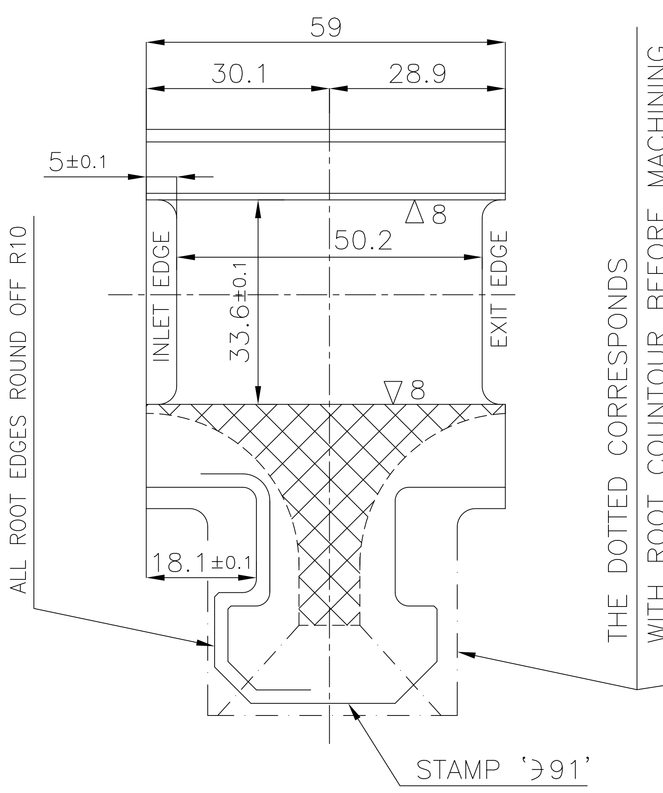
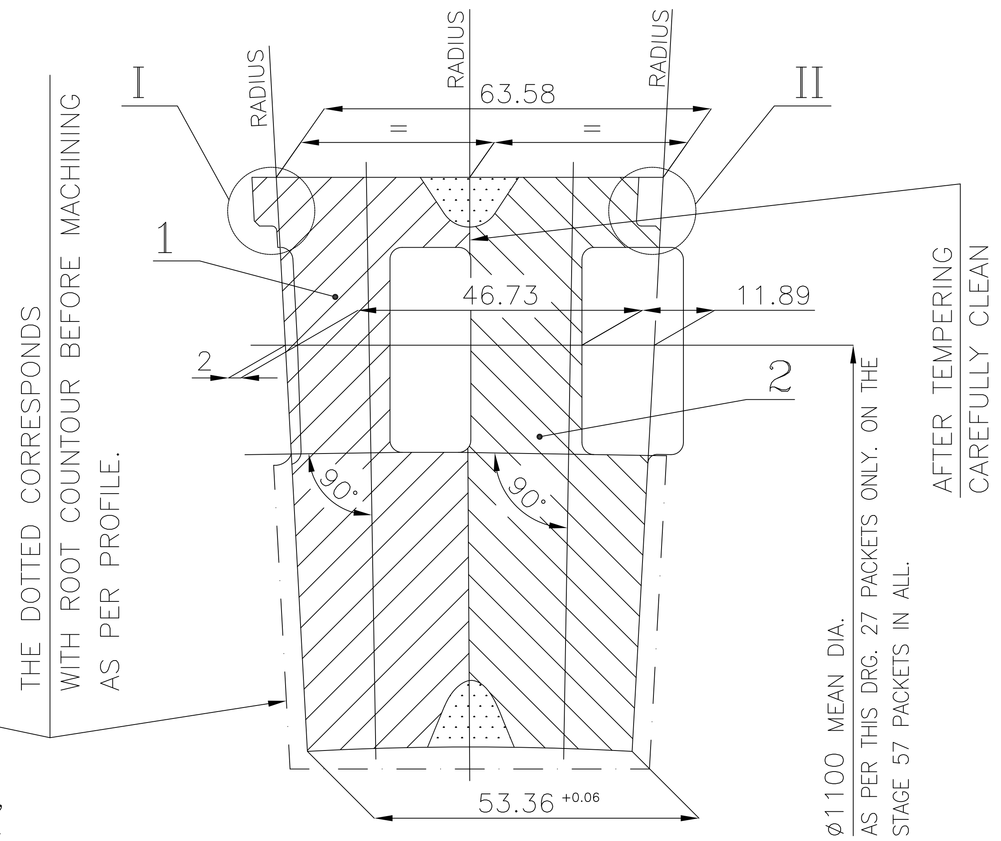
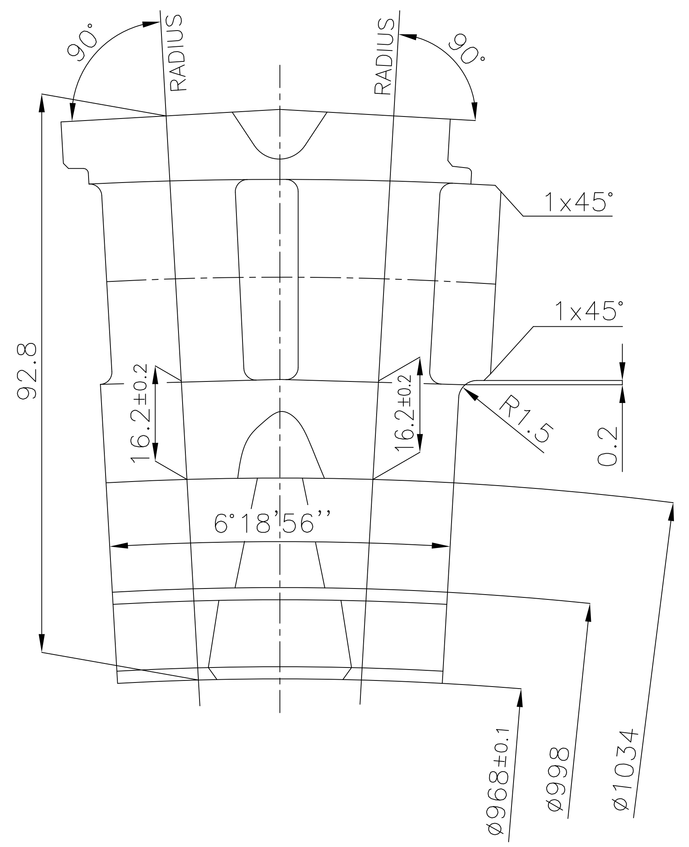
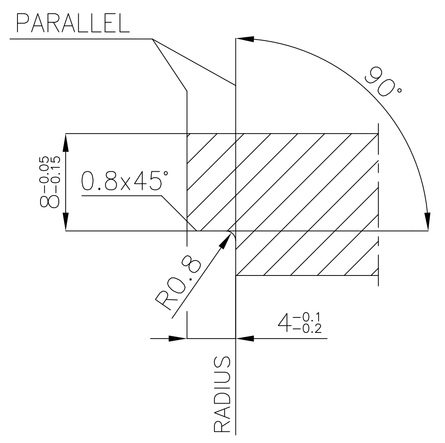
▽6 THE REST

FOR FINAL MACHINING OF PACKETS AFTER ASSEMBLY ON DISC–
SEE FINAL MACHINING DRAWING OF ROTOR

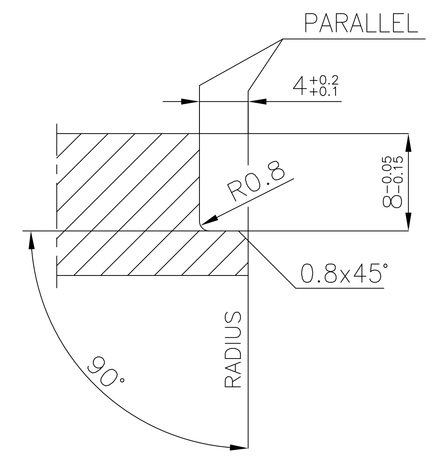




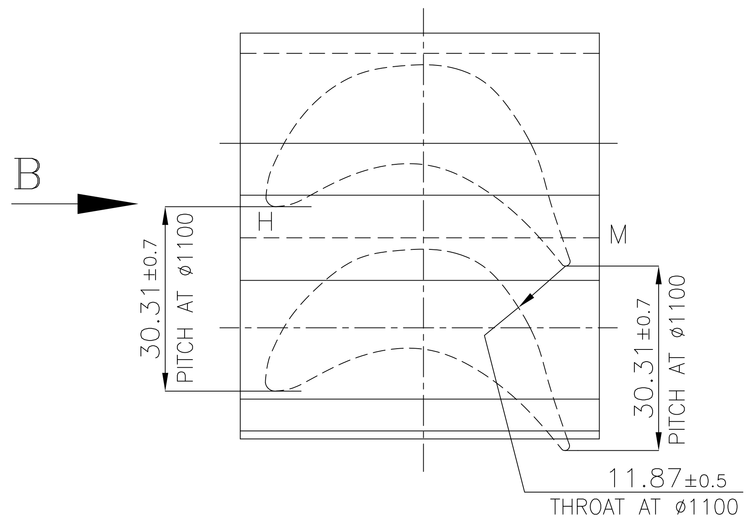


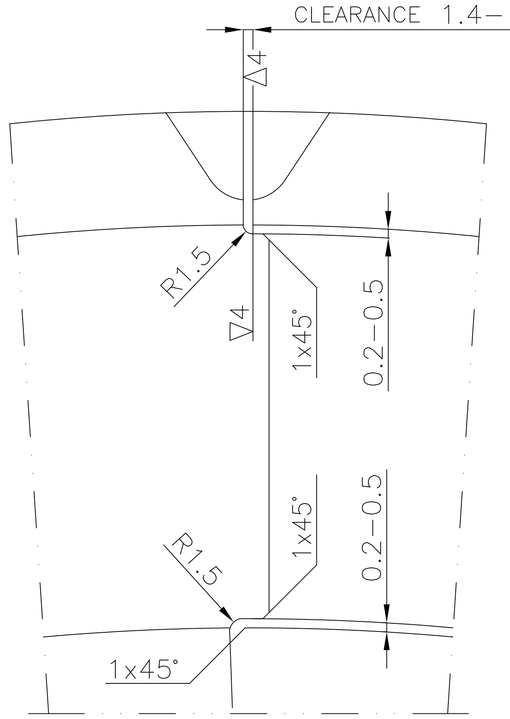


SCALE 2:1
VIEW I



SCALE 2:1
VIEW II





VIEW B

TECHNICAL RIQUIREMENTS :

