BHARATH HEAVY
ELECTRICAL LIMITED
RAMACHANDRAPURAM
HYDRABAD-502032
ANDHRA PRADESH, INDIA

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Telex : 425-6212,6248,6777,6778,
0422-240
Fax : 009-040-0321910,3021954,3020195

ENQUIRY

PURCHASE DEPARTMENT

SUPPLIER CODE: NEWSUP Name&Address	Enquiry No.	Enq. Date	No. of. Items	DUE DATE OF QUOTATION
	B508IT8A1853SR1	**29-DEC-08**	**001**	**24-JAN-09**

Enq. Sl.No	Indent (MPR) No.	Material Code	Drawing No. Description& Specification	Unit Code	Unit	Quantity	Delivery Schedule	
							Date	Quantity
001	IT8P1852 001 IT8P1853 001	TC9518050023	ROTOR FORGING SPEC : HY19480 REV:00 AMND:00 VAR:00 DRG : 33030120154 VAR:00 REV:01	01	NOS	2.000	31-AUG-09	2.000

Remarks:
1) Vendor shall submit the filled format of ANNEXURE-I (Check list for Techno-Commercial terms) along with their technical bid. 2) All necessary documents of this enquiry has sent by E-mail on dated : 29/12/2008.

TEST CERTIFICATE REQ:
YES
GUARANTEE RAQ:
YES
SAMPLE REQ:
NO

For and on-behalf of
Bharat Heavy Electricals Limited

SAMBASIVARAMI REDDY G
DY MANAGER / PURCHASE TC & GT

ANNEXURE - I

TWO PART BID SYSTEM

ENQUIRY NO : B508IT8A1853SR1, Dtd:29/12/2008. DUE DATE: 24/01/2009.

This is a mandatory document to be filled and attached to your technical bid for evaluation
(Otherwise your bid will be disqualified)

CHECKLIST OF GENERAL TERMS & CONDITIONS OF ENQUIRY

Sl. No.	Terms & Conditions	Supplier confirmation	Deviations / Remarks
1.	Two Part Bid shall consist of: • Techno commercial Bid, with all technical specification & scope and all applicable Commercial Terms and Conditions including applicable duties/taxes/other charges, except the price, AND • Price Bid, containing ONLY the price and duties/taxes/other charges applicable and should not contain any technical and commercial terms and conditions. a) Technical bid and price bid should be submitted in separate sealed covers – putting them in third cover. b) The details like Tender No, Due Date, Technical Bid or Price Bid, as the case may be, shall be clearly super-scribed on each cover. The third cover containing both technical and price bid covers should be super-scribed with Tender No, Due date and Supplier name. c) Techno-commercial Bid will be opened first and after freezing technical and commercial conditions only, the Price Bid will be opened. d) The date for the Price Bid opening shall be intimated to all the Techno-commercially qualified bidders before the Price Bid is opened. e) The bidder (s) will also be informed, if their Tehno-commercial bid is not acceptable		
2.	**Revised offers :**. a) The bidders will be allowed to submit the impact due to changes in technical scope /commercial terms. b) Revised offers will not be accepted unless asked for/ or any changes in specification/drawings.		
3.	**Offer validity** should be 90 days minimum from date of Technical bid opening.		
4.	Quoted PRICES (after placement of P.O) shall be FIRM and valid till complete execution of the Order without any escalation/increase for any reason whatsoever.		
5.	**Payment Terms**: • For Indian vendors: 100% payment within 90 days (45 days incase of SSI Units) from the date of dispatch of materials. • For Foreign vendors: 100% payment against irrevocable LC (LC will be opened 30 days prior to dispatch schedule).		
6.	**Packing** :- Packing & forwarded charges if any shall be included in your quoted price.		
7.	**Terms of Delivery:** The items are to be quoted on **Ex-WORKS / FOR – BHEL STORES** for Indian vendors and **FOB – Nearest Port** for Foreign vendors.		

	Delivery Period: _____ weeks/months from the date of LOI/PO Delivery shall be strictly quoted w.r.t. the date of LOI/PO only and not linking to any other aspects like approval of drawing/data sheelts/QP etc. Please note that delivery is the essence of the tender. Offers of best delivery schedules will be preferred.		
8.	**Third Party Inspection:** (Mandatory) 1. The vendor shall submit the test procedure and quality plan for approval immediately on placement of order. These items shall be inspected by M/s LLOYDS (Inspection agency). 2. Inspection charges shall be inclusive in your offer.		
9.	**Guarantee:** Materials should be guaranteed for a period of 18 months from date of supply or 12 months from the date of assembly, whichever is later.		
10.	**Penalty:** a) Penalty (Not Liquidated Damages) will be levied @ 0.5% per week of delayed supply (w.r.t Delivery clause) not exceeding 10% of Total Order value b) No grace period allowed for calculating penalty period. c) Delivery for penalty purpose is w.r.t LR date/ Excise invoice date/ Third party inspection clearance certificate date.		
11.	a) Price Bids Shall be evaluated on landed cost basis i.e., TOTAL COST TO BHEL (after considering CENVAT or VAT benefit, if any) and w.r.t the finalised Technical Scope and Commercial conditions only. b) In case BHEL decides to load the vendor/vendors on any deviations on Commercial condition(s) whatsoever, it shall in advance intimate such criteria for loading to the concerned vendors before price bid opening c) In case of Multiple items, BHEL has the right to evaluate and arrive at the lowest bidder on Individual item / Total basis at its discretion, and in the interests of BHEL.		
12..	If you are new supplier, please indicate the source of Raw material in your technical bid.		
13.	BHEL reserves the right to increase / decrease the quantity indicated in the enquiry.		
14.	Supply should strictly confirm to BHEL drawings / specifications. All tests should be carried out as per BHEL drawings / specifications. All Test certificates, guarantee certificates and Pre inspection reports (PIR) should be furnished along with dispatch documents.		
15.	a) In case of first time supply to BHEL Hyderabad, vendor should comply with the requirements of HY0800099 (first-piece qualification) and HW0850197 (thermal stability test). However, these requirements can be reviewed based on the reference list of the vendor. b) Vertical heat treatment is mandatory. c) Vendor should specifically confirm all clauses of the relevant specifications for every item quoted. d) Reference list along with documentary evidence shall be provided along with techno-commercial bid for evaluation.		
16.	BHEL may choose for placing repeat order for additional quantity, as and when required, with the acceptance of vendor.		
17.	BHEL reserves all rights for rejecting any or all offers without assigning any reason therefore in the interests of BHEL.		

