SUPERCEDES THE OLD SHEET NO.5A, UNDER THE NEW SHEET NO. 6. CHANGE ADVICE NO. S&TSMET-78-107 DATE 15.6.78. SIGN Y.S.T

6.12.2 Sampling method of Test Piece

6.12.2.1 Chemical composition for each melt will be furnished by supplier in the form of original mills certificates and his own certificate also, which will indicate the percentage of Carbon, Silicon, Manganese, Sulpher and Phosphorous and all the alloying elements. ~~(In addition to these, gaseous analysis, including Oxygen and Hydrogen contents)~~ shall be supplied. (e)

6.12.2.2 Testing of Room Temperature mechanical properties shall be carried out by the supplier on minimum two samples per heat-treatment batch for each melt, having lowest and highest hardness values, within the specified hardness and certificates will be furnished.

6.12.2.3 The non-metallic inclusion test, microstructure and grain size measurement shall be carried out by supplier as per the norms given in this specification, on undistorted portion of the broken tensile test piece per heat-treatment batch for each melt.

6.12.2.4 ~~Mill's certificate for fatigue test shall be furnished by supplier for at least two samples per melt for each steel grade in addition to test at his own works at the same rate.~~ (e)

6.12.2.5 ~~Short duration elevated temperature machnical properties tests, for both tensile and impact properties at 400, 500 and 550°C, shall be carried out on at least 2 samples per melt/heat-treatment batch, and the results should be in confirmity with Table No. 3.~~ (e)

6.12.2.6 ~~The test for co-efficient of anisotropy shall be carried out as per Annexure 'A' by the supplier for each melt and the certificates shall be furnished.~~

REV. 01

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

DRAWN / TRACED

SIZE 11

INVENTORY NO. | SIGN & DATE | SUPERSEDES INVENTORY NO. | DUPLICATE INVENTORY NO. | SIGN & DATE

6.13 Vibration Test

6.13.1 The procedure for carrying out the vibration test shall be decided mutually at the time of the placement of purchase order.

6.13.2 The supplier shall however furnish the procedure and the details of equipment already available at his command at the time of quotation.

6.14 Moment Weighing.

6.14.1 The procedure for carrying out the Moment weighing shall be mutually decided at the time of placement of the purchase order.

6.14.2 The supplier shall however furnish the detailed procedure and equipment available at his command for carrying out this test at the time of quotation.

6.15 The finished blades shall be weighed separately in a commercial balance of ± 10 gm. accuracy.

7.0 RETESTING

7.1 If the results of mechanical testing and microstructure are found unsatisfactory, retesting should be performed on double number of specimens which gave unsatisfactory results. Incase of unsatisfactory results shown by even one of the specimen of retesting, re-heat treatment is allowed, after which the batch must be ~~accepted~~ (b) considered as new batch.

7.2 Number of total heat treatment shall not exceed two. However repeat tempering is not considered as repeat heat treatment.

8.0 PRESENCE OF BHEL's REPRESENTATIVES:

8.1 For Indian suppliers.

8.1.1 The representative of the inspection department of M/s BHEL Hardwar shall have free entry at all times while the work on t contract are being carried out. All reasonable facilities shall be provided to the representative including labour to satisfy himself that the blanks/finished blades are made to these specifications. The supplier shall provide and prepare necessary test specimens and supply the labour and appliances for such testing as may be carried out in his premises. Failing facilities at his own works for carrying out prescribed tests, the supplier shall make the necessary arrangements for carrying out the prescribed tests by mutually agreable testing agency.

8.1.2 The tests are to be carried out in presence of the representative of M/s BHEL Hardwar.

8.1.3 The supplier shall inform the purchase department of M/S BHEL Hardwar at least 15 days before the presumed testing with a copy of the letter to the inspection department of M/S B.H.E.L. Hardwar.

8.1.4 The test bars must be marked in such a manner that the inspection marks are visible whenever, necessary, the repunching is done in presence of the representative of M/S B.H.E.L. Hardwar.