1. BEFORE WELDING IT IS NECESSARY TO FIT THE BLADES AMONG THEMSELVES IN THE BLADE SHOP IN PAIRS AND SHOULD BE MARKED ON FACE, FOR THIS a) THE BLADE PACKETS MUST BE PLACED, SO THAT, ALONG THE WHOLE LENGTH H–M (SEE PLAN), AS WELL AS FROM SIDES AT ROOT AND AT BANDAGE, THERE ARE NO STEPS, b) THE ROOTS OF BLADES SHOULD BE FITTED BY PAINT. AT THE PLACES OF PAINT (SHOWN BY CROSSED LINES) CLEARANCES ARE NOT ALLOWED. THE FILING OF ROOT IS DONE FROM THE BACK SIDE OF BLADE. c) WHILE FITTING THE ROOTS, THE NON–COINCIDENCE OF THE WORKING PART OF BLADES MUST NOT EXCEED ±0.1mm. d) WHILE FITTING THE BLADES IN PAIRS AND ALSO BEFORE WELDING THEM IN PAIRS, THE DIMENSIONS OF THROAT AND PITCH AT INLET AS WELL AS AT EXIT SHOULD BE MAINTAINED AT MEAN DIA– WITHIN ALLOWABLE LIMIT (SEE VIEW FROM TOP) AS SUCH THE DIFFERENCE IN PITCHES AT INLET AND OUTLET SHOULD NOT BE MORE THAN 0.5mm.
2. THE BLADES SHOULD BE WELDED IN PAIRS AS PER FITTING IN BLADE SHOP (SEE POINT 1). AFTER WELDING, THE BLADES SHOULD BE HEAT TREATED. WELDING AND HEAT TREATMENT SHOULD BE DONE AS PER SPECIAL INSTRUCTIONS.
3. THE POSITION OF ROOT WITH RESPECT TO INNER WORKING PART OF BLADE IS CHECKED BY TEMPLATE ALLOWING A DEVIAION OF ±0.2.
4. WHILE MACHINING INTERNAL AND EXTERNAL SURFACES OF BLADE PACKET, RADIAL ANGLE TO BE MAINTAINED AS PER TEMPLATE WITH CLEARANCE 0.02 FORM THEORETICAL ANGLE.
5. ADJACENT BLADES SHOULD BE FITTED IN BLADE SHOP AS PER POINT 1 AND IN DOING SO, THE HEIGHT OF CANAL SHOULD BE MAINTAINED 33.6±0.1. EXIT EDGE IN PACKET SHOULD BE FITTED WITH ADJACENT BLADE PACKET AS SHOWN IN VIEW B.
6. PACKET ROOTS ARE TURNED AS PER PROFILE 1172–A DRAWING NO. 32301007 (Гу–1178026), AFTER WHICH BLADES ARE NUMBERED SERIALLY.
7. IN ALL WELDED BLADE PACKETS AND AS WELL AS BETWEEN ADJACENT PACKETS, THE THROAT AND PITCH SHOULD HAVE DIMENSIONS AS SHOWN (IN TOP VIEW), AT THIS THE DIFFERENCE IN PITCHES AT INLET & OUTLET MUST NOT EXCEED 0.5mm.
8. IN THE WELDED ZONE, STEP IN THE CANAL IS NOT ALLOWED MORE THAN 0.4mm.
9. WELD TEST SCOPE ACCORDING TO HW0850199 WITH CATAGORY OF SERVICE REQUIREMENT–1 (AFTER WELDING PACKETS AND AFTER TURNING OF ROOTS).

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

GRADE OF UNTOL.DIM
M/CG.–Ø/M/Ғ AA0230208
WELDING–A/B/Ø/Ø AA0621104
GAS CUTTING–'T3'AA0621101

REV	DATE	ALTERED / CHECKED

~~GMS No.~~ / CBOM No. 00032302000

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	–sd–	05.10.71
STD	M.P.SINGH	–sd–	16.10.71

STATUS OF DRG U

REV	DATE	ALTERED / CHECKED	
02	19.07.10	ALTERED KAILASH	Sd/–
		CHECKED P.K.BANSAL	Sd/–

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.

(STE–10–F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C–200–130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE	NO. OF VAR
DRN	K.M.SINGHAL	–sd–	18.09.71	–
CHD	N.B.MATHUR	–sd–	20.09.71	
APPD	J.N.KARAN	–sd–	23.10.71	73 74

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	1:1	1.77	32302000	–	75 77
CODE 4011					

TITLE : BLADE PACKET 1st STAGE

CARD CODE

DRAWING NO. 32302040 – (7 22 23 24)

SHEET No. 01 | No. OF SHEETS 01

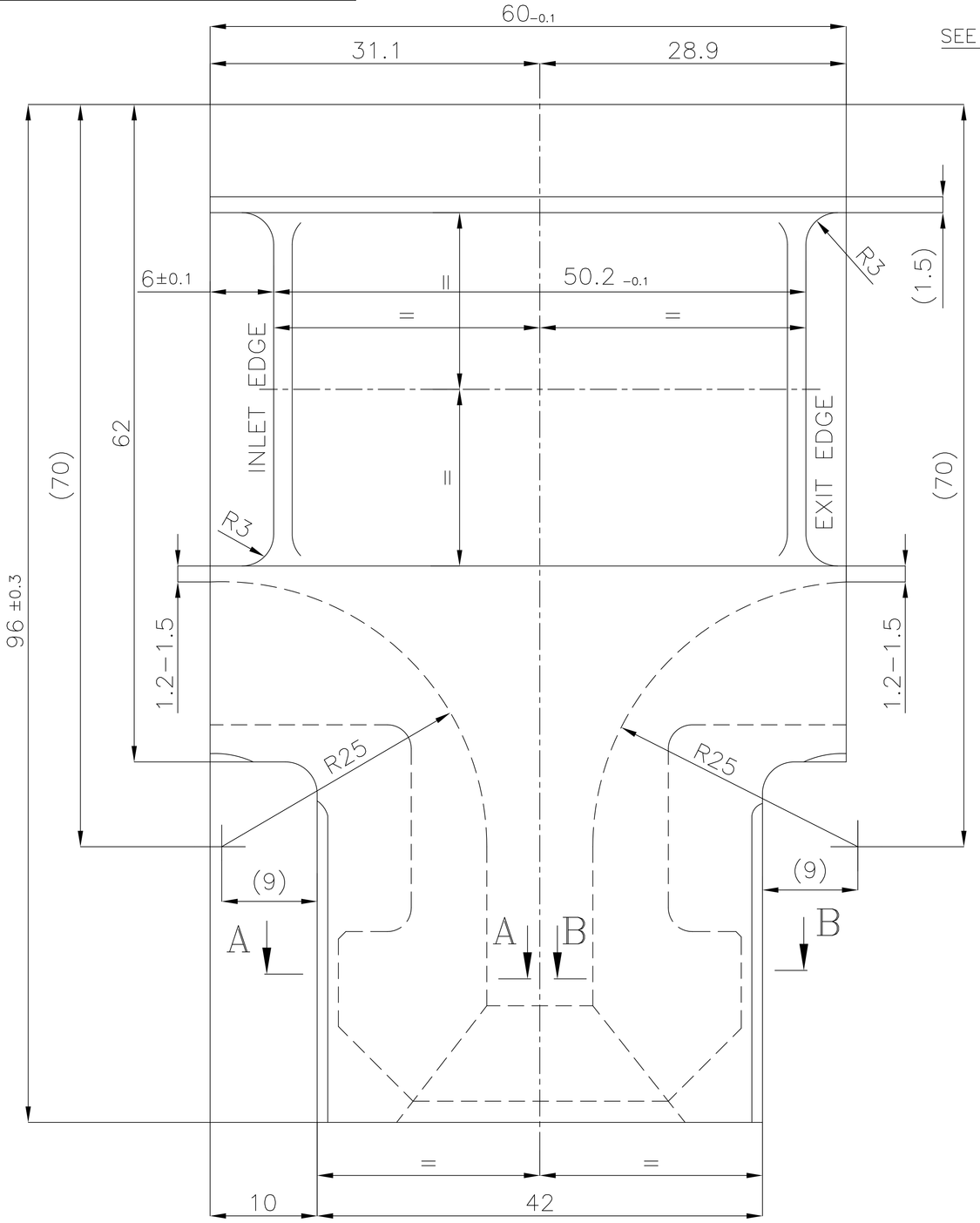
Ref.Drawing No> | Sign & Date | Inventory No.