18.	Vendors shall submit offers within the due date. If, no communication is received from any vendor within the due date, it will be deemed that the vendor can not meet our delivery / technical requirements.		

NOTE TO VENDORS:

a)For new vendors supplying rotors for the first time to BHEL Hyderabad, the clause 16 of the above should be confirmed specifically.
b)Vendors to indicate their response to each of the above clauses either by 'YES' or "NO' in the Supplier confirmation column.
c) Vendors , if taking deviations from the specified conditions , may indicate the same clearly in deviation column and if needed on a separate sheet, with reasons for such deviation and in such a case BHEL reserves the right to reject the offer summarily or load the vendor suitably – solely at its discretion and in its interests.
d) Commercial Conditions quoted in any place other than this format , including stated in Vendor's General Terms and conditions enclosed, if any , shall be summarily ignored and be invalid for evaluation of the Preferred Bidder.
e) Who ever desires to send offers on their own risk (complete in all respect) via E-mail have to send the scanned copies of offers duly signed and stamped, to the common E-mail address – tenderbox@bhelhyd.co.in.Offers sent to any other E-mail ID or in-complete offers or offers without signature and stamp of the vendors shall be treated as un-solicit and will not consider for evaluation purpose.
f) In case of regret, same letter shall be given in open condition (not in sealed cover) or by E-mail to gsrreddy@bhelhyd.co.in.
g) Vendors to note that the above are specific Terms & conditions only , and in respect of other terms and conditions, BHEL's General Terms & conditions will apply and the same can be obtained upon making a request.

Signature of the supplier with stamp.

ALLOY STEEL FORGINGS FOR STEAM TURBINE ROTORS

GR: 23 Cr Mo Ni W V 88

1.0 GENERAL :

This specification governs the technical requirements of steam turbine rotors forged out of steel grade 23 Cr Mo Ni W V 88.

2.0 APPLICATION :

Steam turbine rotors for combined HP/LP cylinder.

3.0 CONDITION OF DELIVERY :

The rotor forgings shall be supplied in dual heat treated and rough machined condition.

4.0 COMPLIANCE WITH NATIONAL STANDARD :

There is no national standard covering this grade of material. However, guidance is taken from Siemens AG Specification No.0-2811-0000-21 (Feb.95).

5.0 DIMENSIONS AND TOLERANCES :

The rotor forgings shall be supplied to the dimensions shown on the ordering drawing. The tolerance shall be as follows unless otherwise specified in the drawing/order.

Upto 500 mm	+ 1 mm
Over 500 mm	+ 2 mm

6.0 MANUFACTURE :

The steel shall be made from basic electric furnace and shall be subsequently refined by Vacuum Carbon Deoxidation (VCD) or Electro Slag Refining (ESR) process. Any other process (like CAB etc.) are acceptable subject to prior approval of BHEL.

Sufficient discard from Top and Bottom shall be made from the ingot to ensure freedom from piping segregation and other injurious defects. The forging process adopted shall ensure homogenity of material throughout the section. It is important to maintain the actual centre of the forging, as far as possible identical with the centre of the ingot. Press straightening, if necessary, may be performed before heat-treatment.

The initial ingot dimensions, general forging process and manufacturing plan shall be submitted alongwith the offer for approval of BHEL.

After heat-treatment, the forging shall be rough machined, to the dimensions and surface finish shown on the ordering drawing.

7.0 CLOCKING SYMBOLS :

Before heat-treatment, clocking symbols 3-6-9-12 shall be stamped on the rotor. If the symbols are transferred during manufacture, they shall be restamped in the same clockwise position. The clocking symbols shall be used for reference purposes in recording the position of defects, etc. the clocking symbols shall be encircled with oil paint for easy identification.