8.2 FOR OVERSEAS SUPPLIERS

8.2.1 Normal testing: the normal test certificate shall be approved by B.H.E.L or by the testing authorities, duly appointed by M/s BHEL Hardwar for purpose, who will be present during testing, the name of the authorised agency shall be intimated after placing the order. (d)

8.2.2 In case any special discussions are to be held in connection with the various clauses of these specifications, the information may be sent directly to M/S B.H.E.L., India, under intimation to the authorised testing agency, sufficiently in advance so that the arrangements are made to depute the technical representative to supplier's works for study and actions.

9.0 TESTS AT BHEL HARDWAR

9.1 M/s BHEL Hardwar reserves the right of rechecking partially or wholly the blanks/finished blades in accordance with the requirements of the present specifications. In case of unsatisfactory results of testing, the whole batch shall be rejected.

9.2 In case of supply of forged blanks of the blades, after final machining each and every blade is subjected to Magnaflux testing. In case hair line cracks are found on any one of the blade, the same shall be rejected and the supplying plant shall have to replace it free of cost, after receiving such notice from BHEL Hardwar.

10.0 INDEPENDENT TEST

10.1 In case of dispute about the compliance of the material with regard to the composition of the test requirements of these specifications, BHEL Hardwar and supplier shallhave the right to have tests conducted by mutually accepted testing authority. The results obtained by the independent testing authority shall be acceptable as final.

10.2 If the material does not comply with these specifications the cost of the independent testing shall be borne by the supplier, if the material complies with these specifications the cost shall be borne by M/s BHEL Hardwar.

11.0 MARKING AND DOCUMENTATION

11.1 Each forged blank shall be marked/stamped for

i) Drawing no.
ii) Forging No.
iii) Heat No.
iv) Batch No.
v) The stamp of the inspection Deptt. of the supplier's plant.

11.1.1 Marking shall be encircled with paint.

11.2 Each finished blade shall be marked at the end of the

REV. 01

WORKED															
STD. CONTL.					d	2	S&TSMET-78-107		15.6.78						
					CHG.	NOS.	DOCU. NO.	SIGN	DATE	CHG.	NOS.	DOCU. NO.	SIGN	DATE	

DRAWN / TRACED

SIZE 11

INVENTORY NO. P-12160 | SIGN & DATE | SUPERSEDES INVENTORY NO. | DUPLICATE INVENTORY NO. | SIGN & DATE

SUPERCEDES THE OLD SHEET NO. 8 UNDER THE NEW SHEET NO. 9. CHANGE ADVICE NO. SRTS MET-78-107 Date 15-6-78. Sign. Y.S.T.

root portion for

(i) Grade of Steel
(ii) Drawing No.
(iii) Forging No. or the serial No.

11.3 Certificates

11.3.1 Detailed certificates shall accompany each batch of accepted blanks/finished blades having the following details. The certificates should also comply with the requirements of Clause 6.12.2.

11.3.1.1 Drawing No.
11.3.1.2 Grade of Steel
11.3.1.3 Batch No. and Melt No.
11.3.1.4 Chemical composition ~~including the gaseous analysis.~~ (e)
11.3.1.5 Grain size measurement report.
11.3.1.6 Inclusion rating report.
~~11.3.1.7 Fatigue strength of the material.~~
~~11.3.1.8 Mechanical properties at elevated temperature for steel grades as per Table No. 3 & 4.~~ (e)
11.3.1.9 Mechanical properties at room temperature.
11.3.1.10 Report on Microstructure studies.
~~11.3.1.11 Coefficient of anisotropy.~~
11.3.1.12 Dimensional report.
11.3.1.13 Magnaflux testing.
11.3.1.14 Vibration test report for finished blades only.
11.3.1.15 Moment weighing for finished blades only.
11.3.1.16 Weight of each finished blade.
11.3.1.17 Quantity and weight.
11.3.1.18 Details of Heat-treatment regimes being followed.
11.3.1.19 No. of the present specification.
11.3.1.20 Name of the supplier of raw-material along with his original certificates.
11.3.1.21 The details of forging Technological process being adopted for manufacturing. (e)
11.3.1.22. THE PARTY SHOULD FURNISH GUARNTEE CERTIFICAT FOR HIGH TEMP. PROP. AS PER-TABLE 3&4. (e)
11.3.2 The certificates must be signed by the Chief of Inspection Department/Chief Metallurgist of the Supplier's Plant.

