Offers received without confirmation to our specification will be rejected.
- 2.1.3. List of customers to whom same or similar item have been supplied along with performance certificates to be enclosed.
- 2.1.4. Information on shipping weight and cubage (length, width & height) to be provided.
- 2.1.5. Incase of foreign bidder offer, the Principal's technical offer should be enclosed.

2.2 Commercial

This part shall include / indicate the following :

- 2.2.1. Port of shipment / Station of despatch
- 2.2.2. Terms of payment
- 2.2.3. Taxes & duties applicable.
- 2.2.4. Delivery Schedule
- 2.2.5. Offer validity
- 2.2.6. Country of origin
- 2.2.7. Percentage of agency commission if any along with a copy of Agency agreement.
- 2.2.8. A copy of “Un-Priced Part II” i.e., a copy of the Price Bid **without the price details** to be enclosed.

3.0 PART II (PRICE- BID)

This part should contain the schedule of price particulars and to be co-related to the technical details provided in Part I.

4.0 OPENING OF TENDERS

The Part I - Technical & commercial bid alone will be opened on the Tender opening date.

The Part II - Price bid of Technically suitable Bidders alone will be opened at a later date. The Technically suitable Bidders will be informed about the price bid opening date.

Clarifications if any required by BHEL for Technical evaluation will be sought from Bidders before opening of Part II - price bid.

5.0 GENERAL

5.1. Incomplete offers will not be considered.

5.2. **Fixed price:** Prices quoted by the bidder shall be firm fixed and not subject to any escalation whatsoever during the period of bid validity and execution of the Purchase Order. A bid submitted with an adjustable price will be treated as non - responsive and rejected. Prices shall be written in words and figures. In the event of difference, the price in words shall be valid and binding. Unit prices shall be considered correct in the event of any discrepancy with regard to total price.

5.3. **Bid currency:** Indian bidders should submit the prices only in Indian Rupees. Foreign bidders may submit their bid in their home currency.

5.4. **Terms of Delivery:** Bidders are required to quote their best delivery period. Foreign Bidders should submit their offer for net **FOB Nearest Sea Port and CFR/CHENNAI Sea port and CFR/Karaikal Sea port.** In the case of CFR terms, container free period of 14 days shall be applicable for releasing empty containers at discharge port and the same should be indicated in the Bill of lading itself.

Indian Bidders should submit their offer for **FOR/ BHEL/TIRUCHY.**

5.5. **Taxes and Duties :** All Taxes and Duties payable as extra to the quoted price should be specifically stated in offers along with CST & VAT / Tariff No. etc., failing which the purchaser will not be liable for payment of such Taxes and Duties.

5.6. **Validity :** The offers shall be kept open for acceptance for **120 days (one hundred and twenty days)** from the date of opening of the tender (Part I).

5.7. **Terms of Payment :**

5.7.1. Indian Bidders

5.7.1.1. The preferred payment terms are indicated below :

5.7.1.2. 100% payment, within 45 to 90 days, after receipt / acceptance of materials at BHEL, Tiruchi, against 2.5% Performance Bank Guarantee on total order value.

5.7.1.3 Foreign Bidders

An Irrevocable Letter of Credit shall be established for 100% of the value of the goods. 10 Performance Bank Guarantee for 2.5% on total order value shall be furnished alongwith negotiable documents. All bank charges outside India are to Vendor's account.

5.8. **Performance Bank Guarantee (PBG):** The Bidder, in the event of an order, should furnish a bank Guarantee from an Indian Bank approved by BHEL, at no extra cost in a proforma prescribed by BHEL, alongwith the order, for an amount equivalent to **2.5% (two and a half percent)** of the value of the contract. The PBG shall be valid for period of 18 months from the date of despatch or **12 months** from the date of receipt / acceptance of the goods at BHEL, Tiruchi which ever is more, with a claim period of two months.

The Performance Bank Guarantee shall be obtained from any one of the following banks who is a member bank in our consortium of banks.