8.0 CHEMICAL COMPOSITION :

The chemical composition of the material in laddle analysis shall be as follows :

Element		C	Si	Mn	Cr	Mo	Ni	W	V	P	S	Al (total)
VCD Pro-cess	Min	0.21	-	0.65	2.05	0.80	0.70	0.60	0.25	-	-	-
	Max	0.23	0.10	0.75	2.15	0.90	0.80	0.70	0.35	0.007	0.007	0.008
ESR pro-cess	Min	0.21	-	0.65	2.05	0.80	0.70	0.60	0.25	-	-	-
	Max	0.23	0.20	0.75	2.15	0.90	0.80	0.70	0.35	0.007	0.005	0.010

For CAB process Si and Al are permitted upto 0.15 & 0.010 max. respectively. All other elements levels shall be similar to VCD Process.

Small deviations in chemical composition are permissible only after approval from BHEL, provided that the specified properties are not impaired.

8.1 **Tramp Elements :** The content of tramp elements such as Cu, As, Sn, Sb shall be low enough to avoid temper embrittlement. The values actually obtained shall be reported in the test certificate for the information of BHEL.

9.0 HEAT TREATMENT :

9.1 Using selective heat treatment, excellent creep characteristics in HP part and good toughness and/or fracture toughness characteristics in LP part can be obtained. For this optimum Quenching and Tempering temperatures must be selected. Vertical liquid/mist tempering must be carried out with a cooling intensity matching the above characteristics. Tempering shall be done in vertical condition. If vertical Tempering facilities are not available, prior approval of BHEL shall be taken for any alternative method.

9.2 Lowest Residual stress must be aimed with proper tempering cycle, including cooling rates from tempering temperatures.

In case of first supply of a new manufacturer, residual stresses attained in the forging shall be checked by 'Ring core' Method. The residual stresses shall not be more than 60 N/mm^2 at any point on the surface. Only after establishing a proper manufacturing cycle including heat treatment cycle, the Residual stress measurement can be dispenased with.

9.3 In case the required properties have not been obtained, reheat-treatment of the forging is to be carried out. The maximum number of reheat-treatments permitted are two. However, retempering is bot considered as reheat treatment.

10.0 SELECTION OF TEST SAMPLES :

10.1 The location of the test pieces shall be shown on the ordering drawing. The test samples shall not be removed before heat treatment.

10.2 The test samples are to be clearly identified with identification number. The association with the forging is to be conformed by BHEL inspector / Lloyd's. the balance material shall be delivered alongwith the forging.

10.3 **Axial Core:** An axial core of ≥ 60 mm dia. must be taken from the LP side journal area of the rotor. The position of the axial core follows from the ordering drawing. Independent of the drawing data, the rotor is to be placed in the forged block in such a way that the axial core lies at the top end of the ingot. The clearance for drilling axial trepanned core shall be given by BHEL depending upon the pattern of results of tangential test specimens, ultrasonic test and residual stress measurements.

Axial core shall be clearly identified so that their original position on the rotor are correlated.

11.0 MECHANICAL PROPERTIES :

11.1 The mechanical properties, when tested on the tangential test pieces shall conform to the following at room temperature.

	Tensile strength N/mm^2 Max.	0.2% proof stress N/mm^2	% Elongation L = 5d min.	% Reduction in area min.	Impact strength J. min.
HP part	830	600-680	15	40	80
LP part	860	630-710	15	40	120

Note: a) Tensile test shall be carried out as per IS:1608 or any National standard.

b) Impact test shall be carried out as per IS:1757 ISO-V notch or any National standard. The minimum impact strength value specified above is the average of three samples at the same location. Only one value is permitted below the specified min. value, but in no case shall be lower than the 2/3 of the same. All values shall be reported in test certificate.

c) The tangential ring must marked clearly with code No. The matching with the forging must be confirmed by the third party inspector through his stamp., the rings must be separated from rotor forging and delivered with the forging.

T: Tangential test piece Q: Radial test piece

11.2 **Axial Core:** The following properties shall be obtained on the axial core samples for the LP part.

0.2% proof Stress	:	630 N/mm^2 Min.
Impact Strength	:	80 J Min. at Room Temperature
(Average of 3 samples) ISO-V notch	:	(in Radial direction).
FATT	:	+ 25°C Max. (in Radial direction).

11.3 BHEL reserves right to extend the LP side axial core uptill the rotor body. In this case, a changed drawing forms the basis.

The following properties shall be achieved in the rotor body area.

0.2% Proof Stress	:	630 N/mm^2 Min.
Impact Strength	:	70 J Min. (in Radial direction)
(ISO-V notch, Average of 3 samples)	:	at Room Temperature.
FATT	:	+ 35°C Max. (in Radial direction).

12.0 **NON-DESTRUCTIVE TEST :**

12.1 **Ultrasonic Test:** The forgings after heat treatment and machanical testing shall be subjected to ultrasonic test, according to impulse echo method with 2-4 MHz normal probe (and special probe if required) over 100% of its surface. In case 100% ultrasonic test is performed prior to heat treatment (which is at the discretion of the supplier) the results of the same shall be compared with the results of the test conducted after heat treatment. In case differences are found, the same shall be mentioned in the test certificate.

Distance Gain size (DGS) method shall be employed for evaluation of indications. The following indications are not allowed.

i) Randomly distributed individual indications with an equivalent flaw size greater than or equal to dia 4 mm. In the near surface region of LP side rotor body upto a depth of approx. 130 mm, equivalent flaw size greater than or equivalent to dia 2 mm is not acceptable.

ii) All individual indications, which supress back wall echo by more than 10%.

iii) All indications either linear or globular forming cluster, irrespective of the size of individual indication.

iv) All indications more than 2 mm dia equivalent flaw size are to be recorded in a scale drawing, with reference to the clocking symbols.