12.0 PACKAGING & TRANSPORT.

12.1 The blades shall be properly packed in boxes for transportation.

12.1.1 The packages must be strong enough and should be provided with steel ~~xxxxx~~ straps or wooden stiffners, to withstand the hazard of loading and unloading at sea port, transport through sea and land and handling by Railways/Road transport.

12.1.2 The size of the package should be small for easy handling preferably about 1.5 m x 1.5 m x 1.0 m.

12.2 The finished blades are paired and packed together on the basis of their moment weights and should be protected from corrosion by wax-coating and packed in thermocoal for proper storage at our plant.

REV. 01

WORKED	Y.S.T.		9/6/78												
STD. CONTL.				d	-	SRTS MET-78-107		15.6.78.							
				CHG.	NOS.	DOCU. NO.	SIGN	DATE	CHG.	NOS.	DOCU. NO.	SIGN	DATE		

DRAWN / TRACED

SIZE 11

INVENTORY NO. | SIGN & DATE | SUPERSEDES INVENTORY NO. | SIGN & DATE | DUPLICATE INVENTORY NO. | SIGN & DATE

12.3 The blades should be fully packed without giving room for movement and chances of striking each other. The package should be suitably compartmentalised to avoid any damage. Preferably the blade shall be packed in smaller boxes which may be put in bigger boxes.

13.0 DEVIATION

13.1 For any deviation from these specifications prior approval must be obtained from BHEL, HARDWAR.

14.0 REJECTION

14.1 BHEL, Hardwar reserves the right to reject the blank/ finished blade not found in conformity with these specifications.

14.2 Material that shows injurious defects while being finished/assembled at BHEL, Hardwar, will be rejected and the supplier shall be notified. After receipt of such a notice, arrangements must be made by the supplier to replace the material free of cost on priority.

(f)

15. CROSS REFERRED STANDARD :

AA 0850118, IS : 1608, IS: 1499, ASTM E 112, IS : 1762

FORM 01.04-2

Purchase Specifications for Finished & Forged Blanks of Blades of Steam Turbine.

0500.706.

REVISION | SHEET NO. 11

Table No. 1

CHEMICAL COMPOSITION

Grade of steel.	% of alloying elements								% Impurities. Not more than.		
	C	Si	Mn	Cr	Ni	Mo	V	Nb	Cu	S	P
12 Cr 13	0.09 to 0.15	≤0.6	≤0.6	12.0 to 14.0	≤0.6	—	—	—	—	0.015	0.020
20 Cr 13	0.16 to 0.24	≤0.6	≤0.6	12.0 to 14.0	≤0.6	—	—	—	—	0.015	0.020
15 Cr 11 Mo 10 V 35	0.12 to 0.19	≤0.6	≤0.7	10.0 to 11.5	≤0.6	0.6 to 0.8	0.25 to 0.40	—	0.3	0.015	0.020
18 Cr 11 Mo 1 Ni 80 V 30 Nb 35	0.15 to 0.21	≤0.6	0.6 to 1.0	10.0 to 11.5	0.5 to 1.0	0.8 to 1.1	0.2 to 0.4	0.2 to 0.45	—	0.015	0.020
10 Cr 16 Ni 14 Mo 23 Nb 11	0.06 to 0.12	≤0.8	≤1.0	15.0 to 17.0	12.5 to 14.5	2.0 to 2.5	—	0.9 to 1.3	0.3	0.020	0.025
C - 20	0.17 / 0.24	0.17 / 0.37	0.35 / 0.65	0.25 Max.	0.25 Max.	—	—	—	0.25 Max.	0.03 Max.	0.03 Max.