STATE BANK OF INDIA, PUNJAB NATIONAL BANK, HDFC BANK,

SYNDICATE BANK, CANARA BANK, INDIAN BANK,

STATE BANK OF HYDERABAD, ICICI BANK,

STANDARD CHARTERED BANK,UCO BANK,

KOTAK MAHINDRA, ORIENTAL BANK OF COMMERCE

STATE BANK OF TRAVANCORE, CENTRAL BANK, IDBI BANK,FEDERAL BANK,

HSBC LTD, DEUTSCHE BANK, CORPORATION BANK, CITI BANK,

BANK OF BARODA, ABN AMRO BANK, UNITED BANK OF INDIA,

VIJAYA BANK, UNION BANK OF INDIA, PUNJAB & SIND BANK,

ANDHRA BANK, BANK OF INDIA, AXIS BANK

- 5.9. **Liquidated damages :** It is clearly understood among the parties to the contract the “ **Time is the essence of the contract** ”. Therefore, the delivery of the goods specified in the purchase order should be made within the time prescribed. Where the seller supplies or despatches the goods beyond the delivery period specified, the purchaser will have no obligation to accept the goods. If accepted liquidated damages at the rate of 1/2% of the price of goods delayed for each week of delay subject to a maximum of 15% of the delayed undelivered goods will be levied.
- 5.10. **Risk purchase :** Alternatively the purchaser at his option will be entitled to terminate the contract and to purchase elsewhere at the risk and cost of the seller either the whole of the goods or any part which the supplier has failed to deliver or despatch within the time stipulated as aforesaid or if the same were not available, the best and the nearest available substitute therefor. The supplier shall be liable for any loss which the Purchaser may sustain by reason of such risk purchases.
- 5.11. **Agency commission :** In case of Foreign Bidders, agency commission if any, payable to their Indian Agents, shall shown separately in the Offer. This will be paid by us in India, in Indian Rupees, on satisfactory completion of the Contract. Copies of current Agency Agreement / Authorization Letter in respect of Agency Commission shall be furnished alongwith offer. For calculation of Rupee equivalent of Agency Commission, exchange rate as prevailing on the date of offer will be taken.
- 5.12. **Test certificates:** The Bidders shall clearly mention in their offer, that Test Certificates as called for in the Technical Specification, in the required number of copies will be provided at no extra cost.
- 5.13. **Cenvat credit :** (for Indian Bidders only) If any Excise Duty is payable, the chapter head / sub-head reference and the rate of the duty should be quoted. If the tender is availing **CENVAT** credit for his input materials, the effect of proforma credit should be passed on to the purchaser.
- 5.14. **Packing and marking :** The Supplier shall arrange for securely protecting and packing the stores to avoid loss or damages during transit.
- 5.15. BHEL shall be at liberty to reject or accept any tender, part or in full, at their own discretion and any such action is not liable for any question or claim against BHEL.

STAINLESS STEEL FORGINGS

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1.0 FORGINGS

Specification:

SA336 Gr. F321 with its supplementary requirements. Edition: The latest edition (As on date of P O) with applicable addenda & code case interpretation. Latest revision of ASTM specifications are applicable for test procedures.

Supplementary Requirements:

S1, S2 (both longitudinal & transverse tests required), S8 (supplier to indicate details), S9.2

Additional Requirement:

As listed below

Size and Qty:

Products and associated test plate / pipe finished as per Drawing/Purchase Order. All forgings, associated test plate / pipe etc. shall preferably be from same melt and heat treatment

Supply Condition:

Solution annealed, pickled & passivated preserved.

2.0 REFERENCE DRAWINGS:

- 3-90-628-00934 (latest) - Top Dished Head
- 3-90-628-00935 (latest) - Guide bush
- 3-90-628-00936 (latest) - Neck
- 3-90-628-00937 (latest) - Production test coupon

3.0 DOCUMENTS TO BE SUBMITTED

- 3.1 ALONG WITH BID: Quality Assurance Program, Proposed manufacturing and test plan, No. of melts & ingots to be used, chemical analysis procedure with guaranteed chemical composition & expected level of trace elements, minimum guaranteed values of forging ratio and grain size, heat treatment (HT) plan, Drawings showing volumes NOT possible for UT scan, applicable test procedures and packing procedure.
- 3.2 PRIOR TO START OF MANUFACTURE: Following details for product as well as associated test plate / pipe shall be submitted for the approval of purchaser :-
 - 3.2.1 QA plan - Detailed QA plan shall be submitted. This should include various stages of forging, HT, inspection, examination including NDE stages, Chemical, Mechanical & Metallurgical testings, dimensional stages, cleaning, pickling, passivation, packing etc. Stages of third party inspection shall be clearly indicated on the same. Purchaser's inspectors must also be engaged. He shall check and approve all document and test certificate related to forging at forge master shop before it is dispatched.
 - 3.2.2 Stage wise Forging plan sketches showing the following :
 - i) Size, melt & no. of blooms to be used. Allocation of products and associated test plates / pipes on blooms. Discard at each end of bloom shall be indicated.
 - ii) Various forging stages indicating direction of forging, reduction ratio & discards. Principal working direction of forgings shall be indicated.
 - iii) Forging contour at the time of heat treatment. Contour shall be as close as possible to the final contour and allowances for heat treatment shall be shown. Supplier shall submit detailed proposal for all products.
 - iv) Material Sampling and Test Plan : Only integral test specimens are to be used for tests specified in following paras. Location, orientation, size and no. of test specimens shall be shown for each forging and its associated test plates and pipes to be supplied. Location of hardness measurements shall also be indicated.
 - v) Forging contour at the stage of UT
 - 3.2.3 HT plan & procedure including thermocouple locations, expected temperature variations, details of furnace loading.
 - 3.2.4 NDE plan & procedures indicating details of probes to be used for different scanning for each forging. Location, orientation and size of reference notches & holes. Detail sketch of UT reference blocks to be used for each scanning direction for each forging.