12.2 The axial bore hole after extracting the axial core, must be subjected to a magnetic crack test. The findings shall be reported to BHEL for acceptance.

13.0 THERMAL STABILITY TEST :

If mentioned in the drawing or purchase order, Thermal Stability test shall be carried out at 30°C below the tempering temperature according to BHEL, Hardwar Standard HW 085 01 97. A and D type swings will not be considered when they are explainable due to surface effect. In case of occurance of B type swing the test shall be conducted till no more stresses are left to be released. C type swing greater than or equal to 0.05 mm shall not be allowed. BHEL Hyderabad reserves right to participate for verfication.

14.0 INSPECTION AT SUPPLIER'S WORKS:

BHEL representative shall have all reasonable facilities offered to him, at any time, by the supplier to satisfy himself that the material is being furnished in accordance with this specification. The representative shall have free access at all times while the work on the contract is being performed, to all parts of the manufactures works.

15.0 TEST CERTIFICATES:

15.1 Five copies of test certificates giving the following details shall be furnished.

a) HY 19480 Rev.00
b) BHEL order No.
c) Item description and Drawing No. of the forging.
d) Supplier's Name.
e) Melt No. and Forge No.
f) Results of chemical analysis alongwith trace elements.
g) Results of Mechanical Tests & FATT.
h) Results of residual stresses.

i) Report of ultrasonic testing giving details of probe type and size, frequency, sensitivity, sketch showing the areas covered etc.
j) Ingot dimensions, forging sequence and details of heat treatment cycles followed.
k) Results of thermal stability test, if called for in the drawing/ purchase order.

15.2 The certificate shall be attested by chief of inspection/chief metallurgist of the supplier and BHEL representative.

16.0 MARKING :

The following details shall be punched clearly on one end of the forging.

a) HY 19480 Rev.00
b) Forging No. and Melt No.
c) Drawing No.
d) Manufacturer's Stamp
e) BHEL Inspector's stamp
f) Clocking symbols.
g) Top and Bottom sides of ingot

17.0 PACKING AND TRANSPORTATION :

Rotor forgings shall be properly protected from corrosion and damage during transit, journal portions shall be protected with anti-corrosive compound.

18.0 REJECTION AND REPLACEMENT:

In the event of any forging proving defective in machining, testing, erection and operation such forging shall be rejected not withstanding any previous acceptance. The supplier shall replace the rejected forgings at his own cost.

LIST OF APPLICABLE STANDARDS ON LIMITS, FITS AND TOLERANCES

1.0 SCOPE:

The standard covers the list of applicable standards on Limits, Fits and Tolerances. These standards are applicable unless or otherwise specified.

2.0 LIST OF APPLICABLE STANDARDS:

SL. NO.	STANDARD NO.		TITLE
1.	AA0230201	-	Limits and Fits (Tolerance grade, Position and Class).
2.	AA0230202	-	Limits and sizes for commercial bolts and nuts.
3.	AA0230204	-	Guide for selection of Fits.
4.	AA0230206	-	Standard limits for Shafts (upto 500 mm).
5.	AA0230207	-	Standard limits for Shafts (above 500 mm and upto 3150 mm).
6.	AA0230208	-	Allowable deviations for dimensions without specified tolerances (linear and angular).
7.	AA0230402	-	Permissible deviations for untoleranced dimensions of castings.
8.	AA0230403	-	Tolerancing system ISO Metric Screw Threads
9.	AA0621101	-	Tolerances and Machining allowances for Flame cutting.
10.	AA0621104	-	General tolerances for welding constructions for length and angles.
11.	AA0621105	-	General tolerances for welded structures – form and position.

NOTE:

1) AA 023 02 08

Medium class of deviation is applicable, if the same is not mentioned on the drgs./specs.

2) AA 023 04 02

Tolerance class 5 is applicable, if the same is not mentioned on the drgs./specs.

3) AA 062 11 04

Accuracy class A is applicable if the same is not mentioned on the drgs.

4) AA 062 11 05

Accuracy class E is applicable, if the same is not applicable on drgs.

	PLANT STANDARD HEEP–HARDWAR	HW 0850197 PAGE 1 OF 6

SUPERSEDES INVENTORY No. — BASED ON TWP.M151, 6/96 — SIGN & DATE

HEAT-STABILITY TEST

1.0 SCOPE:

This specification is valid for heat stability test for H.P and I.P rotor shaft forging of steam turbine.

2.0 REFERENCE DOCUMENTS:

Assistance has been taken from SEP 1950, 5/87 .

3.0 REASON FOR TESTING :

The heat stability test gives information of proper heat-treatment in respect of

- unsymmetrically distributed residual stresses remaining after the tempering operation, which may get relaxed during the service time and thus may cause bending of rotor (B type deflection).
- A rotationally symmetrical microstructure (C-Type deflection)

4.0 SHAFTS TO BE TESTED :

The heat stability test is carried out on shafts only, which have a service temperature of > 450°C. The rotors which have to work at temperature much lower than 150 °C from tempering temperature, insignificant stresses will be released & hence no stability test is required. In addition to these for low service temperature, the shafts are of material having excellent hardenability.

