

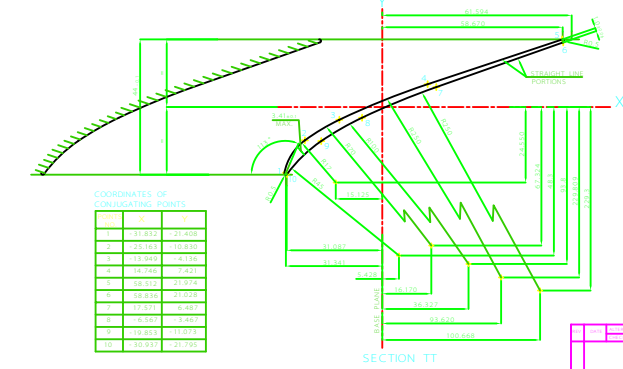
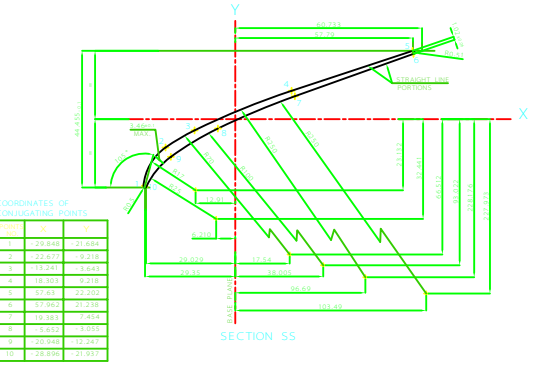
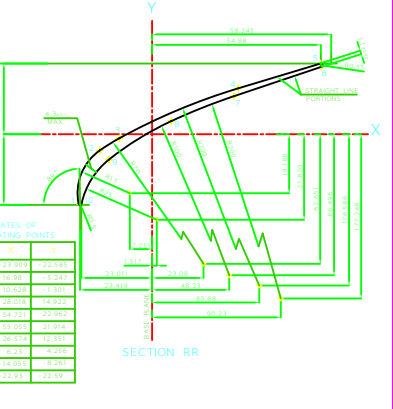
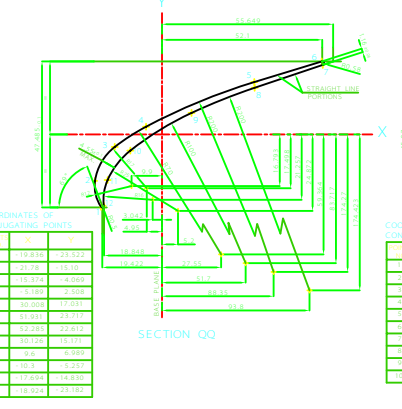
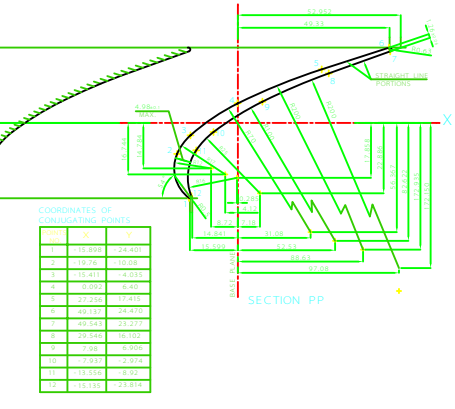
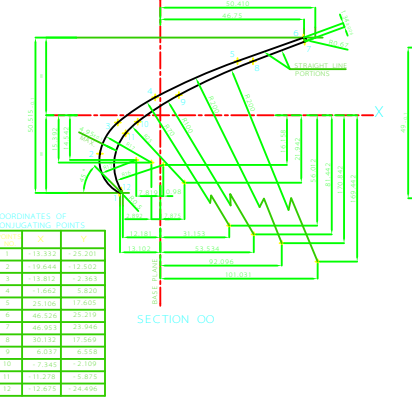
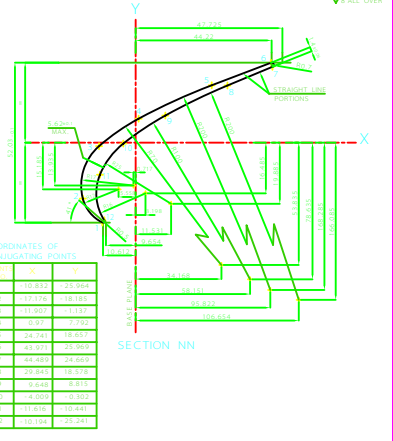
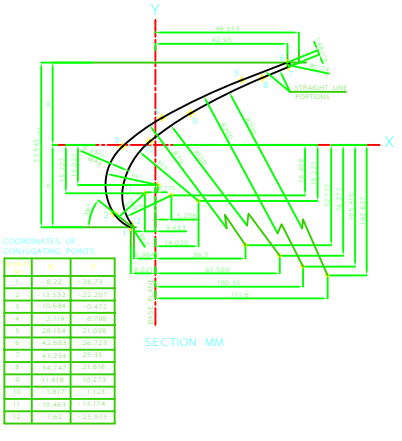
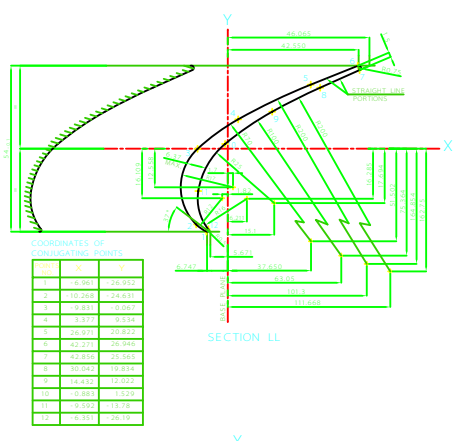
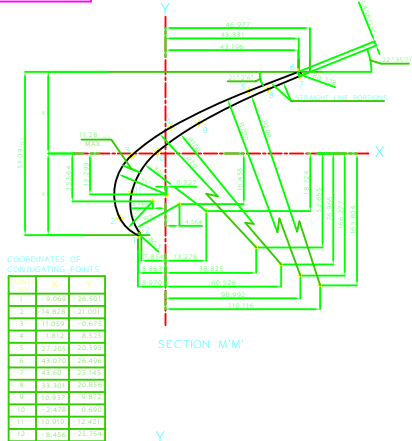
62050EZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