STAINLESS STEEL FORGINGS

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- 3.2.5 Procedure for Micro test, Macro test & Grain size
- 3.2.6 Procedure for IGC test & SCC test
- 3.2.7 Procedure for Inclusion Rating
- 3.2.8 Pickling & Passivation procedure.
- 3.2.9 Packing plans / procedure.
- 3.2.10 Ingot ladle analysis. Check test result for chemical composition (after receipt of ingot at forging shop).

4.0 PRIMARY MELTING

Shall be done in Electric furnace with vacuum degassing.

5.0 SECONDARY MELTING & REFINING

Must be done by Electro slag re-melting (ESR) or vacuum arc re-melting (VAR).

6.0 CHEMICAL COMPOSITION & PROCESS**6.1 Following analysis shall be done:**

Ladle analysis of ingot

Check test for chemical composition after receipt of ingot at forging shop

Product analysis at top and Bottom of each forging including test plate / pipe after heat treatment.

6.2 Carbon shall be restricted to 0.06% max. (aim for 0.03% max.).

Cobalt shall be restricted to 0.2% max. (aim for 0.1% max.).

Sulphur shall be 0.018% max and Phosphorus shall be 0.015% max.

6.3 Associated test plates / pipe called for in the drawing shall also be from the same heat & HT condition as the product and shall receive same extent of forging. The forging plan shall clearly correlate the same.**6.4 Forging reduction ratio : At each stage to be indicated. Final stage: > 3****7.0 HEAT TREATMENT****7.1 All the forgings shall be solution annealed.****7.2 Stage of HT : After machining with final machining allowance. All hollow forging, pipes & other similar products should be machined at ID (with suitable HT allowance) before HT. Surfaces shall be cleaned thoroughly. For other products like dished head HT contour shall be close to final product shape.****7.3 Thermocouples shall be put on all major forgings. Temperature vs. time recording of each thermocouple shall be submitted for approval.****8.0 MECHANICAL & METALLURGICAL TESTS****8.1 Stage of test: After solution annealing HT. Stage of machining out of test specimens shall be cleared only after it is shown that requirements for carrying out UT & its calibration will be ensured.****8.2 Extent of test: Following tests shall be done for each product & associated test plate / pipe from all sections of the forgings on both top and bottom ends. Products may be combined in a single forging stock to reduce the extent of testing. Reduction in testing due to such combination, if any, shall be mutually discussed and agreed. Size of each integral test piece shall be sufficient to carry out required tests. *****8.2.1 Tests from each test piece are:**

- i) Longitudinal Tension test at 20°C - 1 no.
- ii) Longitudinal Tension test at 350°C - 1 no.
- iii) Transverse Tension test at 20°C - 1 no.
- iv) Transverse Tension test at 350°C - 1 no.

* For dished end, all mechanical & metallurgical test shall be done at both 0° & 180° of test coupon. Additional macro, micro & grain size test shall be done at corner of the bottom.

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- v) Impact test (set of three specimens) - 1 no.
- vi) Micro & Grain size - 1 no.
- vii) IGCT - 1no.
- viii) Delta Ferrite - 1no.
- ix) Product analysis - 1no
- x) Macro etch test - 1 no.

8.2.2 **Inclusion rating** - Minimum 6 nos. of specimens (two each at top, bottom & middle) for each bloom at intermediate stage of production

8.2.3 **Hardness test** : Survey on each product.

8.2.4 **Stress Corrosion cracking** - 1 no. from one forging per melt and heat treatment

8.3 Detailed Requirement of Tests

8.3.1 **Tensile tests** : ASTM A370, E21 & E8. Largest standard gauge dia. Specimens of Gauge length = 5d shall be used. If not possible, standard sub size specimen of largest possible gauge dia. May be used after mutual agreement. Stress strain diagram for all tests shall be provided. 0.2% YS shall be obtained by extensometer or stress strain diagram with min. 100X magnification. For high temperature test, minimum 3 thermocouples on different locations on gauge length of specimen shall be used. Soaking period shall be minimum 20 min.

Acceptance:	RT	350 °C
Tensile strength(Mpa) Min	485	420
0.2% Proof strength(Mpa) Min	205	135
1.0% Proof strength(Mpa)	*	*
Elongation on 50 mm % Min	30	*
Reduction in area % Min	45	*

(* values to be reported)

8.3.2 **Impact test**: ASTM A370. at RT (20 °C) Orientation: Longitudinal axis of specimen shall be normal to principal working direction. The energy absorbed, shear fracture & lateral expansion to be reported.

8.3.3 **Hardness test**: ASTM A370. on each forging: along 2 lines 180° apart on both top and bottom surface and along length of forging. For associated test plate / pipe and test coupon - on 200 x 200 mm grids shall be used. Acceptance: HB 192 max.