A heat stability test will be carried out in case of

- prototypes
- new suppliers
- special service conditions or service stresses(decision by design/calculation department)

SUPERCEDES THE [illegible] SHEET
UNDER THE SAME N[illegible]
CHANGE ADVICE No TSX-MTE-98-452
NAME ALS — SIGN — DATE 28.1.99

				NAME	SIGN & DATE
TSX	R. BHATIA	RBhatia/29-1-99	DRAWN		
QAX	TSKaith		WORKED	A.K.SARKAR	12.1.99
STE	A.S.		CHECKED	J.P. MEENA	12.1.99
AGREED DEPTT	NAME	SIGN & DATE	SUPERVISED	V.BARARA	12.1.99

REVISION :

APPROVED: PLANT STANDARDIZATION COMMITTEE

6.48

PREPARED:	ISSUED:	DATE:
MTE	STANDARDS DIVISION	29.1.99

INVENTORY No. P-22 — SIGN & DATE 21/2/99

5.0 TYPES OF DEFLECTION:

The possible types of deflection which can appear during the heat stability test are represented in Annexure : 01 (REFER SEP-1950, 5/87)

6.0 PERFORMANCE OF TEST :

The heat stability test is carried out in the rotational symmetrically machined condition after the completed heat-treatment operation as per the cycle given in Annexure:02.

6.1 Rate of heating up and Temperature Cycle:

About 50°C / hr

6.2 Testing Temperature:

Tempering temperature minus 30°C.

In special cases other temperatures can be agreed upon.

The testing temperature should lie above the service temperature as high as possible to assure that during the later turbine operation possibility of rotor deflection is avoided. The cycle (Ref. Ann:02) marked as firm/dark line is mandatory i.e. one dip of about 150 °C is essential as shown in sketch.

6.3 Cooling Rate:

To avoid new stresses during cooling from testing temperature to room temperature a cooling rate of about 15°C/h till approximately 200°C is to be applied; than a quicker cooling rate can be used.

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CHANGE ADV C. I 8 TSK-MTE-98-452
NAME AKS — SIGN — DATE 29-1-99

REVISION :				
	WORKED BY	AKSARKAR		12-1-99
	CHECKED BY	JPMEENA		12-1-99

6.4 Location of Deflection:

On the coupling a clockwise numbering is to be provided in direction of power run which makes possible the fixing of an appeared deflection on the circumference.

6.5 Readings:

Temperature, deflection and location of deflection are to be checked each hour and documented.

7.0 ACCEPTANCE CRITERIA :

A and D type deflections are caused by radiation and have no influence on the later turbine operation; here exists convection only. These are acceptable.

In case of detection of B - type deflections the cycling of testing temperature shall be continued till the rotor becomes stable, i.e. after the temperature dip of about 150 °C the deflection of the shaft shall lie approximately at the same level in each case at the end of the holding times at testing temperature. After reaching heat stability the shaft is acceptable, independent of the value of the B-type deflection.

C-type deflections ≥ 0.05 mm are not acceptable.

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UNDER THE SAME NO. B.R.
CHANGE ADVICE NO. TSK-MTE-98-452
NAME AKS SIGN DATE 12.1.99