FORM NO. 46 (1-81)

▽ ROLL OVER



- TECHNICAL REQUIREMENTS:
1. CONCAVE AND CONVEX BLADE SURFACES SHOULD SMOOTHLY JOIN ALL GIVEN SECTIONS WITHOUT BREAKS AND DEPRESSIONS.
 2. FOR MUTUAL SECTION LOCATION ALONG BLADE HEIGHT SEE BLADE DRAWING.
 3. SECTIONS SHOWN IN DRAWINGS ALONG CONCAVE & CONVEX BLADE SURFACES ARE NORMAL TO MEAN AXIS OF BLADE.
 4. PERMISSIBLE DEVIATION FROM THEORETICAL PROFILE (CLEARANCE) ALONG CONCAVE AND CONVEX SURFACES: 0.1MM.
 5. INLET ANGLES, SHOWN IN THE DRAWING CORRESPOND TO SKELET-ANGLES.

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

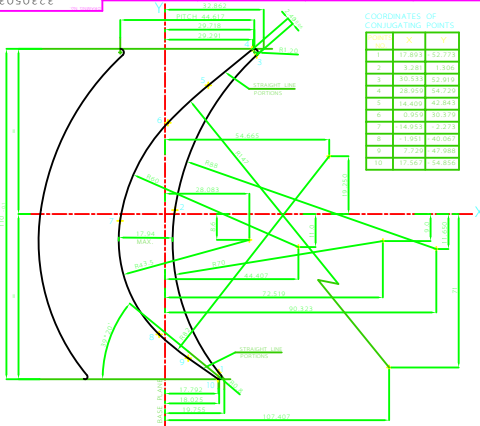
62050EZE		FORM NO. 46 (1-81)	
STEAM TURBINE		STEAM TURBINE	
DATE	12/10/2010	REV	01
DESIGNED BY	...	CHECKED BY	...
DRAWN BY	...	APPROVED BY	...
BHARAT HEAVY ELECTRICALS LTD.		BHARAT HEAVY ELECTRICALS LTD.	
RANIPUR, HARDWAR		RANIPUR, HARDWAR	
BLADE PROFILE		BLADE PROFILE	
NO. 1182		NO. 1182	
32305029		32305029	

LEO50EZE

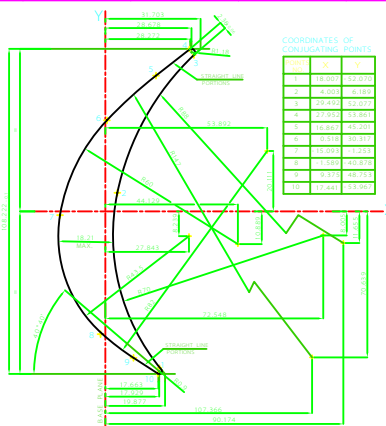
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN MM.)