8.3.4 **Macro etch test**: as per ASTM E340 & E381. On all end surfaces of the forgings.. Surfaces to be free of macro cracks, dendrites and segregation. Surfaces shall be checked for flow lines & internal imperfection. Photograph to be provided. Acceptance S2, R2, C1. Procedure for testing shall be submitted for approval.

8.3.5 **Grain size and micro structure**: As per ASTM E 112. At 100x magnification, parallel to the main deformation direction,. Photo micro graph at 200x to be provided. Structure to be homogeneous. Grain size shall be 5 or finer. Procedure for testing shall be submitted for approval.

8.3.6 **Inclusion Rating** : As per ASTM E45 Method D Plate III. Examination surface direction shall be along the grain flow (normal to principal working direction). Heavy series not allowed. Thin series - 1.5 for each category A, B, C & D) shall be aimed for. Procedure for testing shall be submitted for approval.

8.3.7 **Delta Ferrite**: Acceptance: 4 to 10%. The melting of base material for this purpose shall be carried out using TIG torch & the introduction of heating & cooling shall correspond to the TIG welding conditions. TIG torch parameters and ferritoscope details to be used shall be submitted for approval.

8.3.8 **Inter granular corrosion resistance test (IGCT)**: As per ASTM A262 practice E. Specimen (taken out from T/4 depth) shall be subjected to sensitisation heat treatment (1 solution exposure for 24 hrs.). Specimen shall be bend on mandrel dia of 1'T' (Equal to Thickness). Absence of IGC shall also be confirmed by Micro test at min. 250X. Original Photographs shall be provided. Procedure for testing shall be submitted for approval.

8.3.9 **Stress corrosion cracking**: ASTM G36. U bend specimen as per ASTM G30. Boiling: in MgCl₂ solution. Test specimen shall be fully immersed in test solution. Examination shall be done under 400x magnification and using LPI. Time of crack initiation to be reported.. Test shall be conducted for min. 100 Hrs. Procedure for testing shall be submitted for approval.

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8.4 Retests if required shall be done with the approval of Purchaser.

9.0 NON DESTRUCTIVE TEST

9.1 Stage of test : After HT on contours as close as possible to final contour.

9.2 Surface finish for UT: 6.3 μ m or better to ensure required test sensitivity.

9.3 ULTRASONIC TESTING (UT)

9.3.1 100% volume as per SA388 & SA745 (latest revisions), using reference block technique. Min. 3 point Distance amplitude correction (DAC) curve shall be generated to cover full thickness.

9.3.2 Reference Blocks for UT Calibration

i) Reference Defects : For straight beam, Dia 3 mm flat bottom hole (FBH). For Angle beam, 25 mm long axial & circumferential notches having a depth of max. 3% of final design thickness to be specified for each forging or 6 mm whichever is less. For curved / cylindrical forgings, FBH & notches will be required both on OD & ID.

ii) Reference FBH & notches can be m/c'd on integral extension/extra margins on the product. Separate reference blocks from acoustically similar (back wall echo within 25% for same thickness & geometry) material that has similar chemistry and processing history can also be used.

iii) Reference blocks used shall also be supplied.

9.3.3 Scanning Directions Normal beam from all accessible surfaces. Angle beam from OD & ID in two circumferential and two axial directions. For rod, disks and cylindrical forgings, angle beam scanning in axial direction need not be done if normal beam scanning in axial direction with required sensitivity is done.

Additional for plates : Continuous parallel paths, transverse and parallel to major axis with min. 10% overlap for both normal & angle beam.

9.3.4 Recording & Acceptance: All indications equal and above 50% of DAC (Reference defect indication) shall be recorded for review. Crack like indications irrespective of echo height are unacceptable. Indication less than that from reference hole/notch shall normally be acceptable.

9.4 LPI & Visual

9.4.1 100% surface as per practice E 165. Test chemicals shall not contain halogen and sulphur more than 25 PPM. Following relevant indications (indications having major dimensions greater than 1.6 mm) are unacceptable:-

- i) Any linear indications of length greater than 1.6 mm for materials less than 16 mm thick, and greater than 3.2 mm for material 16 mm thick or more.
- ii) Rounded Indications with dimensions greater than 3.2 mm for thickness less than 16mm and greater than 4.8 mm for thickness 16mm and greater.
- iii) Four or more relevant indication in a line separated by 1.6 mm or less edge to edge
- iv) Ten or more relevant indications in any 3871 mm² of area whose major dimension is no more than 152 mm with the dimensions taken in the most unfavourable location relative to the indications being evaluated.

10.0 FINISH

Free from mill scales and injurious defects like scales, laps, seams, folds, cracks, string, tears, blisters, scratches, etc.

11.0 REPAIR

Repairs involving fusion welding is not permitted. Surface defects can be removed by mechanical means with the approval of PURCHASER and the defective areas shall be smoothly dressed up with the adjacent surface followed by LPI. The minimum thickness after repair shall meet the drawing/specification requirements. Details shall be recorded.

12.0 NON - CONFORMANCE

All non-conformities shall be recorded & reported for the approval of purchaser.