REVISION :				
	WORKED BY	AKSARKAR		12-1-99
	CHECKED BY	JP MEENA		12-1-99

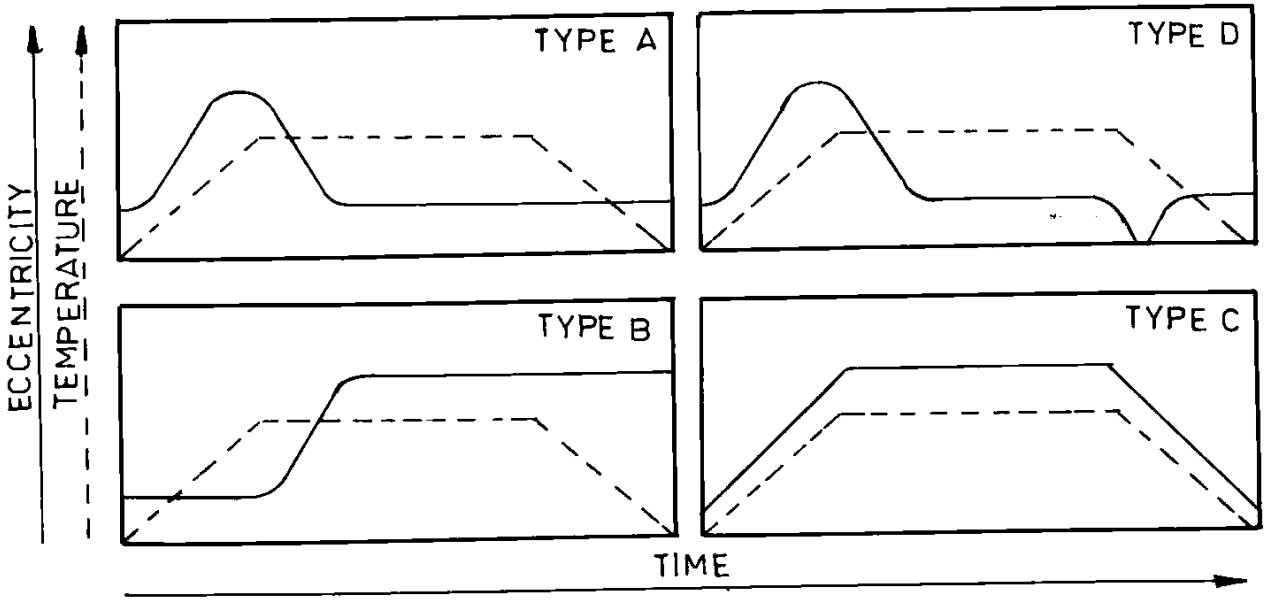
PLANT STANDARD

HEEP—HARDWAR

HW 0850197

ANNEXURE-01

TYPES OF DEFLECTION



SUPERCEDES THE OLD DRG. SHEET
UNDER THE SAME NUMBER
CHANGE ADVICE NO. TSX-MTE-98-452
NAME AKS SIGN DATE 29.1.99

WORKED BY	A.K.SARKAR		12.1.99
CHECKED BY	J.P.MEENA		12.1.99

P-22

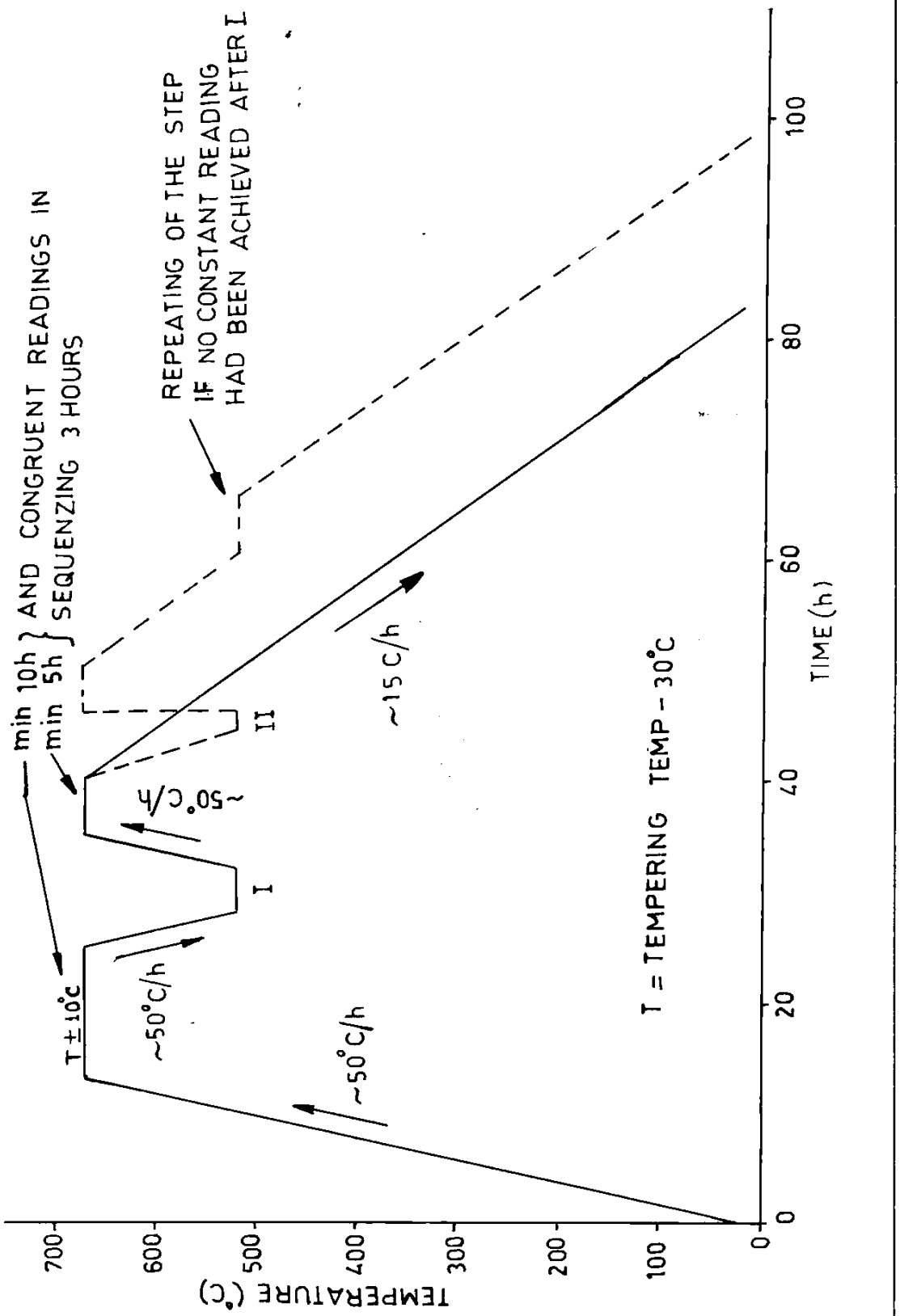
PLANT STANDARD

HEEP—HARDWAR

HW 0850197

PAGE 5 OF 6

ANNEXURE-02



WORKED BY	A.K.SARKAR		12-01-99
CHECKED BY	J.P.MEENA		12.01.99

INVENTORY NO P-22

SIGN & DATE 6/2/99

SUPERSEDES INVENTORY NO

SIGN & DATE

FORM DG 03

SIGN & DATE

INVENTORY NO SUPERSEEDS

PLANT STANDARD

HW 0850197

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ANNEXURE-I

RECORD OF CHANGES

REV CODE	NO OF CHGS	DOCU NO	SHEET NO	SIGN	DATE	REV CODE	NO OF CHGS	DOCU NO	SHEET NO	SIGN	DATE
C	-	TSX-MTE-98-452	SUPERSEDES OLD SPEC. UNDER THE SAME NUMBER		28.1.99						