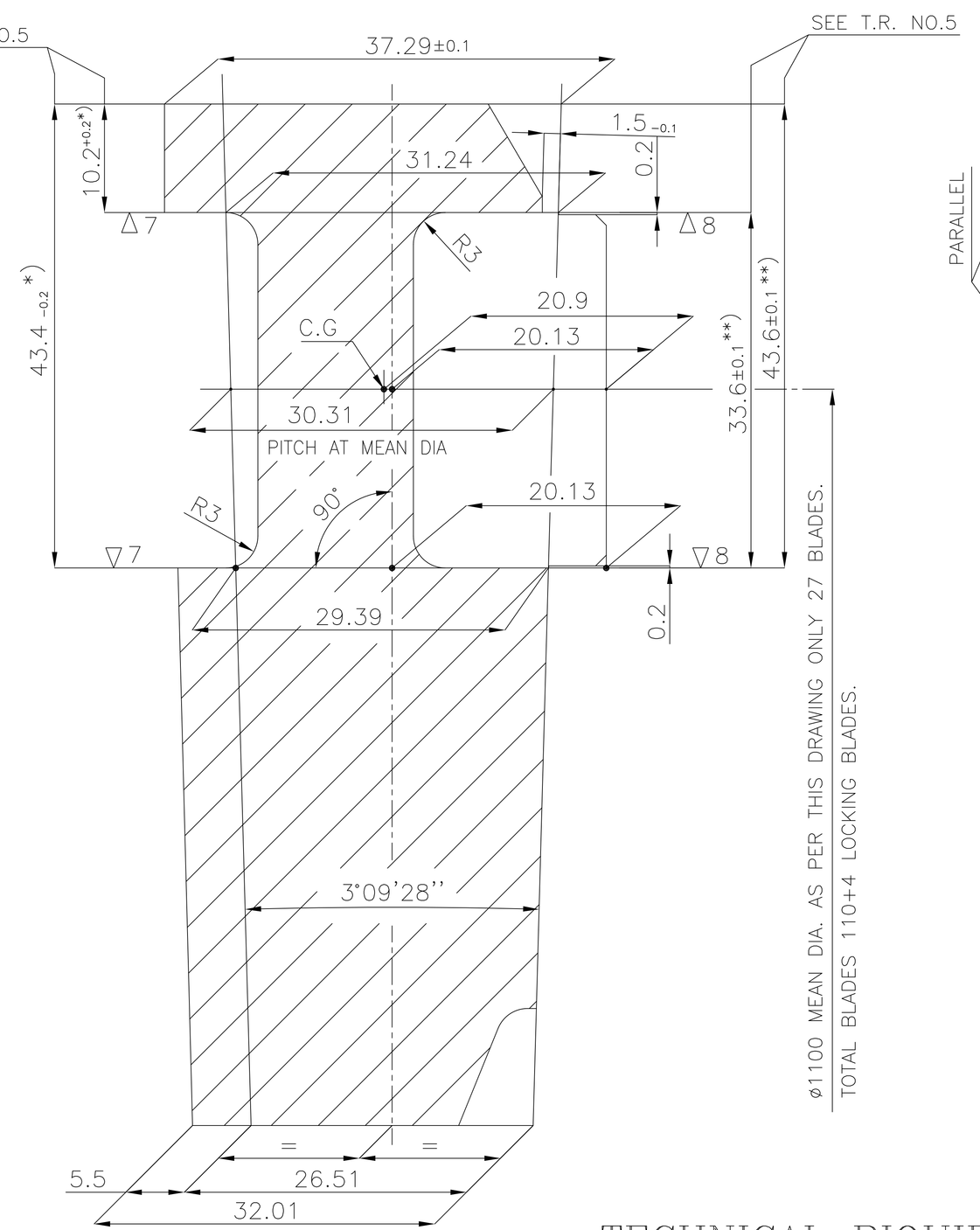
SIZE A2

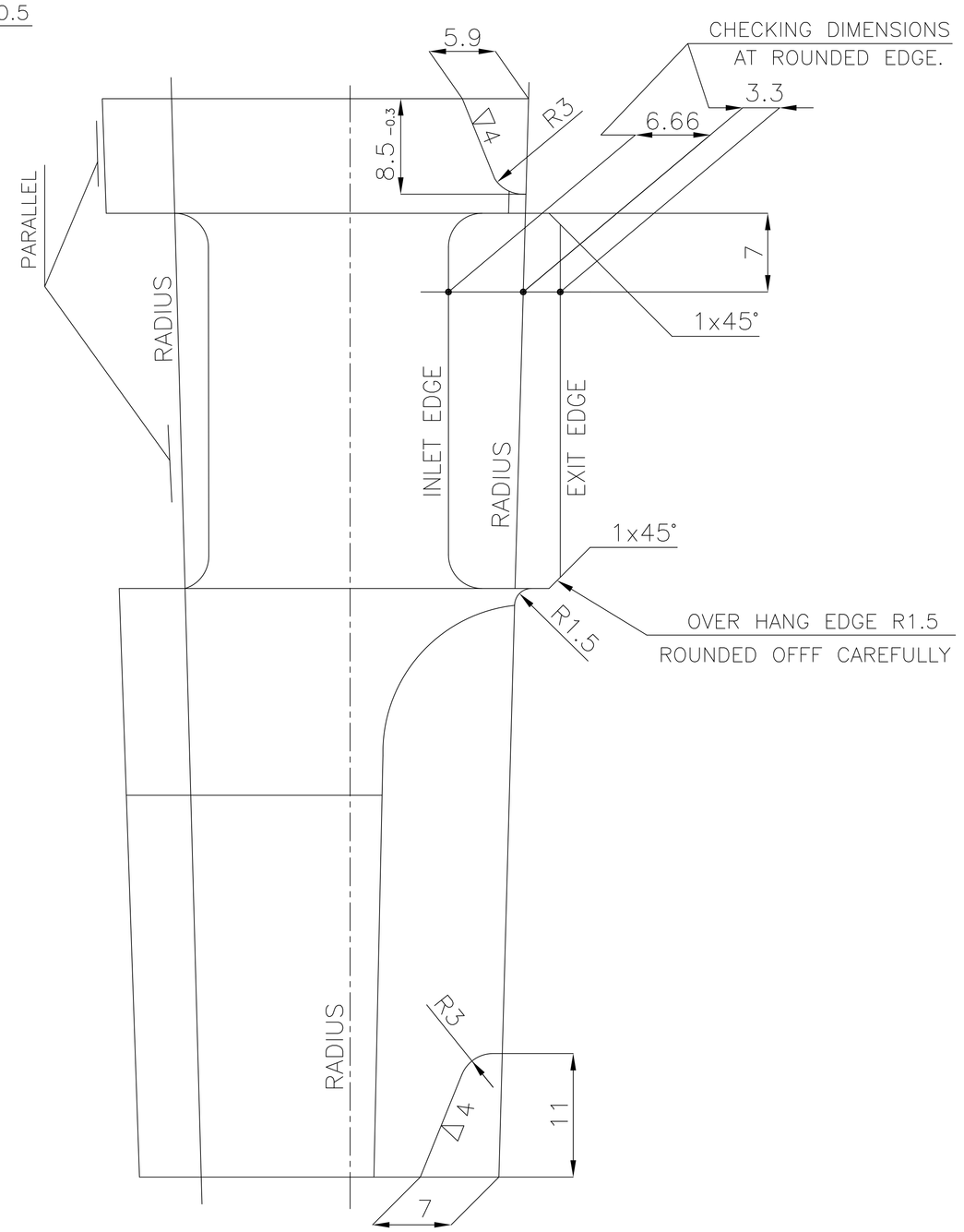
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 44(B)

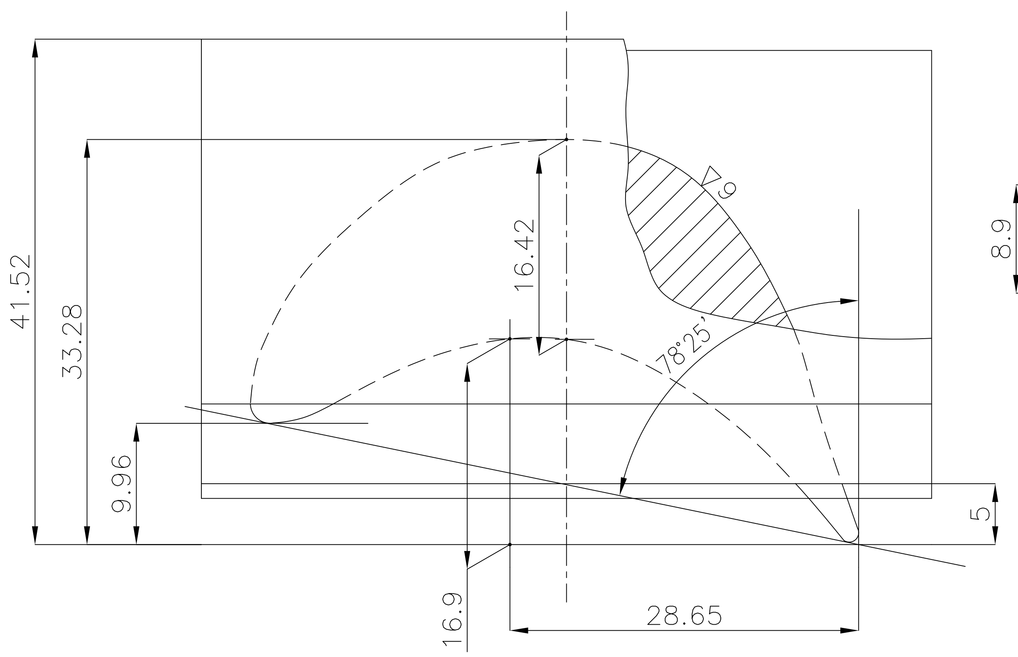
DRAWING No. 32302041

▽6 THE REST

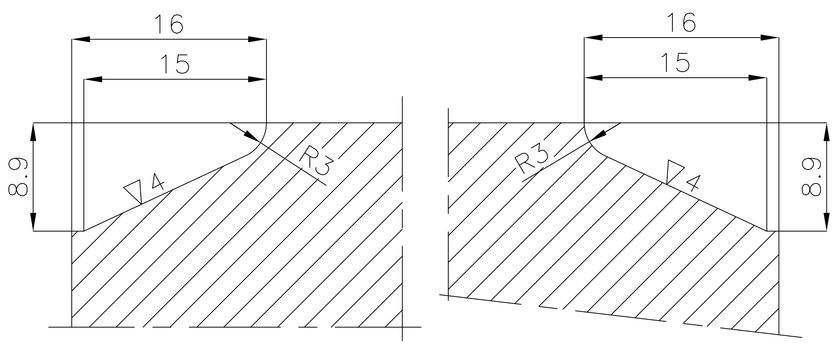








BLADE PROFILE NO.1173 DRG. NO.32302081 (Γy–1137409)
(LEFT ROTATION)



SECTION AA

SECTION BB

TECHNICAL RIQUIREMENTS :

1. PROFILE AND POSITION OF WORKING PART OF BLADE WITH RESPECT TO ROOT IS CHECKED BY TEMPLATE WITH ALLOWABLE CLEARANCE SHOWN ON PROFILE DRAWING.
2. DISPLACEMENT OF INTERNAL PROFILE WITH RESPECT TO EXTERNAL RADIAL SURFACE NOT MORE THAN ±0.2.
3. BLADES OF ONE PACKET SHOULD BE FITTED TOGETHER IN THE BLADE SHOP, PRIOR TO WELDING AS PER POINT 1 ON BLADE PACKET DRAWING.
4. AFTER MANUFACTURING THE BLADES, CHECK BY ETCHING FOR ABSENCE OF CRACKS & HAIR CRACKS.
5. **) DIMENSIONS ON INTERNAL PROFILE ARE FINAL.
   *) DIMENSION ON EXTERNAL PROFILE ARE GIVEN TAKING INTO ACCOUNT THE ALLOWANCE FOR FITTING WITH ADJACENT BLADE. (SEE POINT 6 OF BLADE PACKET DRAWING).
6. DIMENSIONS IN BRACKETS ARE FOR REFERENCE ONLY.