13.0 MARKING

Engraving on each item with the following details (apart from specification) with low stress stamps, and identified by a halogen free painted border line.

- | | | |
|------------------------------|--------------------------|--------------------------------|
| 1. Maker's name | 4. Specification & grade | 7. PURCHASER |
| 2. Size | 5. Maker's emblem/code | 8. Inspecting authority's seal |
| 3. Melt & Heat treatment no. | 6. Drawing no. | |

14.0 PRESERVATION AND PACKING

After passivation, all surfaces shall pass white cloth swab test. Sea worthy packing shall be ensured. Procedures / plans shall be submitted for these.

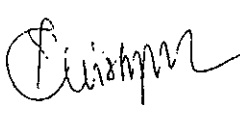

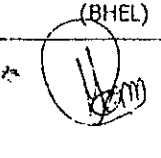
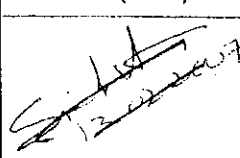
15.0 INSPECTION AND CERTIFICATION

The supplier shall confirm that the product comply with this specification. The inspection & tests shall be carried out in presence of the third party inspecting agency authorised by PURCHASER and also the Purchaser's Inspectors. All inspection reports & test certificates shall be submitted to PURCHASER for approval along with manufacturer's comments on the same. Shipping shall take place only after clearance / approval from PURCHASER. Each item shall be backed by 5 copies of test certificate furnishing the following details legibly in English language and certified by the inspecting authority:

1. Purchase Order no.(PURCHASER), MPS no. & Test certificate no.
2. Specification & Grade with applicable year of code
3. Quantity & Size
4. Drawing no.
5. Heat no.
6. Steel making process
7. Chemistry including incidental elements - Ladle & Product analysis
8. HT details of the material & test coupons
9. Mechanical & Metallurgical test results as per para 6.0
10. NDE test results with reference & acceptance standard
11. Repairs details, if any
12. Cleaning & surface treatment details
13. Dimensional reports
14. All recorded documents as in clause 3.1) & any other report/ procedure called for

16.0 AUDIT CHECKS AT PURCHASER.

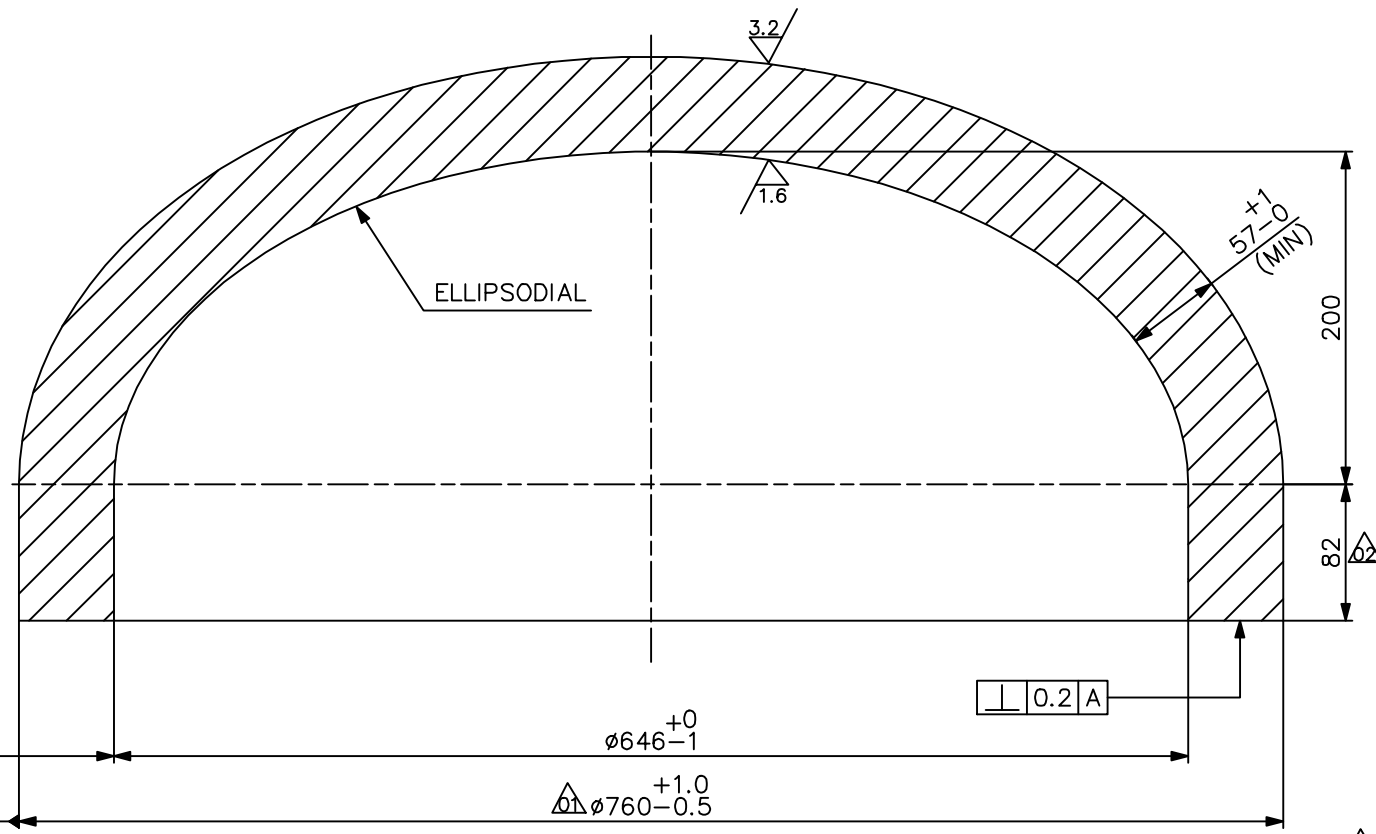
PURCHASER reserves the right to carry out audit checks for chemistry, HT condition, mechanical testing, metallurgical testing & NDT on representative test bars or plates or on the job, at their discretion. If any item is found to be defective during check tests or during subsequent processing at PURCHASER place, such items are liable for rejection.