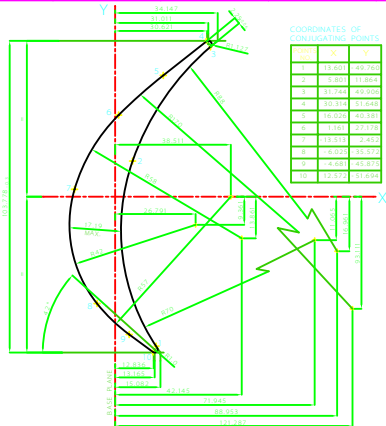
FORM: 00.44.1.8.1



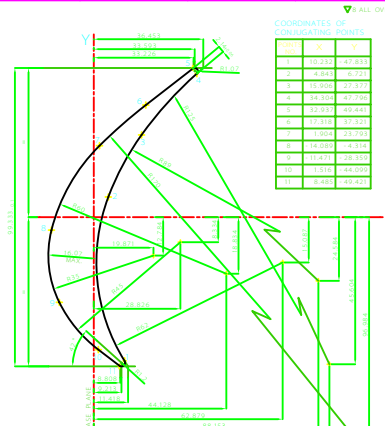
SECTION AA



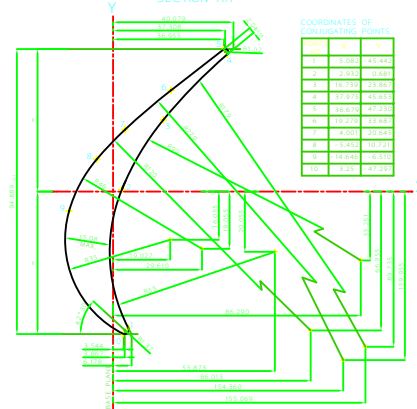
SECTION BB



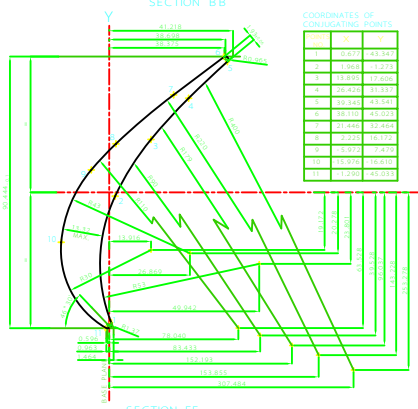
SECTION CC



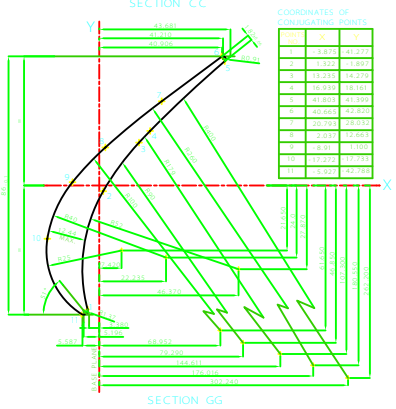
SECTION DD



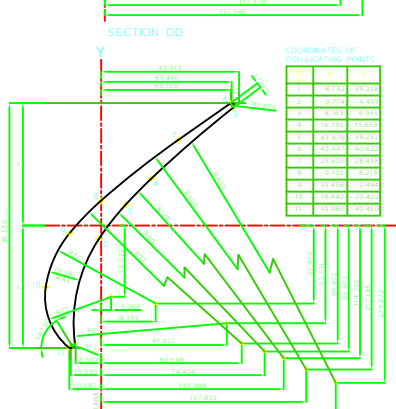
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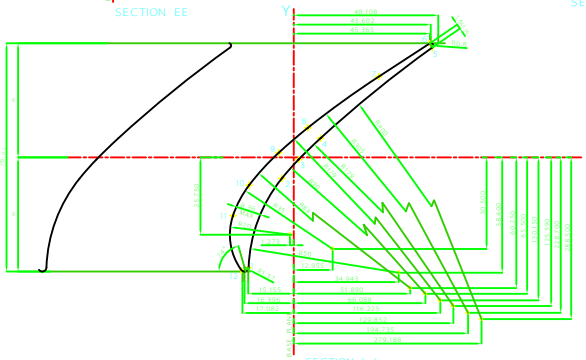
SECTION FF