18Cr11Mo1Ni80V30Nb35
CS60–0500.706
2x11MØ

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

GRADE OF UNTOL.DIM		
M/CG.–Ø/M/F AA0230208		
WELDING–A/B/C/D AA0621104		
GAS CUTTING–'T3'AA0621101		
REV	DATE	ALTERED / CHECKED

~~CMS No.~~ / CBOM No. 00032302000			STATUS OF DRG
AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	–sd–	05.10.71
STD	M.P.SINGH	–sd–	16.10.71

REV	DATE			
01	13.07.10	ALTERED	KAILASH	Sd/–
		CHECKED	P.K.BANSAL	Sd/–

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.
(STE–10–F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C–200–130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE	NO. OF VAR
DRN	K.M.SINGHAL	–sd–	17.09.71	–
CHD	N.B.MATHUR	–sd–	20.09.71	
APPD	J.N.KARAN	–sd–	23.10.71	73 74

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	2:1	0.8	32302000	–	75 77
CODE 4011					

TITLE : BLADE 1st STAGE

CARD CODE

DRAWING NO. 32302041 – (7 22 23 24)

SHEET No. 01 | No. OF SHEETS 01

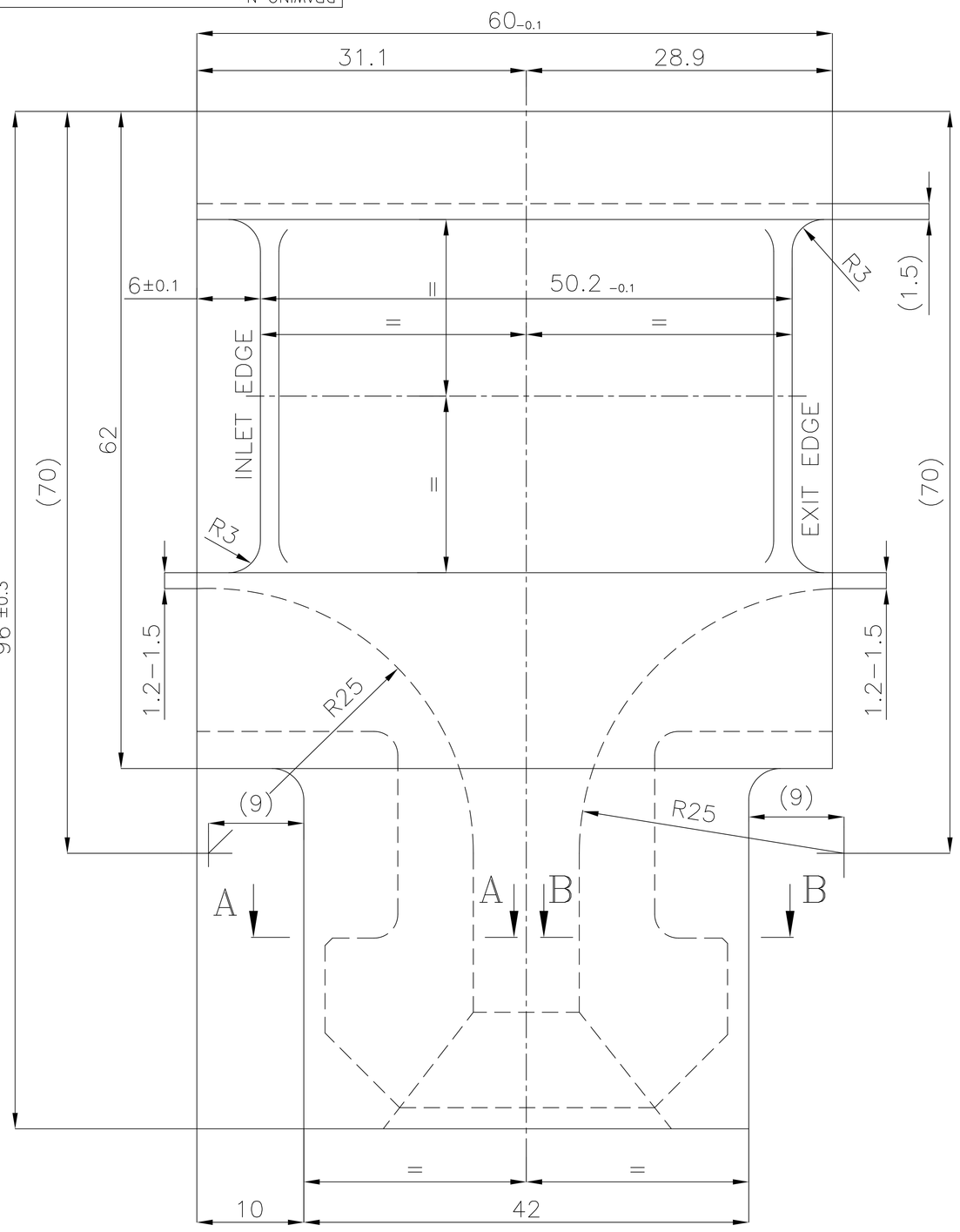
Ref.Drawing No> B–1183563 | Sign & Date | Inventory No.

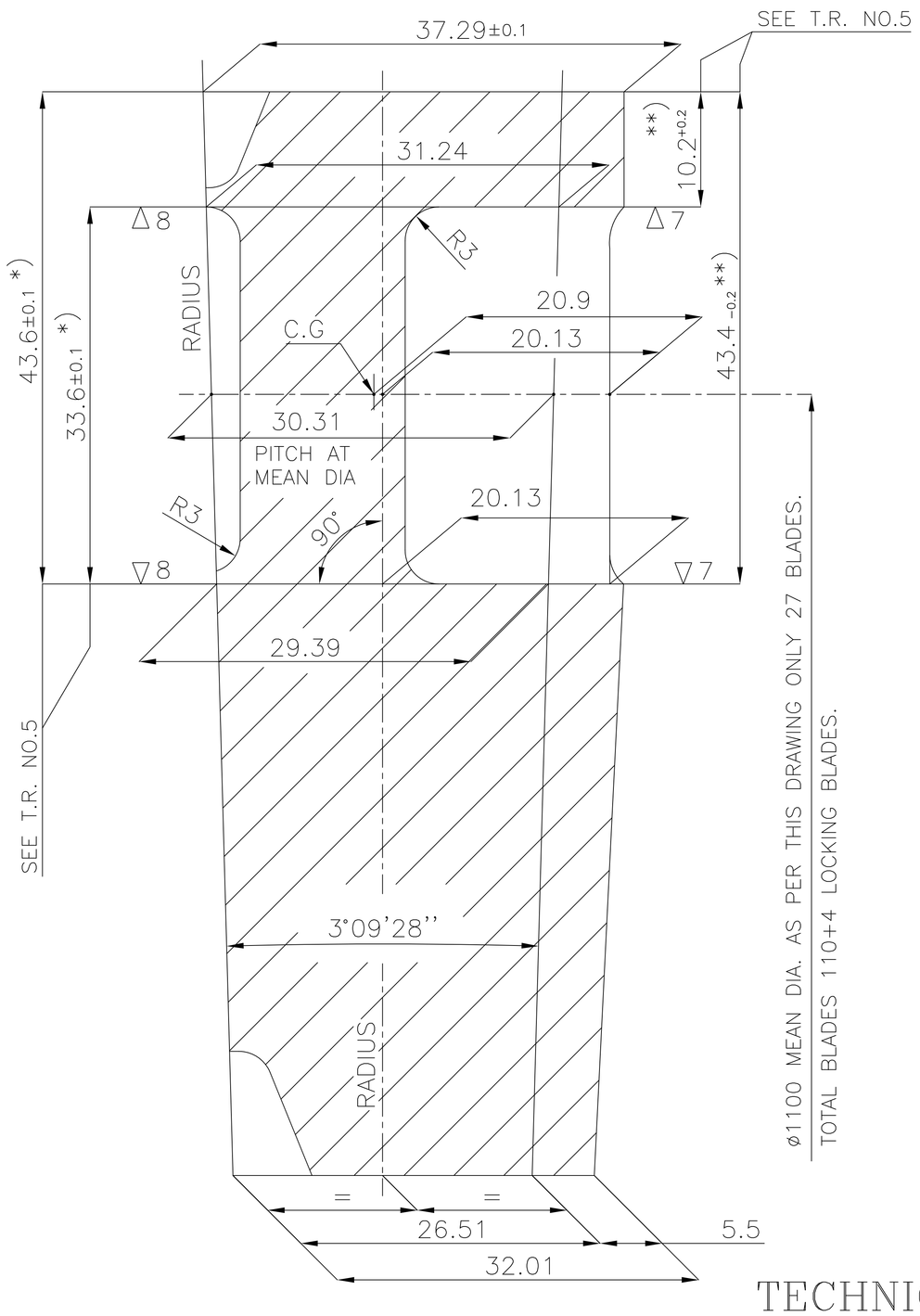
SIZE A2

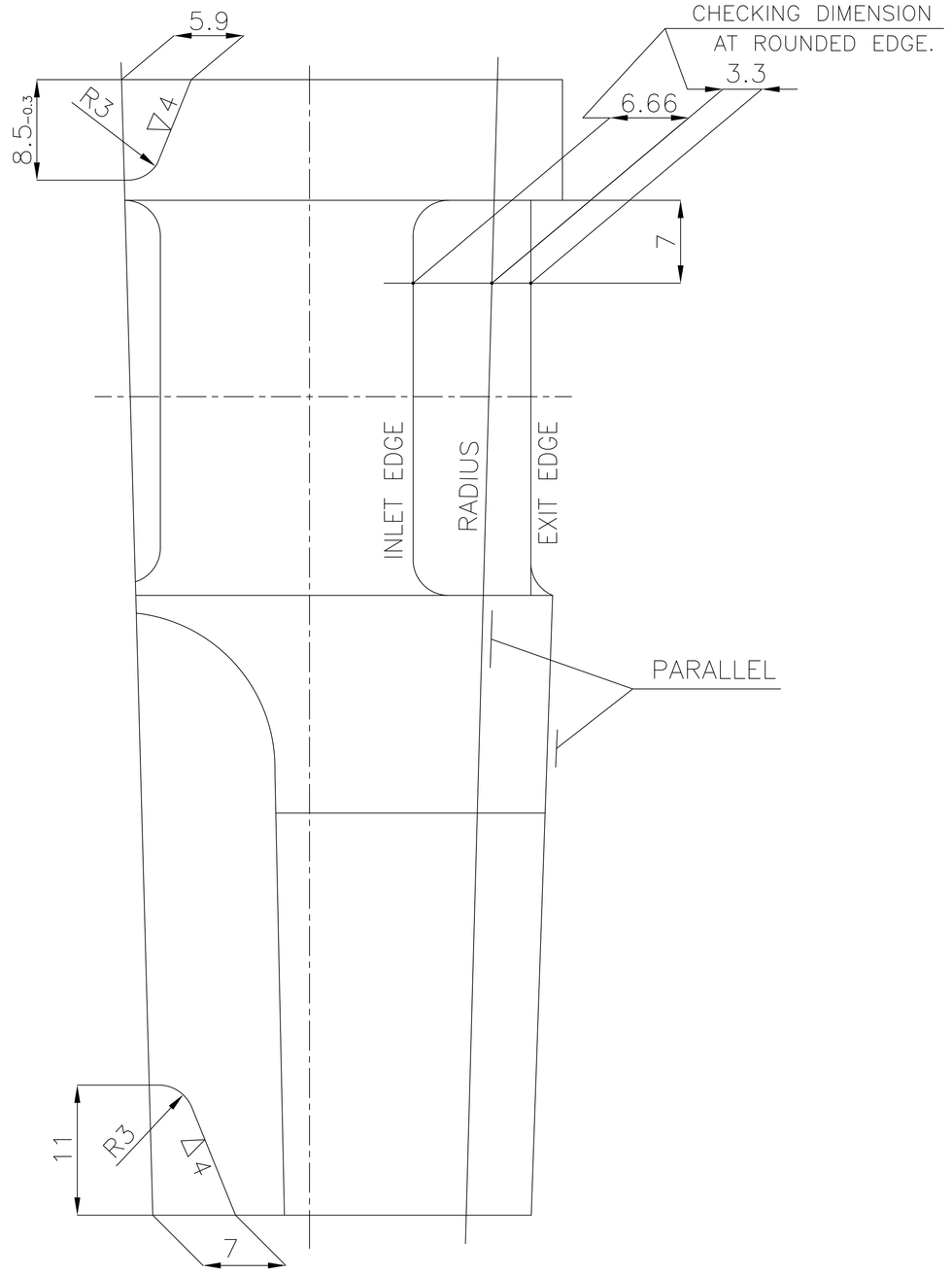
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 44(B)