Prepared (BHEL)	Reviewed (PlantLab/BHEL)	Approved (BHEL)	Approved (BARC)
 K. Krishnamoorthi	 P. Sundaramoorthy	 M Ponnusamy	 13-12-2007

APR
Y. Srinivas

3-90-628-00934
DRAWING NO:

ALL DIMENSIONS ARE IN MILLIMETERS



NOTES: —

1. MATERIALS SPECIFICATION: SA336 F321 AND AS PER APPROVED TDC.
2. MANUFACTURE, EXAMINATION & TESTING: AS PER APPROVED TDC.
3. THE COMPONENT SHALL BE FORGED AS CLOSE TO THE FINISHED SHAPE AS POSSIBLE.
4. THE COMPONENT SHALL BE SUPPLIED IN FINISH MACHINED CONDITION AS SHOWN.
5. DETAILED DRAWING INDICATING VARIOUS SAGES OF MANUFACTURE, AND LOCATION OF TEST SPECIMENS SHALL BE SUIMITTED FOR PURCHASER'S APPROVAL BEFORE START OF PRODUCTION.
6. IN ADDITION TO THE TOP DISHED HEAD, PTC REQUIREMENTS SHALL BE MADE FROM THE SAME MELT AND HEAT TREATMENT BATCH AS PER DRG. NO: 3-90-628-00937.
7. QTY. — 5 Nos.

AS PER IS:2102-1969					
TOLERANCE IF UNSPECIFIED SHALL BE AS PER TABLE BELOW. ALL DIMENSOINS ARE MM. UNLESS SPECIFIED OTHERWISE					
LINEAR				ANGULAR	
DIMENSIONS	TOL	DIMENSIONS	TOL	DIMENSIONS	TOL
UP TO 6	±0.1	315-1000	±0.8	UP TO 10	± 1'
6-30	±0.2	1000-2000	±1.2	10 TO 50	± 30'
30-120	±0.3	2000-4000	±2.0	50 TO 120	± 20'
120-315	± 0.5	4000-8000	± 3.0	120 TO 400	± 10'
RADII AND CHAMFERS	0.5-3	3-6	6-30	400 UPWARDS	± 05'
TOLERANCE	+/-0.2	+/-0.5	+/-1.0	PERMISSIBLE DEVIATIONS FOR RANGE OF LENGTHS IN MILLIMETERS OF THE SHORTER SIDE OF THE ANGLE CONCERNED.	

REV	DATE	ALTERED :	REV	DATE	ALTERED :
02	271206	CHD&APPD : <i>[Signature]</i>	01	061006	CHD&APPD : <i>[Signature]</i>

DETAIL-B DELETED BY BARC
SURFACE FINISH ADDED & NOTE NO.5
REVISED BY BARC

DISHED HEAD OD MODIFIED.

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

I/III HEAT EXCHANGER
(W.O.: D125 to D129)



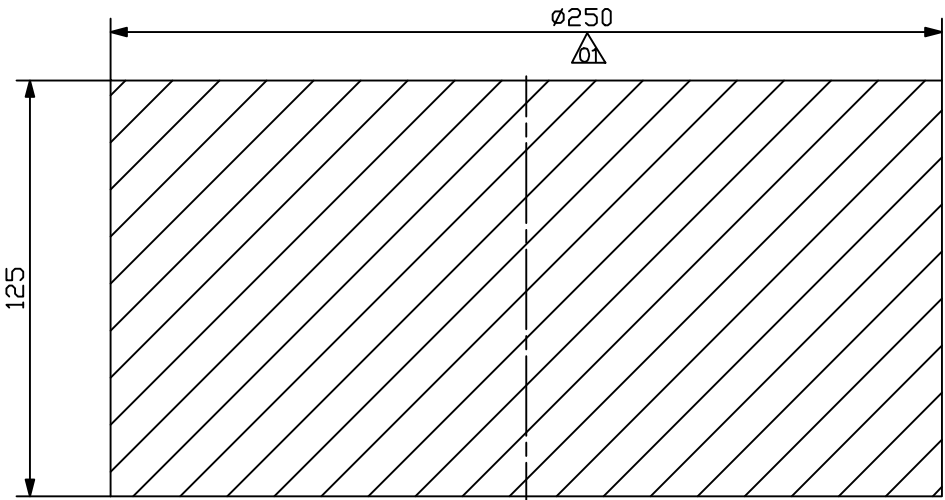
Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014