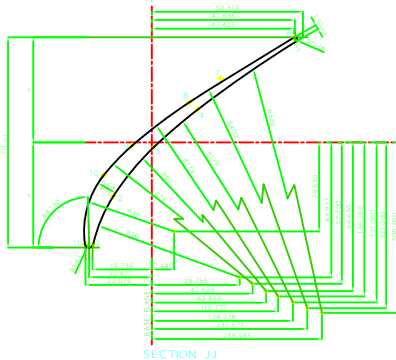
SECTION GG



SECTION HH



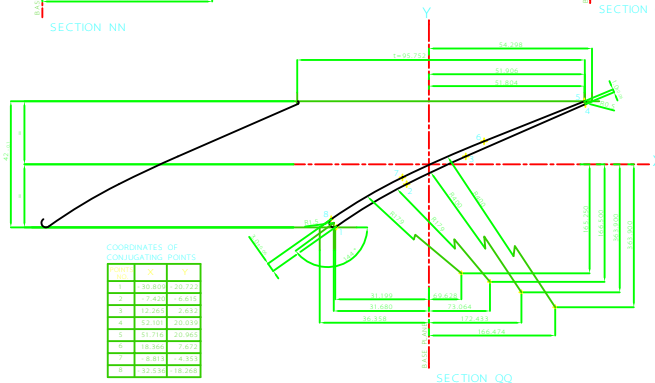
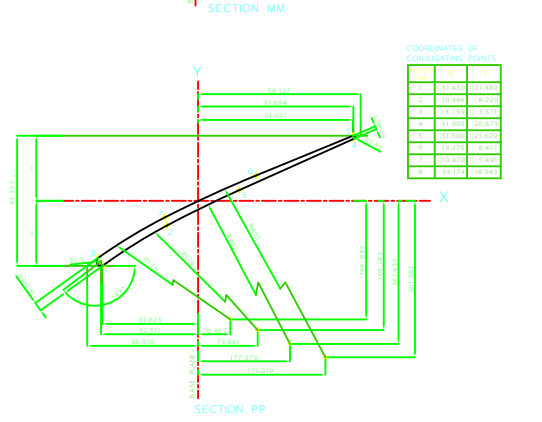
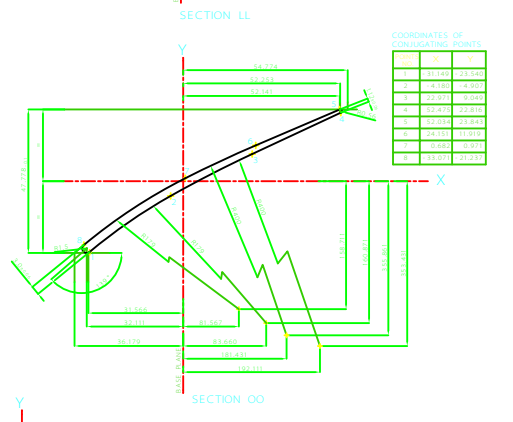
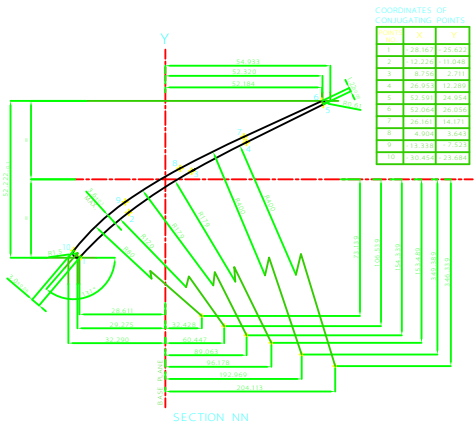
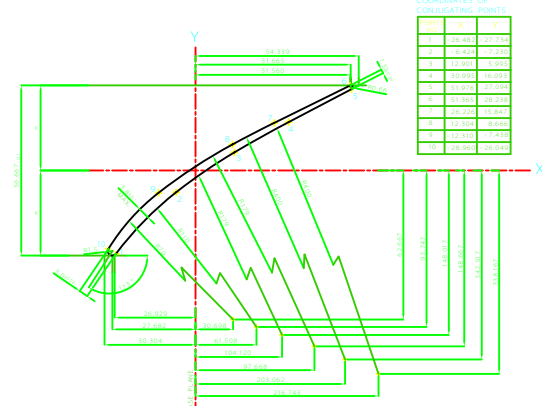
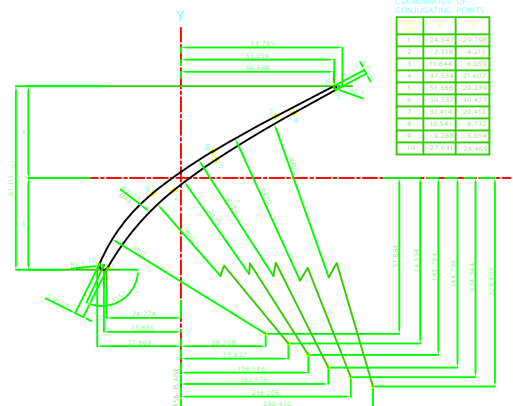
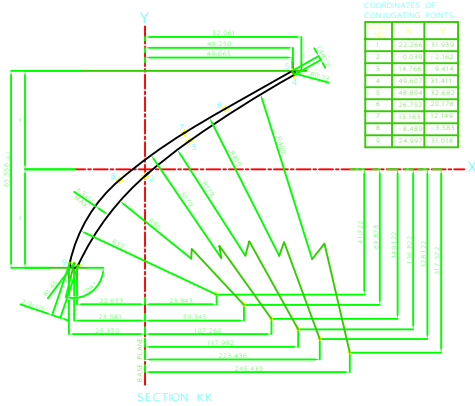
SECTION I-I



SECTION J-J

SUPERSEDES OLD DRAWING WHERE THE SAME NUMBER WITHOUT ANY CHANGE

DRAWING NO.		REV. OF PRODUCT		STEAM TURBINE	
FORM NO.		REV. OF DRAWING PRODUCT		REV. OF PRODUCT	
DATE		DATE		DATE	
DRAWN BY		CHECKED BY		APPROVED BY	
DESIGNED BY		DESIGNED BY		DESIGNED BY	
SCALE		SCALE		SCALE	
PROJECT NO.		PROJECT NO.		PROJECT NO.	
JOB NO.		JOB NO.		JOB NO.	
SHEET NO.		SHEET NO.		SHEET NO.	
TOTAL SHEETS		TOTAL SHEETS		TOTAL SHEETS	
DATE OF ISSUE		DATE OF ISSUE		DATE OF ISSUE	
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ISSUE DATE		ISSUE DATE		ISSUE DATE	
ISSUE BY		ISSUE BY		ISSUE BY	



CONCAVE & CONVEX BLADE SURFACES SHOULD SMOOTHLY JOIN ALL GIVEN SECTIONS WITHOUT BREAKS, PROJECTIONS AND DEPRESSIONS.