(a)

INVENTORY NO. | SIGN & DATE | SUPERSEDES INVENTORY NO. | DUPLICATE INVENTORY NO. | SIGN & DATE

REV. 01

WORKED	A.K. MITHAL 7/8	d	1	S&TS MET-78-107		15/6/78								
STD. CONTL.	P.C. KHARE 29/11	a	1	S&TS/MET/-76-1		13/1/76								
		CHG.	NOS.	DOCU. NO.	SIGN	DATE	CHG.	NOS.	DOCU. NO.	SIGN	DATE			

DRAWN / TRACED P.C. KHARE.

SIZE 11

FORM 01.04-2

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

0500.706.

REVISION | SHEET NO. 12

TABLE No. 2.

MECHANICAL PROPERTIES AT ROOM TEMP

GRADE OF STEEL	CATEGORY OF STRENGTH CS	MECHANICAL PROPERTIES					HARDNESS	
		YIELD STRENGTH Kg-f/mm² $\sigma_{0.2}$	ULTIMATE TENSILE STRENGTH Kg-f/mm²	% ELONGATION. $\delta 5$	% RED. IN AREA Ψ	IMPACT STRENGTH Kg-fm/CM² a_n	BRINELL HARDNESS HB	DIA. OF INDENTATION. mm.
12Cr13	CS 45	⩾45·0	⩾63·0	⩾20·0	⩾60·0	⩾8·0	197–229	4·3–4·0
20Cr13	CS 50	50·0–65·0	⩾70·0	⩾18·0	⩾60·0	⩾7·0	207–241	4·2–3·9
	CS 60	58·0–72·0	⩾77·0	⩾15·0	⩾50·0	⩾6·0	229–268	4·0–3·7
15Cr11Mo 70 V35	CS 55	55·0–68·0	⩾72·0	⩾15·0	⩾50·0	⩾6·0	217–255	4·1–3·8
	CS 70	70·0–83·0	⩾83·0	⩾13·0	⩾40·0	⩾4·0	255–285	3·8–3·6
18Cr11Mo1 Ni80 V30 Nb35	CS 60	60·0 72·0	⩾77·0	⩾14·0	⩾50·0	⩾6·0	235–255	3·95–3·8
10Cr16Ni14 Mo2 3Nb11	CS 22	⩾22·0	⩾56·0	⩾40·0	⩾50·0	⩾12·0	180–143	4·5–5·0
C-20	CS 20	⩾20.0	⩾40.0	⩾26	⩾55	⩾6.0	111–156	5.6–4.8

(a)

Rev. 01

	CHG.	NOS.	DOCU. NO.	SIGN	DATE	CHG.	NOS.	DOCU. NO.	SIGN	DATE
WORKED	Mithal	1	1d	1	S&TS MET-78-107		15.6.78					
STD. CONTL.			a	1	S&TS (MET)-76-1		13.1.76					

DRAWN / TRACED P.C. Khare.

SIZE 11

INVENTORY NO. P. 1280 | SIGN & DATE | SUPERSEDES INVENTORY NO. | DUPLICATE INVENTORY NO. | SIGN & DATE

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

0500.706.

REVISION 01 | SHEET NO. 12 15

SHORT DURATION MECHANICAL PROPERTIES

TABLE No. 3.