DRAWING No. 32302042

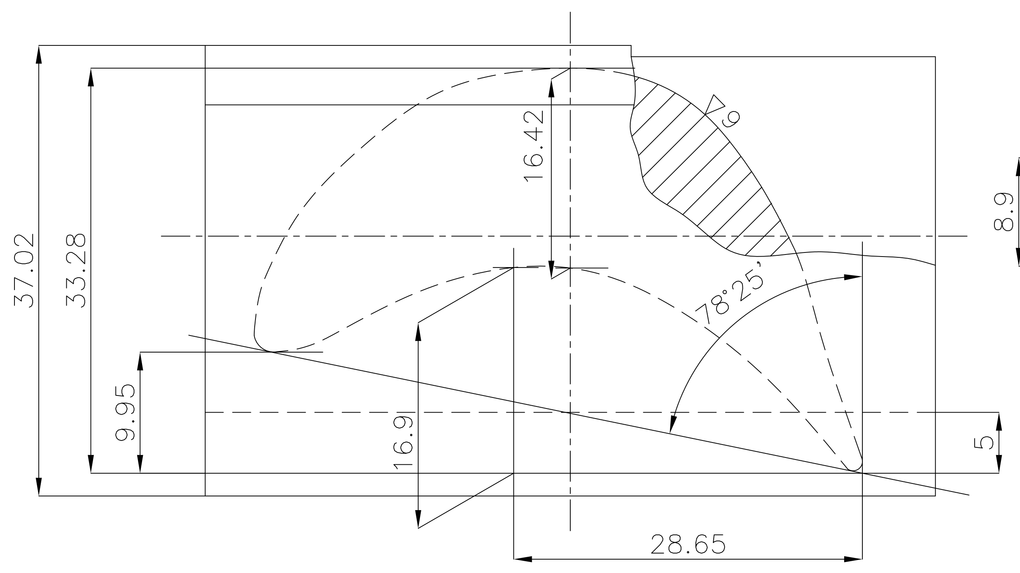
▽6 ~~THE REST~~



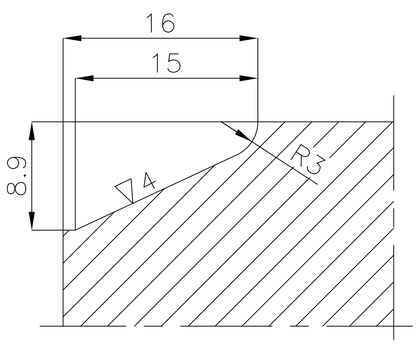




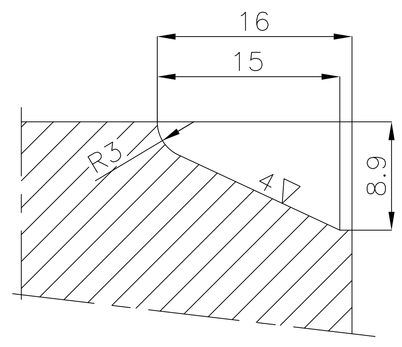
ø1100 MEAN DIA. AS PER THIS DRAWING ONLY 27 BLADES.
TOTAL BLADES 110+4 LOCKING BLADES.



BLADE PROFILE NO.1173 DRG. NO.32302081 (Γy–1137409)
(LEFT ROTATION)



SECTION AA



SECTION BB

TECHNICAL RIQUIREMENTS :

1. PROFILE AND POSITION OF WORKING PART OF BLADE WITH RESPECT TO ROOT IS CHECKED BY TEMPLATE WITH ALLOWABLE CLEARANCE SHOWN ON PROFILE DRAWING.
2. DISPLACEMENT OF INTERNAL PROFILE WITH RESPECT TO EXTERNAL RADIAL SURFACE NOT MORE THAN ±0.2.
3. BLADES OF ONE PACKET SHOULD BE FITTED TOGETHER IN THE BLADE SHOP, PRIOR TO WELDING AS PER POINT 1 ON BLADE PACKET DRAWING.
4. AFTER MANUFACTURING THE BLADE CHECK BY ETCHING FOR ABSENCE OF CRACKS & HAIR CRACKS.
5. *) DIMENSIONS ON EXTERNAL PROFILE ARE FINAL.
   **) DIMENSION ON INTERNAL PROFILE ARE GIVEN TAKING INTO ACCOUNT THE ALLOWANCE FOR FITTING WITH ADJACENT BLADE. (SEE POINT 6 OF BLADE PACKET DRAWING).
6. DIMENSIONS IN BRACKETS ARE FOR REFERENCE ONLY.

18Cr11Mo1Ni80V30Nb35
CS60–0500.706
2xllMø

GRADE OF UNTOL.DIM
M/CG.–Ø/M/F AA0230208
WELDING–A/B/C/D AA0621104
GAS CUTTING–'T3'AA0621101

REV	DATE	ALTERED / CHECKED

~~GMS No.~~ / CBOM No. 00032302000 — STATUS OF U DRG

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	–sd–	05.10.71
STD	M.P.SINGH	–sd–	16.10.71

REV	DATE	ALTERED KAILASH Sd/– / CHECKED P.K.BANSAL Sd/–
01	13.07.10	

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.

(STE–10–F0165)

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C–200–130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE
DRN	K.M.SINGHAL	–sd–	17.09.71
CHD	N.B.MATHUR	–sd–	20.09.71
APPD	J.N.KARAN	–sd–	23.10.71

NO. OF VAR: – (73 74)

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	2:1	0.77	32302000	–	(75 77)
CODE 4011					

TITLE : BLADE 1st STAGE

CARD CODE

DRAWING NO. 32302042 – (7 22 23 24)

SHEET No. 01 | No. OF SHEETS 01

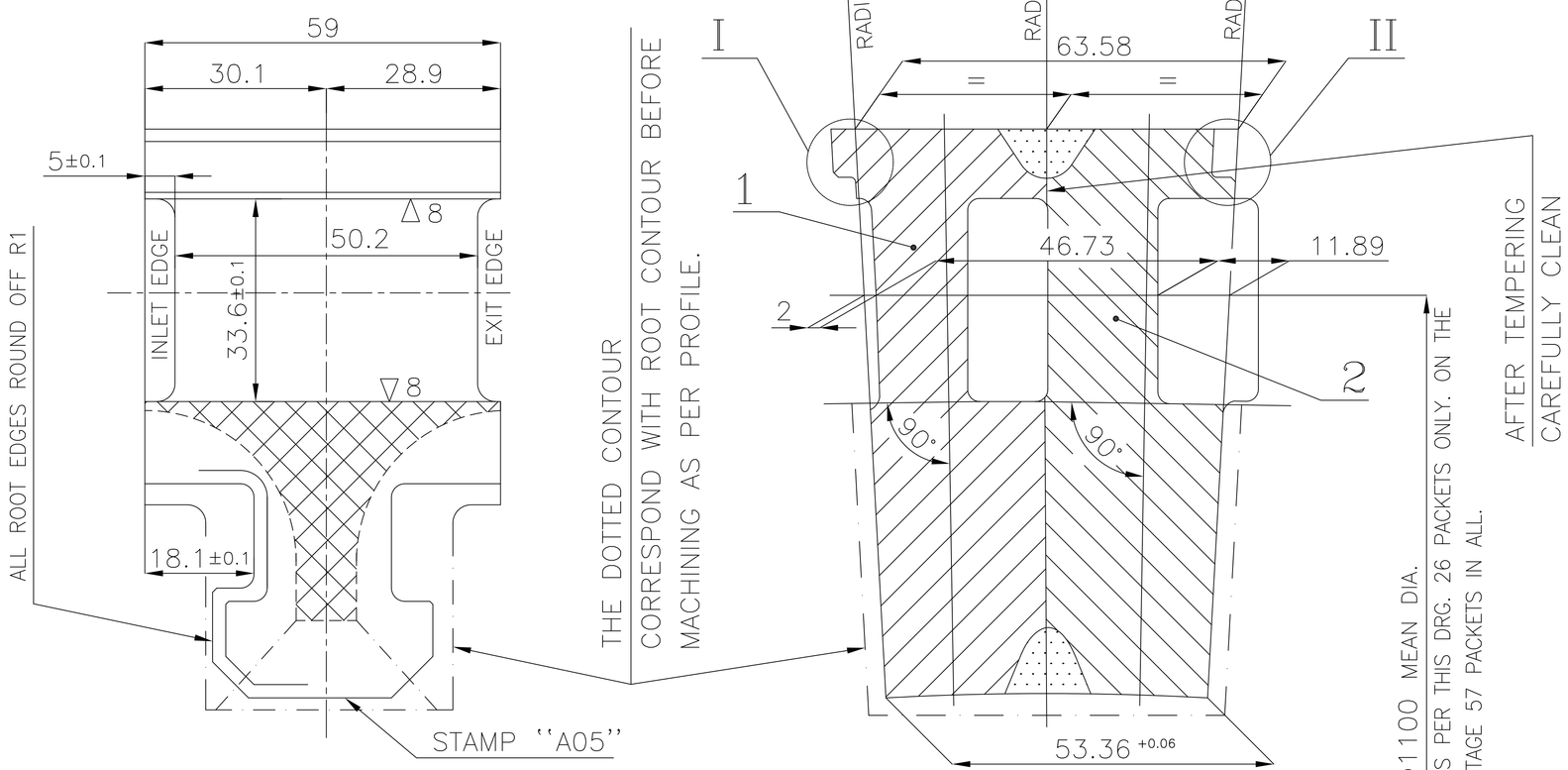
SIZE A2

Ref.Drawing No> B–1183564 | Sign & Date | Inventory No.