(C) SUPERCEDES THE OLD DRG SHEET UNDER THE SAME NUMBER
CHANGE ADVICE NO. TSX-MTE-98-452 DATE 28/1/99
NAME AKS SIGN DATE

DISTRIBUTION OF PRINTS

DEPTT	TGE	STE	AME	DME	HGE	HTE	ACE	HXE	MTE	MRL	IN-SUL SYS	HLE	TSX	THC	PPX	MCX	CSX
		✓							✓	✓			✓				

DEPTT	AIX	OSX	CCX	FAX	TFX	TLX (J&T)	TTX-GTX	TTX ST	TTX HT	TTX EM	WT	QAX	QCX	PCM	WC 202	WC 205	WC 227
								✓				✓	✓				

DEPTT	FBM BL II	HTM WC276	STM WC236	TLM WC832	ACM WC291	CIM WC330	FGM WC356 /361	SUM WC370	WWM WC 386	HXM WC 390	WEX WC 6100	ESX	TRX	TAX	AVP	~~BP GTE~~	HY
																✓	4

SIGN. & DATE 21/2/99

INVENTORY NO. P-22

REVISION								
DRAWN								
WORKED	A.K.SARKAR		12.1.99					
CHECKED	J.P.MEENA		12-1-99					

PROCEDURE FOR FIRST PIECE QUALIFICATION OF STEAM TURBINE ROTOR FORGINGS

1.0 SCOPE

This testing procedure is valid for all turbine shafts and turbine shaft parts at the supplier works for quality assurance and/ or supplier qualification. These tests are in addition to the tests already specified in the order drawing and specification.

2.0 REFERENCED DOCUMENTS

EN 10291, PA 14/24.21 of SIEMENS.

3.0 INSPECTION PERSONNEL

Inspections and correction of the punching is only allowed for qualified and named personnel.

4.0 TESTING

4.1 General

If tangential and axial cores are given in the order drawing, it is essential that the purchaser is contacted and an agreement is reached with reference to the taking of the specimens. If tangential or axial cores are not specified in the order drawing, same is to be mutually agreed between the BHEL and the manufacturer before placement of purchase order.

4.2 Testing at the tangential core

For the determination of the basic mechanical properties tangential cores are planned (see order drawing).

The creep rupture properties are to be determined from specimens of a separate additional tangential core.

The test position can be seen in attachment 1; the specimens shall be taken from the middle of the core at the maximum radial depth.

Testing specimens according to EN 10291, section 7

The following requirements are to be fulfilled:

1. $T = 560^0C$,
   Initial stress $\sigma_o = 230\ MP_a$,
   Rupture time $t_u = >1000h$

2. $T = 560^0C$,
   Initial stress $\sigma_o = 127\ MP_a$,
   Plastic elongation A_p 1000h < 0.3%
   Plastic elongation A_p 3000h < 0.5%

3. $T = 530^0C$,
   Initial stress $\sigma_o = 210\ MP_a$,
   Plastic elongation A_p 1000h < 0.27%

4.3 Testing at the axial core

The testing position is to be seen at attachment 1.

Testing specimens according to EN 10291, section 7

The following requirements are to be fulfilled:

1. $T = 560^0C$,
   Initial stress $\sigma_o = 230\ MP_a$,
   Rupture time $t_u = >1000h$

2. $T = 560^0C$,
   Initial stress $\sigma_o = 127\ MP_a$,
   Plastic elongation A_p 1000h <0.3%
   Plastic elongation A_p 3000h < 0.5%

3. $T = 530^0C$,
   Initial stress $\sigma_o = 210\ MP_a$,
   Plastic elongation A_p 1000h < 0.27%.

5.0 Test report

The test report has to included the following results according to EN 10291 section 11.1:

- Testing temperature
- Initial stress σ_o
- Rupture time t_U
- Rupture elongation A_U (for specimen 1)
- Rupture reduction area Z_U (for specimen 1)
- Plastic elongation A_P for 1000h and 3000h (for specimen 2)
- Plastic elongation A_P for 1000h (for specimen 3)

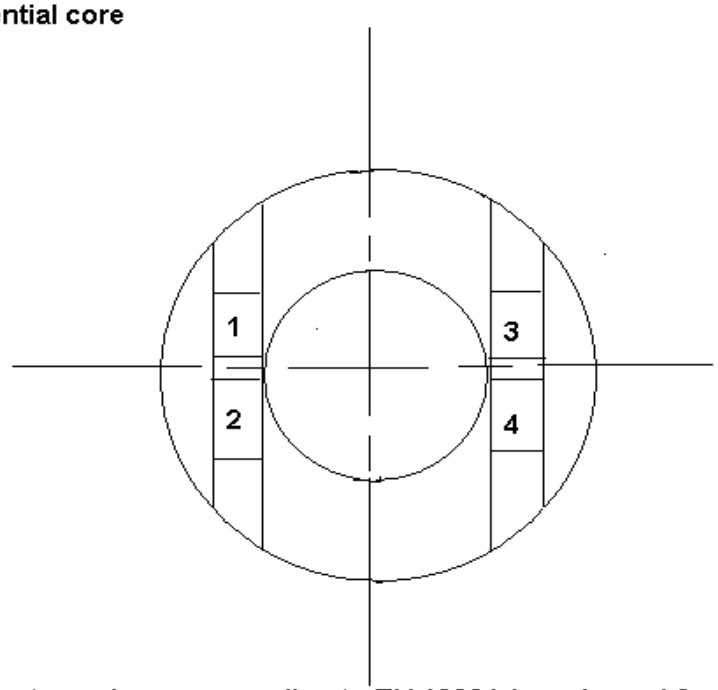
At continuous elongation measurement the whole creep curve is to reported.