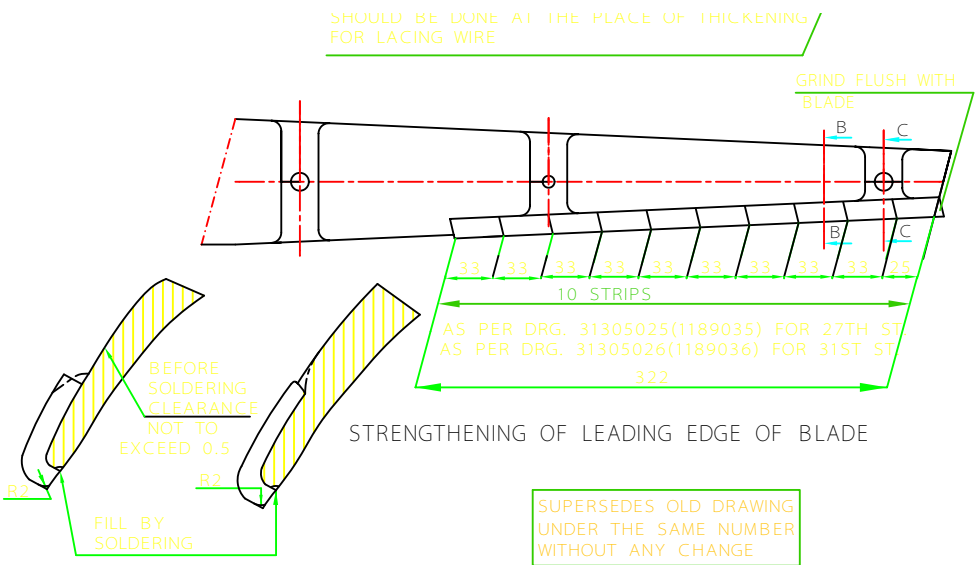
TECHNICAL REQUIREMENTS:

1. MUTUAL LOCATION OF SECTIONS ALONG BLADE HEIGHT SEE INO BLADE DRAWING NO. 22305004 (1138422) AND 22305008 (1138427).
2. SECTIONS SHOWN IN THIS DRAWING ALONG CONCAVE AND CONVEX SURFACES ARE NORMAL TO THE MEAN BLADE AXIS.
3. PERMISSIBLE DEVIATION FROM THEORETICAL PROFILE (CLEARANCES) ALONG CONCAVE AND CONVEX SURFACES: 0.1MM.
4. INLET ANGLES OF SECTIONS, SHOWN IN THIS DRAWING CORRESPONDS TO THE SKELETON ANGLES.
5. WHERE NO RADIUS IS GIVEN, WILL BE TREATED AS STRAIGHT LINE ON PROFILES.

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

APPROVED		DATE		REV. OF PRODUCT		STEAM TURBINE	
DESIGNER	CHECKER	DATE	REV.	NO.	DATE	NO.	DATE
SHARAT HEAVY ELECTRICALS LTD. RANPUR, HARDWAR				22305000 32305031			
BLADE PROFILE NO. 1183				A3- SIZE			

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SECTION AA

TECHNICAL REQUIREMENTS :-

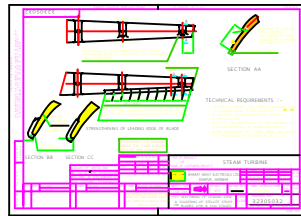
1. BEFORE SOLDERING THE STRIPS, ROUNDING RADI OF LEADING EDGE TO BE POLISHED TO V8-V9.
2. CLEARANCE BETWEEN JOINT OF STRIPS IS NOT ALLOWED.
3. REST OF THE DIMENSIONS AS PER DRAWING NO. 32305004(1138422) & 32305008(1138427).
4. AFTER SOLDERING THE STRIPS GRIND AS SHOWN BY CHAIN LINES IN SECTION B-B & C-C.