DEPT NC	GRADE OF UNTOL DIM C/M/F	SCALE 1: 4	WEIGHT (Kg) 365	REF TO ASSY / OLD DWG	ITEM NO	No OF ITEMS
CODE 150						
TITLE TOP DISHED HEAD (ELLIPSODIAL)			CARD CODE U 01	DRAWING NO : 3-90-628-00934		REV 02

Size A3

3-90-628-00935
DRAWING NO:

ALL DIMENSIONS ARE IN MILLIMETERS



NOTES: —


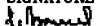


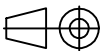
1. MATERIALS SPECIFICATION: SA336 F321 AND AS PER APPROVED TDC.
2. MANUFACTURE, EXAMINATION & TESTING: AS PER APPROVED TDC.
3. THE COMPONENT SHALL BE SUPPLIED IN FINISH MACHINED CONDITION AS SHOWN.
4. SURFACE FINISH SHALL BE $\sqrt{6.3}$ OR FINER ALL OVER.
5. DETAILED DRAWING INDICATING VARIOUS STAGES OF MANUFACTURE, AND LOCATION OF TEST SPECIMENS SHALL BE SUIMTTED FOR PURCHASER'S APPROVAL BEFORE START OF PRODUCTION.
6. IN ADDITION TO THE GUIDE BUSH, PTC REQUIREMENTS SHALL BE MADE FROM THE SAME MELT AND HEAT TREATMENT BATCH AS PER DRG. NO: 3-90-628-00937.
7. BLOCK SIZE : $\varnothing 250 \times 125$ THK
8. BLOCK QTY. — 7 Nos.

AS PER IS: 2102-1969					
TOLERANCE IF UNSPECIFIED SHALL BE AS PER TABLE BELOW. ALL DIMENSOINS ARE MM. UNLESS SPECIFIED OTHERWISE					
LINEAR				ANGULAR	
DIMENSIONS	TOL	DIMENSIONS	TOL	DIMENSIONS	TOL
UP TO 6	± 0.1	315-1000	± 0.8	UP TO 10	$\pm 1'$
6-30	± 0.2	1000-2000	± 1.2	10 TO 50	$\pm 30'$
30-120	± 0.3	2000-4000	± 2.0	50 TO 120	$\pm 20'$
120-315	± 0.5	4000-8000	± 3.0	120 TO 400	$\pm 10'$
RADI AND CHAMFERS	0.5-3	3-6	6-30	400 UPWARDS	$\pm 05'$
TOLERANCE	$+/-0.2$	$+/-0.5$	$+/-1.0$	PERMISSIBLE DEVIATIONS FOR RANGE OF LENGTHS IN MILLIMETERS OF THE SHORTER SIDE OF THE ANGLE CONCERNED.	

REV	DATE	ALTERED :
01	130107	CHD&APPD :

BLOCK SIZE AND BLOCK QTY. CHANGED BY BARC.
NOTE NO.5 REVISED BY BARC.