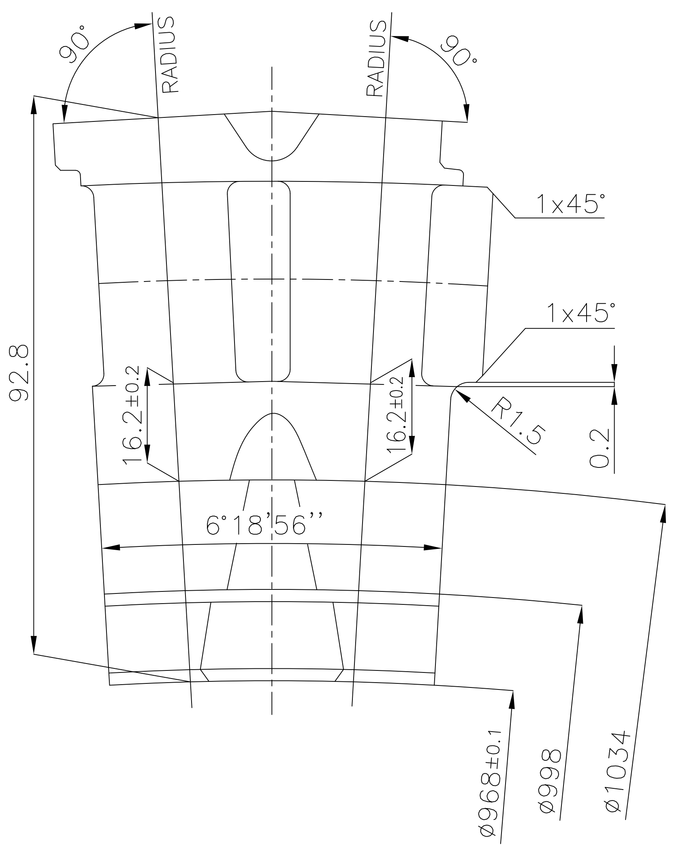
DRAWING No. 32302050

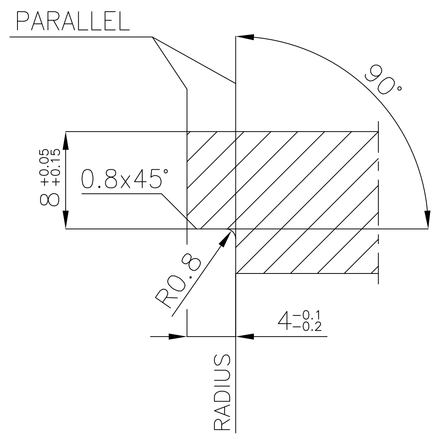
▽6 THE REST

FOR FINAL MACHINING OF PACKETS AFTER ASSEMBLY ON DISC–
SEE FINAL MACHINING DRAWING OF ROTOR

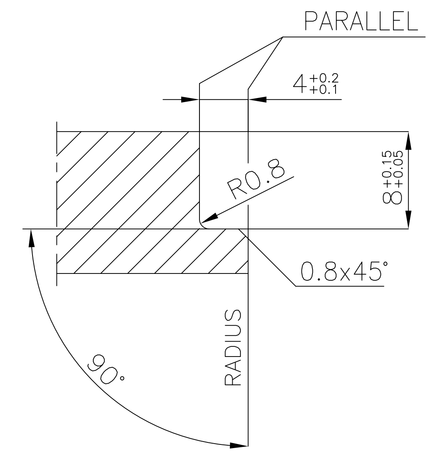


ROOT PROFILE NO.1172A

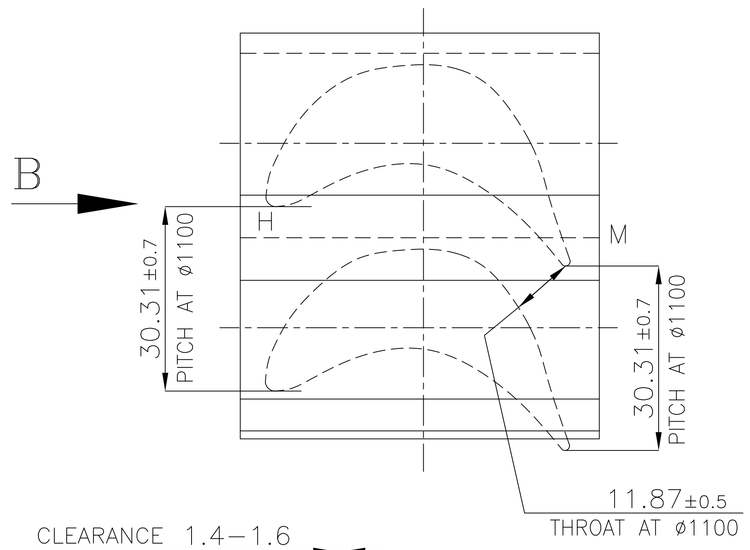


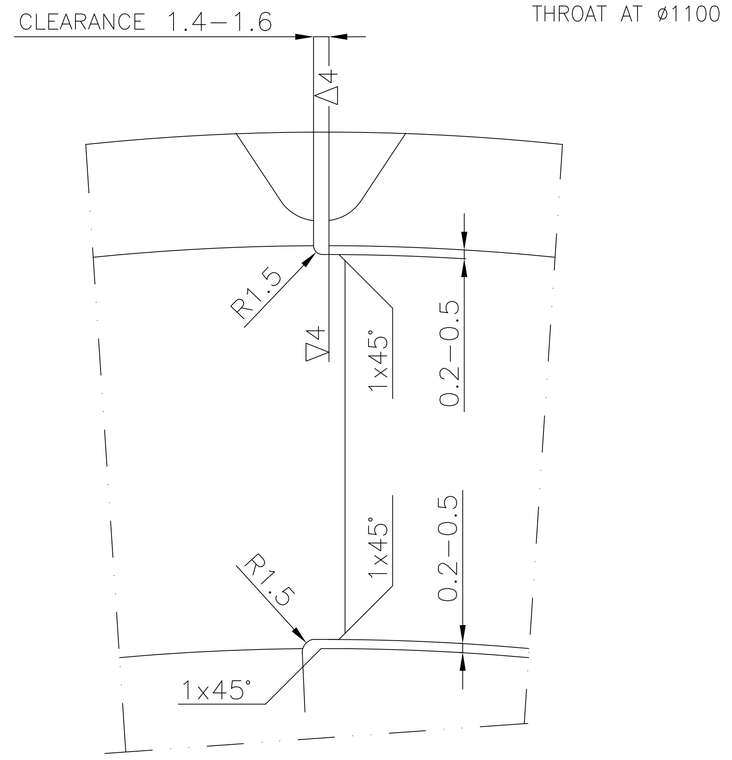


SCALE 2:1
VIEW I



SCALE 2:1
VIEW II





VIEW B

TECHNICAL RIQUIREMENTS :

1. BEFORE WELDING IT IS NECESSARY TO FIT THE BLADES AMONG THEMSELVES IN THE BLADE SHOP IN PAIRS AND SHOULD BE MARKED ON FACE, FOR THIS a) THE BLADE PACKETS MUST BE PLACED, SO THAT, ALONG THE WHOLE LENGTH H–M (SEE PLAN), AS WELL AS FROM SIDES AT ROOT AND AT BANDAGE, THERE ARE NO STEPS, b) THE ROOTS OF BLADES SHOULD BE FITTED BY PAINT. AT THE PLACES OF PAINT (SHOWN BY CROSSED LINES) CLEARANCES ARE NOT ALLOWED. THE FILING OF ROOT IS DONE FROM THE BACK SIDE OF BLADE. c) WHILE FITTING THE ROOTS, THE NON–COINCIDENCE OF THE WORKING PART OF BLADES MUST NOT EXCEED ±0.1mm. d) WHILE FITTING THE BLADES IN PAIRS AND ALSO BEFORE WELDING THEM IN PAIRS, THE DIMENSIONS OF THROAT AND PITCH AT INLET AS WELL AS EXIT SHOULD BE MAINTAINED AT MEAN DIA– WITHIN ALLOWABLE LIMIT (SEE VIEW FROM TOP) AS SUCH THE DIFFERENCE IN PITCHES AT INLET AND OUTLET SHOULD NOT BE MORE THAN 0.5mm.
2. THE BLADES SHOULD BE WELDED IN PAIRS AS PER FITTING IN BLADE SHOP (SEE POINT 1). AFTER WELDING, THE BLADES SHOULD BE HEAT TREATED. WELDING AND HEAT TREATMENT SHOULD BE DONE AS PER SPECIAL INSTRUCTIONS.
3. THE POSITION OF ROOT WITH RESPECT TO INNER WORKING PART OF BLADE IS CHECKED BY TEMPLATE ALLOWING A DEVIAION OF ±0.2.
4. WHILE MACHINING INTERNAL AND EXTERNAL SURFACES OF BLADE PACKET, RADIAL ANGLE SHOULD BE MAINTAINED AS PER TEMPLATE WITH CLEARANCE 0.02 FORM THEORETICAL ANGLE.
5. ADJACENT BLADES SHOULD BE FITTED IN BLADE SHOP AS PER POINT 1 AND IN DOING SO, THE HEIGHT OF CANAL SHOULD BE MAINTAINED 33.6±0.1. EXIT EDGE IN PACKET SHOULD BE FITTED WITH ADJACENT BLADE PACKET AS SHOWN IN VIEW 'B'.
6. PACKET ROOTS ARE TURNED AS PER PROFILE 1172–A DRAWING NO. 32301007 (Гу–1178026), AFTER WHICH BLADES ARE NUMBERED SERIALLY.
7. IN ALL WELDED BLADE PACKETS AND AS WELL AS BETWEEN ADJACENT PACKETS, THE THROAT AND PITCH SHOULD HAVE DIMENSIONS AS SHOWN (IN TOP VIEW), AT THIS THE DIFFERENCE IN PITCHES AT INLET & OUTLET MUST NOT EXCEED 0.5mm.
8. IN THE WELDED ZONE, STEP IN THE CANAL IS NOT ALLOWED MORE THAN 0.4mm.
9. FOR FINAL MACHINING OF PACKETS AFTER ASSEMBLY ON DISC– SEE FINAL MACHINING DRAWING OF TOTOR.
10. WELD TEST SCOPE ACCORDING TO HW0850199 WITH CATAGORY OF SERVICE REQUIREMENT–1 (AFTER WELDING PACKETS AND AFTER TURNING OF ROOTS).