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

SECTION BB	SECTION CC
GRADE OF UNTOL.DIM	
M/CG.-C/M/F AA0230208	
WELDING - A/B/C/DA0621104	
GAS CUTTING - 'T3'AA0621101	

GMS No./C B O M No.		STATUS OF DRG		TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT	
AGREED DEPT	NAME	SIGN	DATE	STEAM TURBINE	
SIT	S.C. JETLY		12.08.73	BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR	
DRN	NAME	SIGN	DATE	NO. OF VAR	
CHD	K.M. SINGHAL	Sd/-	04.08.71		
APPR	N.B. MATHUR	Sd/-	16.05.74		
	K.L.KHURANA	Sd/-	19.09.74	73	74
REV	DATE	ALTERED CHECKED	REV	DATE	ALTERED CHECKED
01	15.11.11	H.L.BIND CHECKED B.P.SINGH			
THIS DRAWING SUPERSEDES OLD DRG UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER. (STE-11-F0313)			DEPT STE	SCALE	WEIGHT (KG)
			CODE 4011	NTS	
			TITLE	CARD CODE	REF. TO ASSY. DRG.
			MACHINING OF LEADING EDGE & SOLDERING OF STELLITE STRIPS ON BLADES 27th & 31st STAGES	32305032	32305000
			DRAWING NO. 32305032		ITEM No. 23
			SHEET NO. 01		NO. OF SHEETS 01

SIZE A3



HEEP	PURCHASE SPECIFICATION		0500.706	
	Purchase specification for finished and Forged Blanks of Blades of Steam Turbine.		BASED ON	
B. H. E. LTD. HARDWAR			REVISION 1978- ^d	
MET	2.60	SHEET NO. 1		TOTAL SHEETS 14

ORDERING SPECIFICATION

1.0 GENERAL

1.1 The present specification covers the technical requirements for Die forged Steam Turbine working and Guide Blades in finished as well as in forged condition.

2.0 SUPPLY CONDITION

2.1 The working and Guide blades are to be supplied in finally heat treated condition.

2.2 The supplies are to be made either in as forged condition with allowances for finish machining or in finally machined condition as per the drawing dimensions, as per our requirements in the purchase order.

3.0 CLASSIFICATION, STEEL GRADE, CATEGORIES ETC.

3.1 Complete designation of steel, including grade, category of strength and the specification number shall be taken from the respective drawing of the blades for the purpose of supply. *Alternate steel grade can be accepted after discussion with BHEL.*

3.2 In accordance with the mechanical properties required, the various blade forgings are characterised by category of strength, henceforth referred to as 'CS'.

3.3 The various grades of steels for blades to be used for attaining the various categories of strength, CS, alongwith the detailed mechanical properties at room temperature shall be as per Table No.2 unless otherwise agreed.

4.0 DESIGNATION

4.1 The designation of the material may be taken from the respective drawings.

4.2 For example, the designation 15 Cr-11 Mo 70 V35
CS 55-0500.706
has got following interpretation.

4.2.1 15 Cr-11 Mo 70 V35 : Designation of steel as per IS:1762 the chemical composition of which may be taken from Table No.1.

4.2.2 CS 55 : Category of strength, 'CS'

4.2.3 00500.706 : No. of the present specification.

5.0 TECHNICAL REQUIREMENTS

5.1 For Material of Blades:

REV. 01
(REAFFIRMED)
DT. 16-01-2007

INVENTORY NO. SIGN & DATE SUPERSEDES INVENTORY NO. DUPLICATE INVENTORY NO. SIGN & DATE CO-ORDINATING DEPT.

WORKED BY	MITHAL	18/1/79						
CHECKED BY	MITHAL	18/1/79						
SUPERVISED	S.P. SINGH	21/1/79	APPROVED	S.P. SINGH	IN FORCE FROM			
STD. CONTROL	S.P. SINGH	21/1/79	(S.P. SINGH)					

CHG.	NOS.	DOCU. NO.	SIGN.	DATE
d	2	SATSMET-78-107	V.B.	15-1-78
c	1	S.R.T.S(MED)-76-31	M.B.	4/3/78

DRAWN / TRACED

PURCHASE SPECIFICATION FOR FINISHED AND FORGED BLANKS OF BLADES OF STEAM TURBINE

0.500.706

REVISION 01

SHEET No. 2

SUPERSEDES THE OLD SHEET UNDER THE SAME SHEET NUMBER.
 CHANGE ADVICE NO. S&TSMET-78-107
 DATE 15.6.78.

- 5.1.1. The chemical composition of the steel shall be as per Table No. 1 *unless agreed otherwise* (e)
- 5.1.2. The steel shall be manufactured in Electric furnace, it shall thereafter be refined by Electroslag re-melting process
- 5.1.2.1 ~~Coefficient of anisotropy shall be determined in accordance with the method given in Annexure-A and the value of coefficient should be greater than or equal to 0.6.~~ (e)
- 5.1.3 ~~The oxygen and hydrogen content shall not exceed the following values:~~
 - 5.1.3.1 ~~Oxygen : 30 ppm~~ (e)
 - 5.1.3.2 ~~Hydrogen : 2.5 ppm~~
- 5.1.4 The average Austenitic grain size shall be ASTM 5 to 8, when checked as per ASTM Standard E 112.
- 5.1.5 For non-metallic inclusion testing, the test sample shall be taken on a longitudinal plane midway between the centre and surface of the material. The rating of the inclusion content shall be based upon average length of the inclusion the longest inclusion and the general background when tested as per ASTM Standard E 45, the acceptance norms, as per plate III of thin series shall be as follows:-
 - 5.1.5.1 *<mainly* (e)