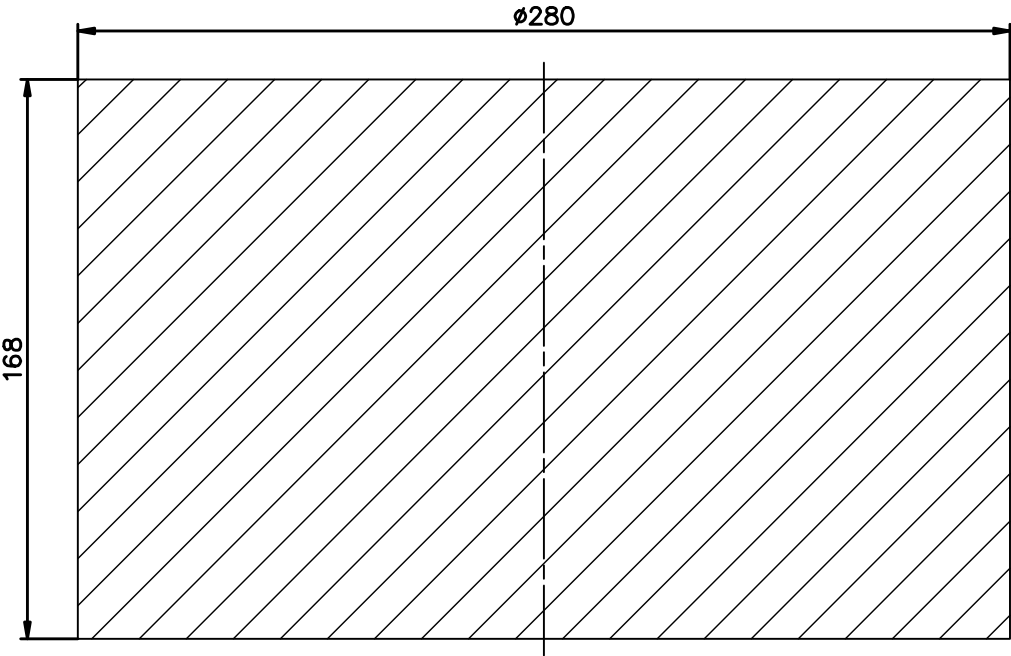
CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT			I/III HEAT EXCHANGER (W.O.: D125 to D129)							
 05-229/D			Bharat Heavy Electricals Ltd		DRN	NAME NJR/STV	SIGNATURE 	DATE 140906	No. OF VAR	
			UNIT: HIGH PRESSURE BOILER PLANT		CHD	RR/S.K		140906		
			TIRUCHIRAPALLI - 620014		APPD	SK		140906		
DEPT NC	GRADE OF UNTOL DIM		SCALE	WEIGHT (Kg) 50	REF TO ASSY / OLD DWG				ITEM NO	No OF ITEMS
CODE 150	C/M/F		1:2							
TITLE GUIDE BUSH					CARD CODE U 01	DRAWING NO : 3-90-628-00935				REV 01

Size A3

3-90-628-00936
DRAWING NO:

ALL DIMENSIONS ARE IN MILLIMETERS



NOTES: -


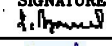

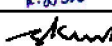
1. MATERIALS SPECIFICATION: SA336 F321 AND AS PER APPROVED TDC.
2. MANUFACTURE, EXAMINATION & TESTING: AS PER APPROVED TDC.
3. THE COMPONENT SHALL BE SUPPLIED IN FINISH MACHINED CONDITION AS SHOWN.
4. SURFACE FINISH SHALL BE $\sqrt{6.3}$ OR FINER ALL OVER.
5. DETAILED DRAWING INDICATING VARIOUS STAGES OF MANUFACTURE, AND LOCATION OF TEST SPECIMENS SHALL BE SUIMTTED FOR PURCHASER'S APPROVAL BEFORE START OF PRODUCTION.
6. IN ADDITION TO THE GUIDE BUSH, PTC REQUIREMENTS SHALL BE MADE FROM THE SAME MELT AND HEAT TREATMENT BATCH AS PER DRG. NO: 3-90-628-00937.
7. BLOCK SIZE : $\varnothing 280 \times 168$ THK
8. BLOCK QTY. - 7 Nos.

AS PER IS: 2102-1969					
TOLERANCE IF UNSPECIFIED SHALL BE AS PER TABLE BELOW. ALL DIMENSOINS ARE MM. UNLESS SPECIFIED OTHERWISE					
LINEAR				ANGULAR	
DIMENSIONS	TOL	DIMENSIONS	TOL	DIMENSIONS	TOL
UP TO 6	± 0.1	315-1000	± 0.8	UP TO 10	$\pm 1^{\circ}$
6-30	± 0.2	1000-2000	± 1.2	10 TO 50	$\pm 30'$
30-120	± 0.3	2000-4000	± 2.0	50 TO 120	$\pm 20'$
120-315	± 0.5	4000-8000	± 3.0	120 TO 400	$\pm 10'$
RADI AND CHAMFERS	0.5-3	3-6	6-30	400 UPWARDS	$\pm 05'$
TOLERANCE	$+/-0.2$	$+/-0.5$	$+/-1.0$	PERMISSIBLE DEVIATIONS FOR RANGE OF LENGTHS IN MILLIMETERS OF THE SHORTER SIDE OF THE ANGLE CONCERNED.	

REV	DATE	ALTERED :
01	130107	CHD&APPD :

BLACK QTY. & NOTE NO.5 REVISED BY BARC.

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		I/III HEAT EXCHANGER (W.O.: D125 to D129)						
 05-229/D		Bharat Heavy Electricals Ltd UNIT: HIGH PRESSURE BOILER PLANT TIRUCHIRAPALLI - 620014		DRN	NAME NJR/STV	SIGNATURE 	DATE 140906	NO. OF VAR
DEPT NC	GRADE OF UNTOL DIM C/M/F		SCALE 1:2	WEIGHT (Kg) 85	CHD	RR/SK	140906	
CODE 150				APPD	SK		140906	
TITLE NECK				CARD CODE U 01	REF TO ASSY / OLD DWG			ITEM NO
				DRAWING NO : 3-90-628-00936				REV 01

Size A3