STEEL GRADE	HEAT-TREATMENT (FOR REFERENCE ONLY)	TEMPERATURE °C	MECHANICAL PROPERTIES				
			YIELD STRENGTH Kgf/mm² σ0.2	ULTIMATE TENSILE STRENGTH Kg./mm²	% ELONGATION. δ5	% RED. IN AREA. ψ	IMPACT STRENGTH. KgM/CM² an
15Cr11Mo70V35.	HARDEN AT 1080 – 1100°C IN AIR, TEMPER AT 720°C – 740°C FOR 2HRS. FOR CS55	20°C	55-67	74-77	17-20	66	15-17
		400°C	47-49	58-60	15-17	64-66	19-31
		500°C	42-43	51-52	21-22	68-70	21
		550°C	44-45	54	16	65-67	20
		600°C	41.5	45	20	78-79	21-22
	HARDEN AT 1080-1100°C IN AIR TEMPER AT 670-680°C FOR 5 HRS. FOR CS 70	20°C	69-80	85-92	15-17	55-56	5-8
		400°C	64-66	75-77	13-14	57-60	14
		500°C	53-54	59	18	69	15-18
		550°C	53-56	59-62	14-15	64-65	13-14
		600°C	51	54	17-18	75	14-18
18Cr11Mo1Ni80V30Nb35.	HARDEN AT 1100-1140°C IN AIR TEMPER AT 750°C FOR FOR 10HRS. FOR HB 223-229.	20°C	57	73-78	16-23	61-66	11-19
		400°C	53	62	18	74	-
		500°C	47.5	50	20.5	81	-
		550°C	43	44.5	17.5	85	-
		600°C	36.5	38	19.5	87	-
10Cr16Ni14Mo23Nb11.	HARDEN AT 1100-1130°C IN AIR TEMPER/AGE. AT 750°C FOR 10-12 HRS. FOR CS 22	20°C	25-29	56-65	30-48	35-54	10-12
		400°C	17-19	48-53	30-33	28-50	8-14
		500°C	16-18	47-52	31-35	33-46	10-20
		550°C	15-17	45-50	31-33	31-46	8-16
		600°C	15-17	43-48	29-34	34-46	9-17

INVENTORY NO. P-1260 | SIGN & DATE | SUPERSEDES INVENTORY NO. | DUPLICATE INVENTORY NO. | SIGN & DATE

REV. 01

		CHG.	NOS.	DOCU. NO.	SIGN	DATE	CHG.	NOS.	DOCU. NO.	SIGN	DATE
WORKED	Mithal 7/8/74										
STD. CONTL.	P SINGH 7/8/74	d	1	SATS MET-78-107		15-6-78					

DRAWN/TRACED P.C. Khare.

SIZE 11

Purchase Specification for Finished & Forged Blanks of Blades of Steam Turbine.

0500.706.

REVISION 01 | SHEET NO. 14

HIGH TEMPERATURE PROPERTIES

Table No. 4

Grade of Steel	Test Temperature °C	Rupture Stress Kg/mm²		Stress resulting in an elongation of 1% by creep in Kg/mm²	
		10,000 Hrs.	100,000 Hrs	10,000 Hrs.	100,000 Hrs.
15Cr 11Mo 70V35	550°C	16·0–21·0	13·0–16·0	—	9·0
	600°C	9·7	—	—	4·0–5·0
18Cr11Mo1Ni 80 V30 Nb 35	535°C	—	20·0	—	14·0
	550°C	—	17·0 – 18·0	—	12·0
	600°C	—	⩾8	—	7·0
10Cr16 Ni 14Mo23 Nb11	550°C	26·0	21·0	—	16·0–18·0
	600°C	20·0	15·0	14·5–17·0	9·0–12·0
	650°C	13·0	9·5	10·5–12·5	5·0–7·0
	700°C	6·0–7·5	3·5–5·0	6·0	2·2

INVENTORY NO. | SIGN & DATE | SUPERSEDES INVENTORY NO. | DUPLICATE INVENTORY NO. | SIGN & DATE

REV. 01

WORKED	A.K. MITHAL		7/8/74											
STD. CONTL.				d	1	SETS NET-78-107	Y.S.L	15-6-78						
				CHG.	NOS.	DOCU. NO.	SIGN	DATE	CHG.	NOS.	DOCU. NO.	SIGN	DATE	

DRAWN / TRACED P.C. Khare.

SIZE 11