SILICATES	: 1	A	B	C	D
OXIDES	: 1				
SULPHIDES	: 1	1.5	1.5	1.5	1.5
 - 5.1.5.4 ~~The desirable limit of each type of non-metallic inclusion is 1, however, maximum 1.5 may be allowed in case only any one of the above stated inclusions exceed 1. In no cases the total of three types of inclusions should exceed 2.5~~ (e) *4.5*
- 5.1.6 Fatigue Testing.
 - 5.1.6.1 The fatigue strength of the material in hardened and tempered condition to the various categories of strength as per table No. 2 is to be checked under following test conditions.
 - 5.1.6.1.1 Type of loading : Cantilever type.
 - 5.1.6.1.2 No. of cycles specimen should withstand without fracture: 10⁷.
 - 5.1.6.1.3 Test RPM : 3000/6000. (e)
 - 5.1.6.1.4 The acceptable average values of the fatigue strength for different grades of steels shall be 50% of UTS obtained and in any case no sample shall show a value less than 45% of UTS.
 - 5.1.7 Mechanical properties at Elevated Temperatures.
 - 5.1.7.1 Short duration mechanical properties: The short duration tests shall be carried out at various temperatures on hardened and tempered samples and the values shall conform to Table No. 3.
 - 5.1.7.1.2 The average rupture stress, 1% Creep Stress Values as per Table No. 4 shall be guaranteed by the supplier at 10,000 hrs. and 100,000 hrs. at temperatures given in the above referred table either by conducting fresh tests or by actual test dates already available at Supplier's end for the same steel.

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REV. 01

WORKED	Y.S.T. 9/6/74																		
STD. CONTRL.			d	-	S&TSMET-78-107	15.6.78													
			CHG. NOS.		DOCU. NO.	SIGN	DATE	CHG. NOS.		DOCU. NO.	SIGN	DATE							

Purchase specification for Finished and Forged Blanks of Blades of Steam Turbine.

0500-706

REVISION 01 SHEET NO. 3

5.2 For Blade Forgings:

- 5.2.1 The forged blanks of blades shall correspond to drawings prepared by BHEL Hardwar and agreed to with the supplier. In case, the drawings supplied by BHEL Hardwar are those of finish blades, the forging allowances shall be mutually agreed with the supplier.
- 5.2.2 The blade forgings shall be given final heat treatment which shall include hardening with high tempering as per the regimes of the supplying plant.
- 5.2.3 The mechanical properties at room temperature of the heat treated blanks on the longitudinal specimens shall correspond to Table No.2.
- 5.2.3.1 Proof stress ($\sigma_{0.2}$), % Elongation (δ_5), % Reduction in area (Ψ) and Charpy impact strength (α_n) are mandatory properties U.T.S. (σ_b) and Hardness are for information only.
- 5.2.3.2 Hardness is not an acceptance characteristic, but serves for checking the homogeneity of heat treatment and selection of blanks for mechanical testing.
- 5.2.3.3 If the thickness of the blank at the root portion is above 60 mm, 10% reduction is permissible in the impact strength values.
- 5.2.4 The visual inspection of forged blanks of blades shall not reveal cracks, hair line cracks and other metallurgical defects, which impair the quality of the blades. No surface defects are allowed.
- 5.2.4.1 In addition to visual examination, each and every blank shall be subjected to Magnaflux testing.
- 5.2.5 Scales shall be removed from the blanks of blades.
- 5.2.6 If necessary, the heat treated blanks may be subjected to hot or cold straightening with further tempering to relieve the stresses. The temperature of heating before straightening and of subsequent tempering shall be 50°C below the temperature of tempering after hardening.

5.3 For finished Blades.

- 5.3.1 In addition to the requirements mentioned in clause 5.2, the finished blades shall fulfil following additional conditions.
 - 5.3.1.1 The dimensions and the tolerances of each and every blade shall be checked with the help of templates to ensure its conformity to the respective drawing dimensions. *The template drawings shall be got certified by BHEL before manufacturing the templates.*
 - 5.3.1.1.1 The dimensions of the blade profile at every section shall be recorded in a proper proforma, and shall be despatched alongwith the supplies.
 - 5.3.1.1.2 The templates used for checking the profile of the finished blades shall be surrendered to BHEL Hardwar alongwith the last consignment.

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 SIGN & DATE

REV. 01

WORKED	MITRA	21/11/74												
STD. CONTRL.	R.SINGH	21/11/74	b	1	SATS (mat) 26 to BHEL	2.2.76								
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Purchase specification for Finished and Forged Blanks of Blades of Steam Turbine.