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

GRADE OF UNTOL.DIM
M/CG.–Ø/M/F AA0230208
WELDING–A/B/C/D AA0621104
GAS CUTTING–'T3'AA0621101

REV	DATE	ALTERED / CHECKED

~~GMS No.~~ / CBOM No. 00032302000 — STATUS OF DRG: U

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	–sd–	05.10.71
STD	M.P.SINGH	–sd–	16.10.71

REV	DATE		
02	13.07.10	ALTERED KAILASH	Sd/–
		CHECKED P.K.BANSAL	Sd/–

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.
(STE–10–F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C–200–130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE
DRN	K.M.SINGHAL	–sd–	18.09.71
CHD	N.B.MATHUR	–sd–	20.09.71
APPD	J.N.KARAN	–sd–	23.10.71

NO. OF VAR: –

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	1:1	1.77	32302000	–	
CODE 4011					

TITLE : BLADE PACKET 1st STAGE

CARD CODE

DRAWING NO. 32302050 –

SHEET No. 01 | No. OF SHEETS 01

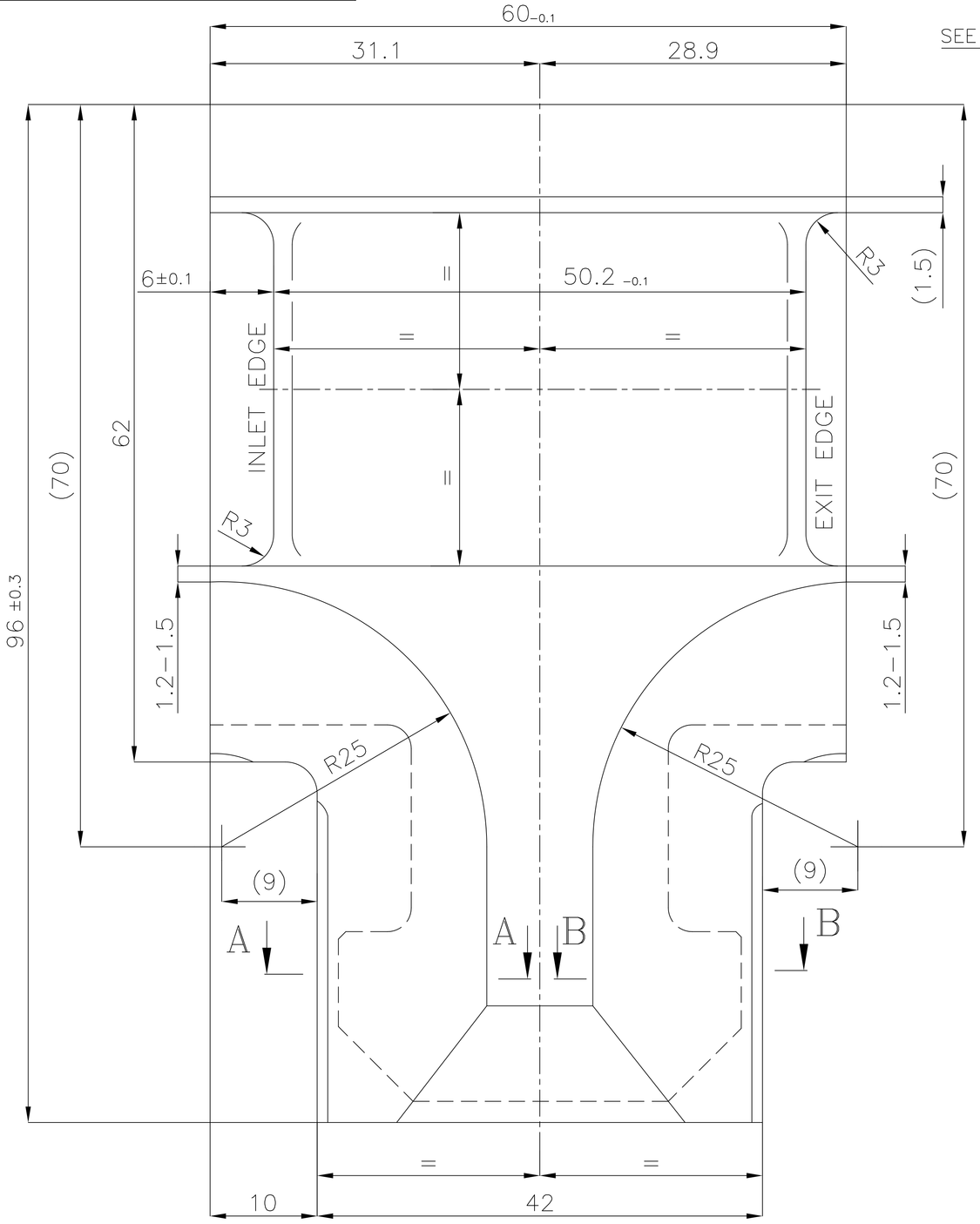
SIZE A2

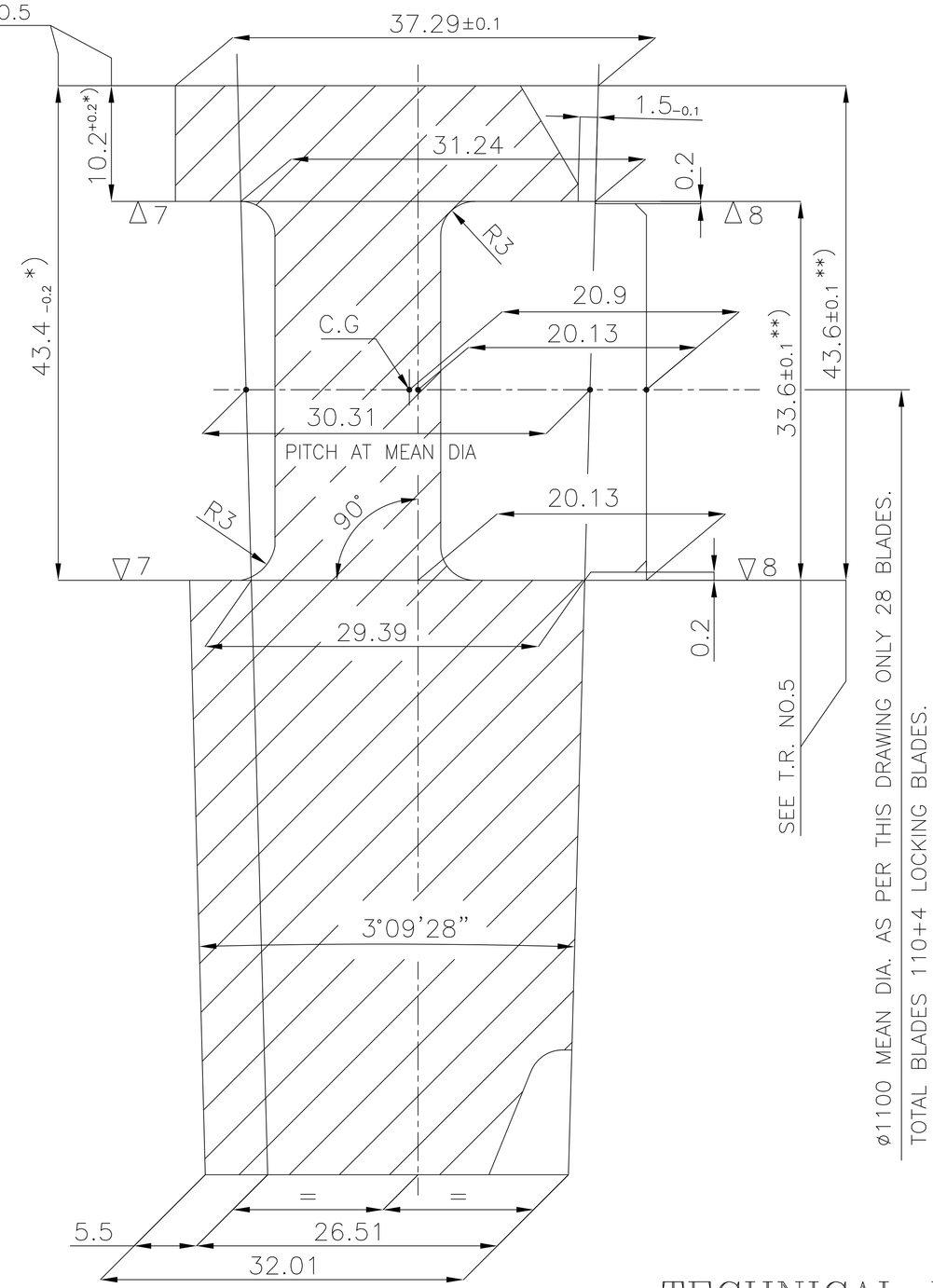
Inventory No. | Sign & Date | Ref.Drawing No>

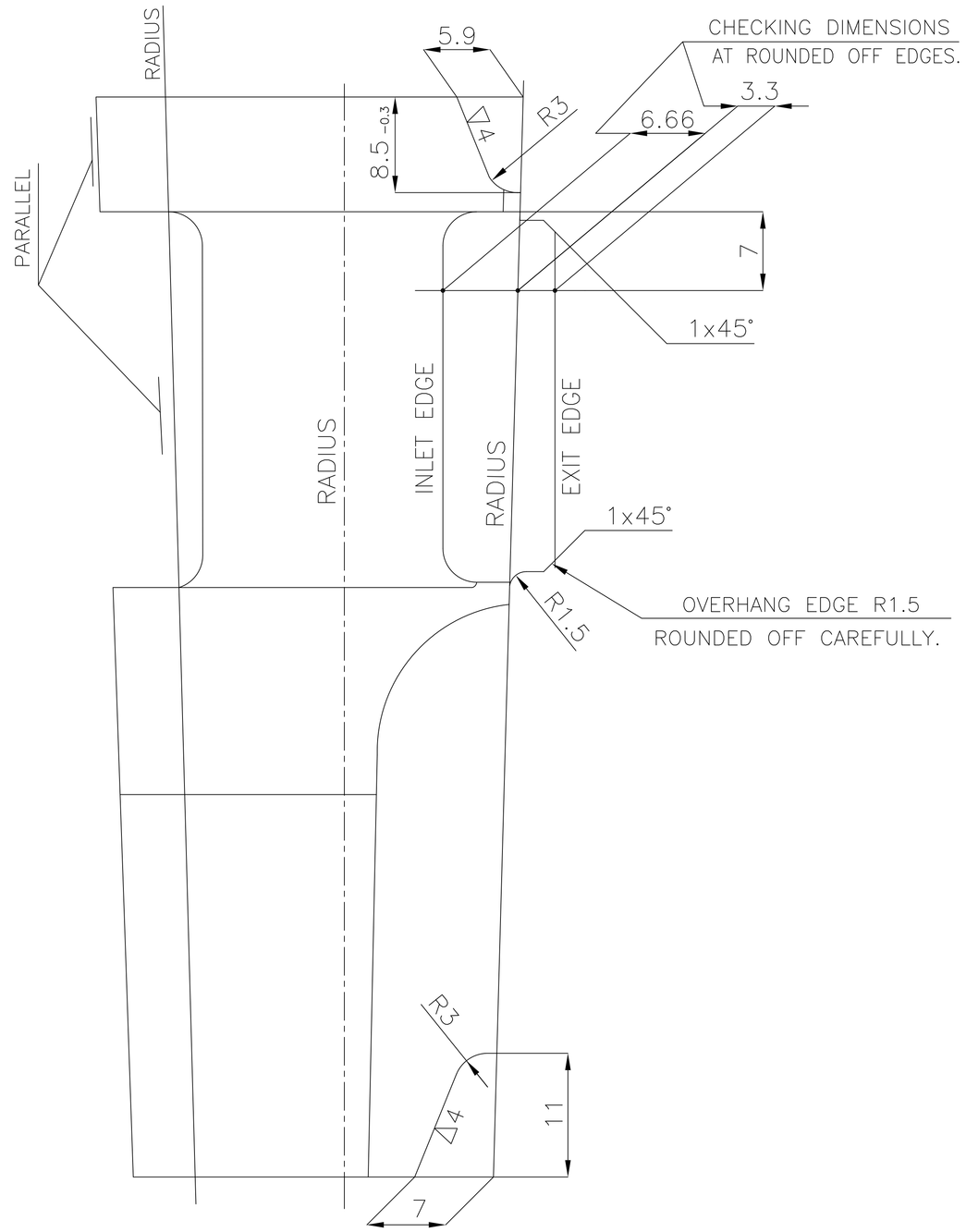
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 44(B)