6.0 DEVIATIONS

Any deviation has to be reported to BHEL for review and acceptance.

ATTACHMENT-1

Test position in the tangential core

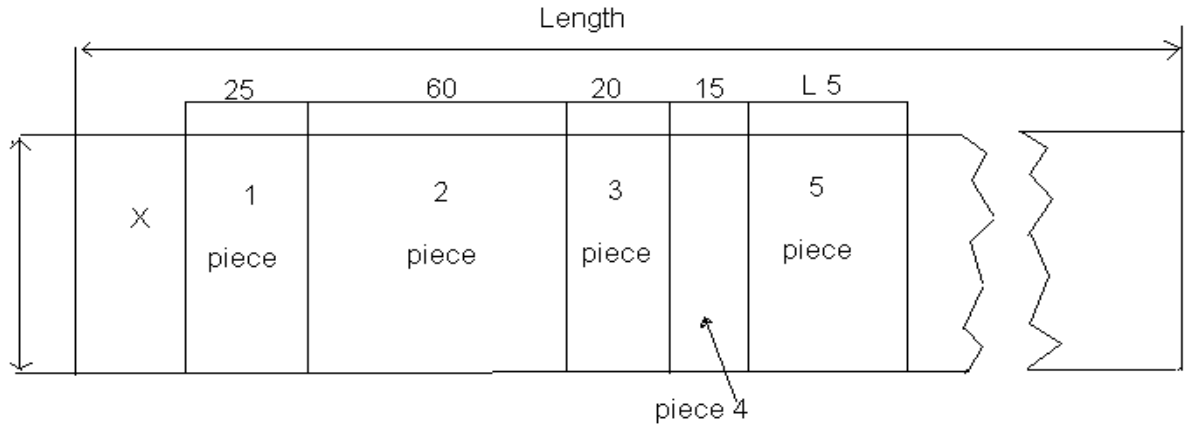


Supplier testing

3 creep-rupture test specimens according to EN 10291 (specimen 4 for reserve)

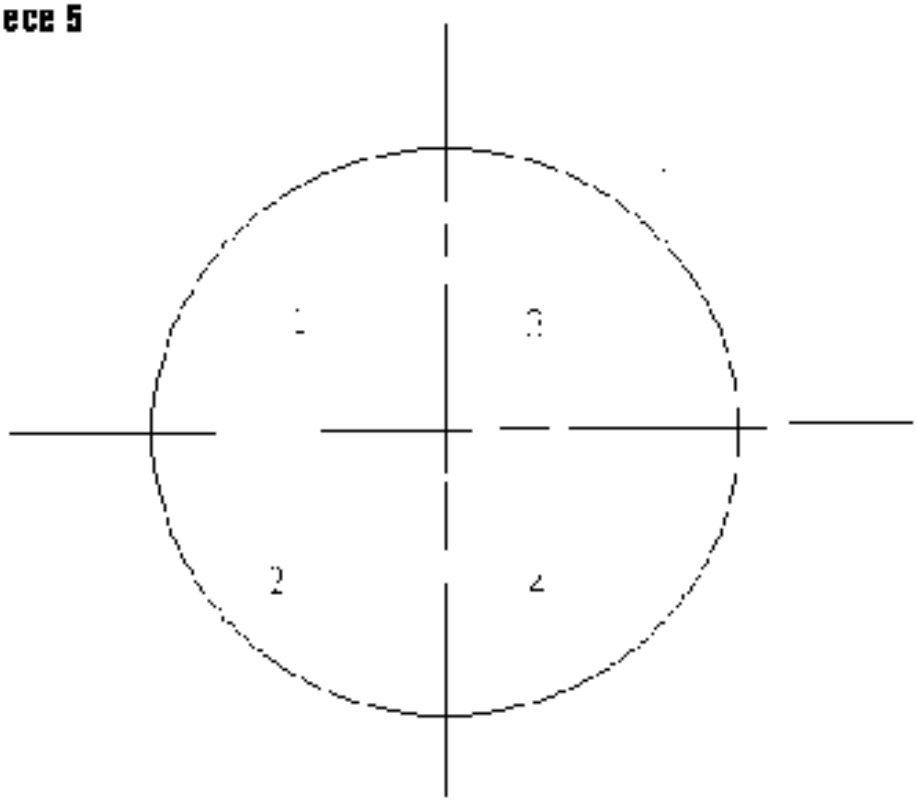
Test Position in the axial Core

Marking



L 5... The length of piece 5 depends on the length of the creep-rupture specimens.

Piece 5



3 Creep rupture test specimens according to EN 10291 (specimen 4 for reserve)