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- 5.3.2 Each and every blade shall be subjected to Magnaflux testing for ensuring complete freedom from any surface and sub surface defects.
- 5.3.3 Each and every blades shall be subject ed to vibration test. The acceptance norms for the vibration characteristics of separate blades shall be supplied at the time of placement of the purchase order.
- 5.3.4 Each and every blade shall be subjected to moment-weighing for the purpose of selection and pairing for fitting on the turbine disc.
- 5.3.4.1 The two blades of a particular stage having their center of gravity at the same place shall be paired together by the supplier and supplied in a packet.
- 5.3.4.2 The supplier shall find out the centre of gravity for each and every blade together with its deviation from the theoretical centre of gravity.
- 5.3.5 Each and every blade shall be weighed in a commercial balance of ± 10 gms accuracy.
- 5.3.5.1 The allowable tolerance in weight of each finished blade may be taken from the respective drawing.

6.0 INSPECTION, TESTING AT SUPPLIER'S PLANT

- 6.1 The blanks for blades/finished blades are inspected by the Inspection Department of the supplier's plant on the basis of the requirements of the present specification.
- 6.2 Blanks/finished blades are offered for inspection in batches. Batches consist of blades of one drawing number, of same melt and heat treated together.
- 6.3 The following is the basis of inspection.
 - 6.3.1 Chemical Composition.
 - 6.3.2 Dimensions.
 - 6.3.3 Hardness.
 - 6.3.4 Mechanical properties.
 - 6.3.5 Microstructure
 - 6.3.6 Magnaflux testing
 - 6.3.7 Vibration tests in case of only finished blades.
 - 6.3.8 Moment weighing for finished blades only.
 - 6.3.9 Weight of finished blade.
 - 6.3.10 ~~Coefficient of Anisotropy: AS PER Annexure 'A'~~ ^(e)
 - 6.3.11 In addition to these, the Inspection Department of the supplier's plant shall certify adherence of the mutually agreed forging technological processes.

6. The chemical composition shall be checked for each melt in accordance with IS:288-59 (or any other equivalent national standard) and shall conform to Table No.1

6.4.1 Before using the billets, these shall be subjected to 100% checking by ~~spectral method~~ ^(e) for the main alloying elements.
 ULTRASONIC TEST AS PER AA0050118 QUALITY LEVEL II

6.5 Visual inspection and Magnaflux testing is to be carried out on each and every blank/finished blade. There shall not be any surface defects like cracks, hair line cracks,

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STD. CONTR.	RS INCH	15/6/78	d 1	SATSMEF-78-10	YAL	15.6.78				

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Purchase specification for finished and Forged Blanks of Blades of Steam Turbine.

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fins & loose scales etc.

6.6 *Correctness of* Each blank/finished blade shall be thoroughly checked for the dimensions with the help of templates and other special measuring instruments. *and ensured*

6.7 Each and every blank of blade shall be subjected to hardness testing, minimum at two places at the two ends. The difference in the diameter of impression in any blank shall not exceed 0.1 mm for blank length upto 700 mm and 0.2 mm for above 700 mm length.

6.7.1 Hardness testing is to be carried out as per IS:1500.

6.7.2 In case where allowance for finish machining is less, it is allowed to determine hardness with 5 mm diameter ball and 750 Kg load.

~~6.8 To determine the mechanical properties at room temperature, atleast 2% of blanks are taken from each batch (but not less than 5 pcs) with extreme values of the hardness.~~

6.8
~~6.8.1~~ In case of developmental order, the frequency of testing would be mutually agreed upon at the time of placement of the purchase order.

6.9 Following test pieces are cut out from each chosen blank.

6.9.1 Out of working and guide blades under 500 mm length, one specimen for tensile test and two specimens for impact test.

6.9.2 Out of working and guide blades of above 500 mm length, one tensile and two impact test specimens are taken from each end.

6.9.3 It is however permitted for blades (both working and guide) where it is not possible to take out tensile and impact specimens from one blank, to use two blanks of nearly same hardness for the purpose of tensile and impact testing *as mutually agreed.*

6.10 Tensile test is to be performed as per IS:1608-88 (or any other equivalent national standard) on cylindrical specimen of gauge length $L_0=5d_0$ where d_0 is the diameter of the specimen and is equal to 10 mm.

6.10.1 In case of insufficient dimensions of the blank, it is permissible to use proportional cylindrical specimen of $d_0=5$ mm.

6.11 Charpy impact strength is to be determined as per IS:1499-88 (or any other equivalent national standard) on 2 mm 'U' notch specimen ($r=1$ mm).

6.12 The microstructure studies are to be carried out on the undistorted portion of the broken tensile test specimen.

6.12.1 The details of the microstructure in hardened and tempered condition shall be mutually agreed upon at the time of placement of the purchase order.

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STD. CONTR.	P.SINGH	1/9/76		1	SATS(MET)-76-31	BAK	2.2.76						
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