DRAWING No. 32302051

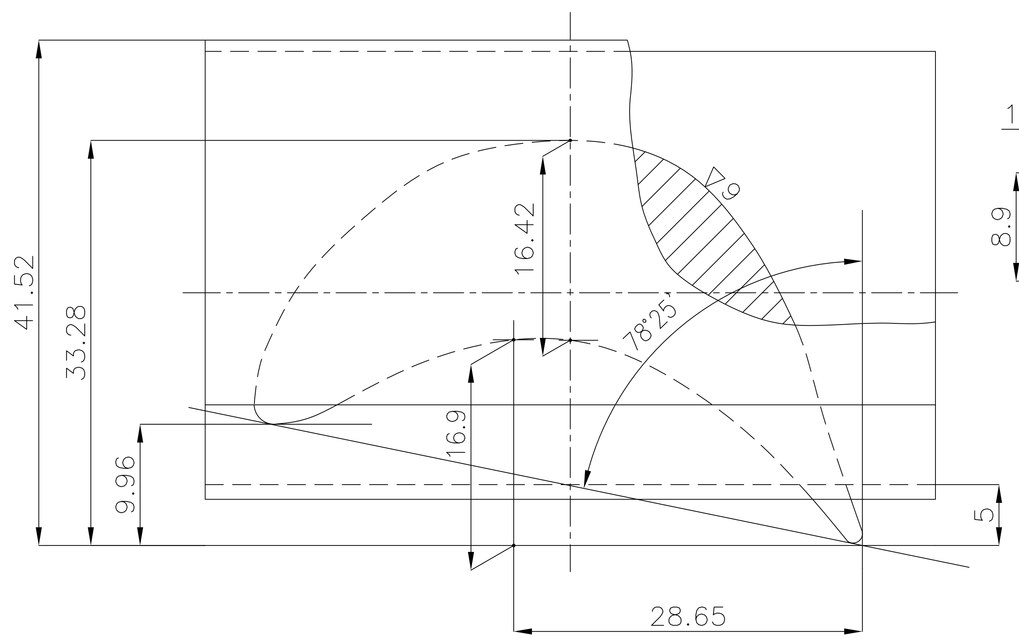
▽6 THE REST





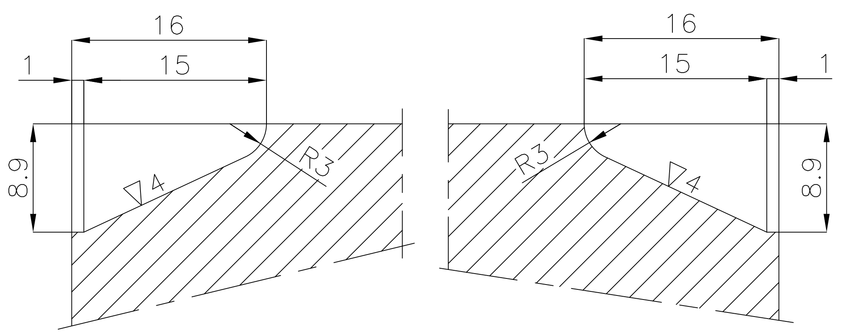


ø1100 MEAN DIA. AS PER THIS DRAWING ONLY 28 BLADES.
TOTAL BLADES 110+4 LOCKING BLADES.



BLADE PROFILE NO.1173 DRG. NO.32302081 (Γy–1137409).
(LEFT ROTATION)

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE



SECTION AA

SECTION BB

TECHNICAL RIQUIREMENTS :

1. PROFILE AND POSITION OF WORKING PART OF BLADE WITH RESPECT TO ROOT IS CHECKED BY TEMPLATE WITH ALLOWABLE CLEARANCE SHOWN ON PROFILE DRAWING.
2. DISPLACEMENT OF INTERNAL PROFILE WITH RESPECT TO EXTERNAL RADIAL SURFACE NOT MORE THAN ±0.2.
3. BLADES OF ONE PACKET SHOULD BE FITTED TOGETHER IN THE BLADE SHOP, PRIOR TO WELDING AS PER POINT 1 ON BLADE PACKET DRAWING.
4. AFTER MANUFACTURING THE BLADE CHECK BY ETCHING FOR ABSENCE OF CRACKS & HAIR CRACKS.
5. **) DIMENSIONS AT INTERNAL PROFILE ARE FINAL.
   *) DIMENSION AT EXTERNAL PROFILE ARE GIVEN TAKING INTO ACCOUNT THE ALLOWANCE FOR FITTING WITH ADJACENT BLADE. (SEE POINT 6 OF BLADE PACKET DRAWING).
6. DIMENSIONS IN BRACKETS ARE FOR REFERENCE ONLY.

10Cr16Ni14Mo23Nb11
CS22–0500.706
1x16H13M26

GRADE OF UNTOL.DIM			
M/CG.–Ø/M/∀ AA0230208			
WELDING–A/B/Ø/Ø AA0621104			
GAS CUTTING–'T3'AA0621101			
REV	DATE	ALTERED	
		CHECKED	

~~GMS No.~~ / CBOM No. 00032302000 — STATUS OF DRG: U

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	–sd–	05.10.71
STD	M.P.SINGH	–sd–	16.10.71

REV	DATE		
01	13.07.10	ALTERED KAILASH	Sd/–
		CHECKED P.K.BANSAL	Sd/–

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.
(STE–10–F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C–200–130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE
DRN	K.M.SINGHAL	–sd–	17.09.71
CHD	N.B.MATHUR	–sd–	20.09.71
APPD	J.N.KARAN	–sd–	23.10.71

NO. OF VAR: –

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	2:1	0.8	32302000	–	
CODE 4011					

TITLE : BLADE 1st STAGE

CARD CODE

DRAWING NO. 32302051 –

SHEET No. 01 | No. OF SHEETS 01

Ref.Drawing No> B–1183561

Sign & Date

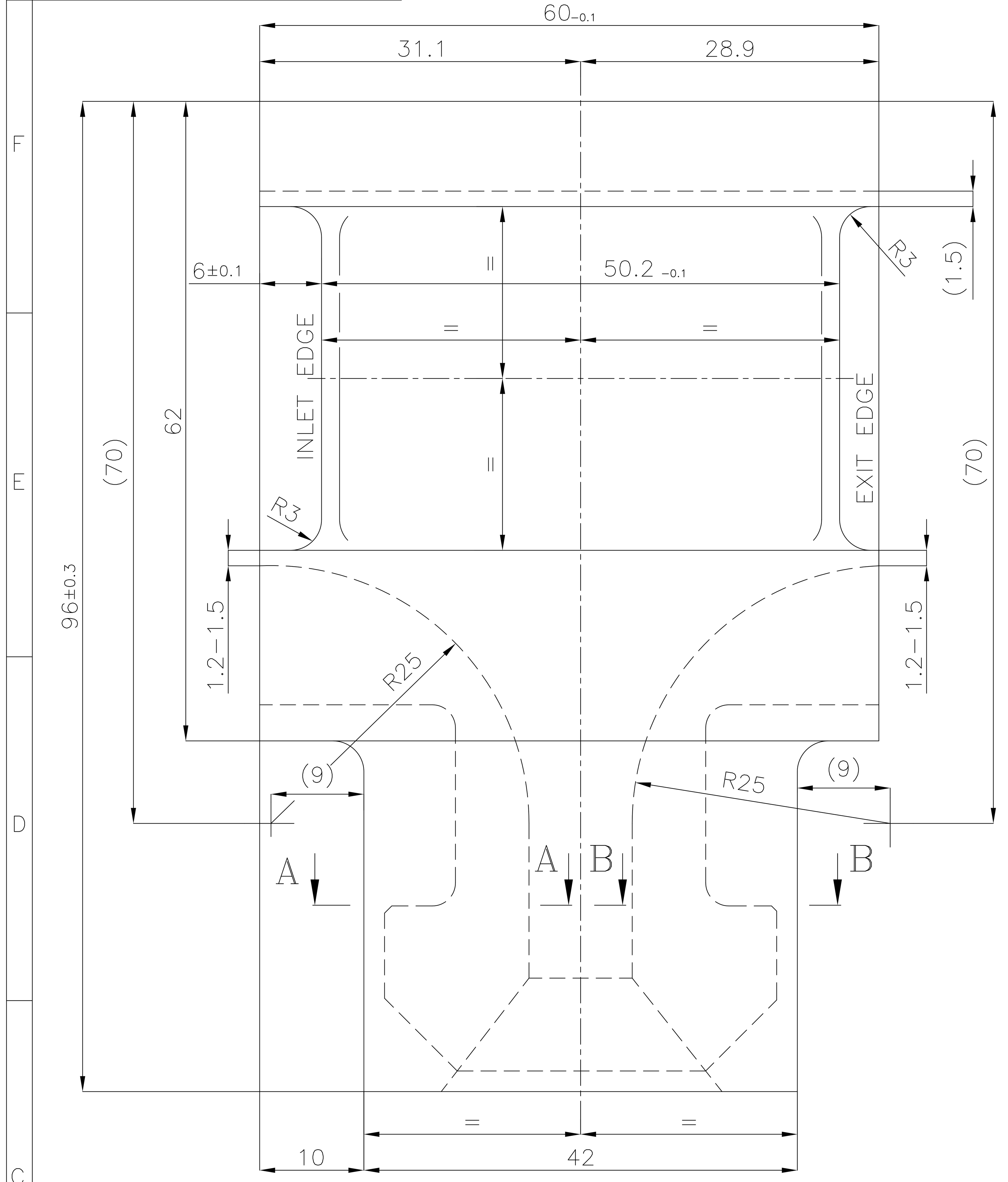
Inventory No.

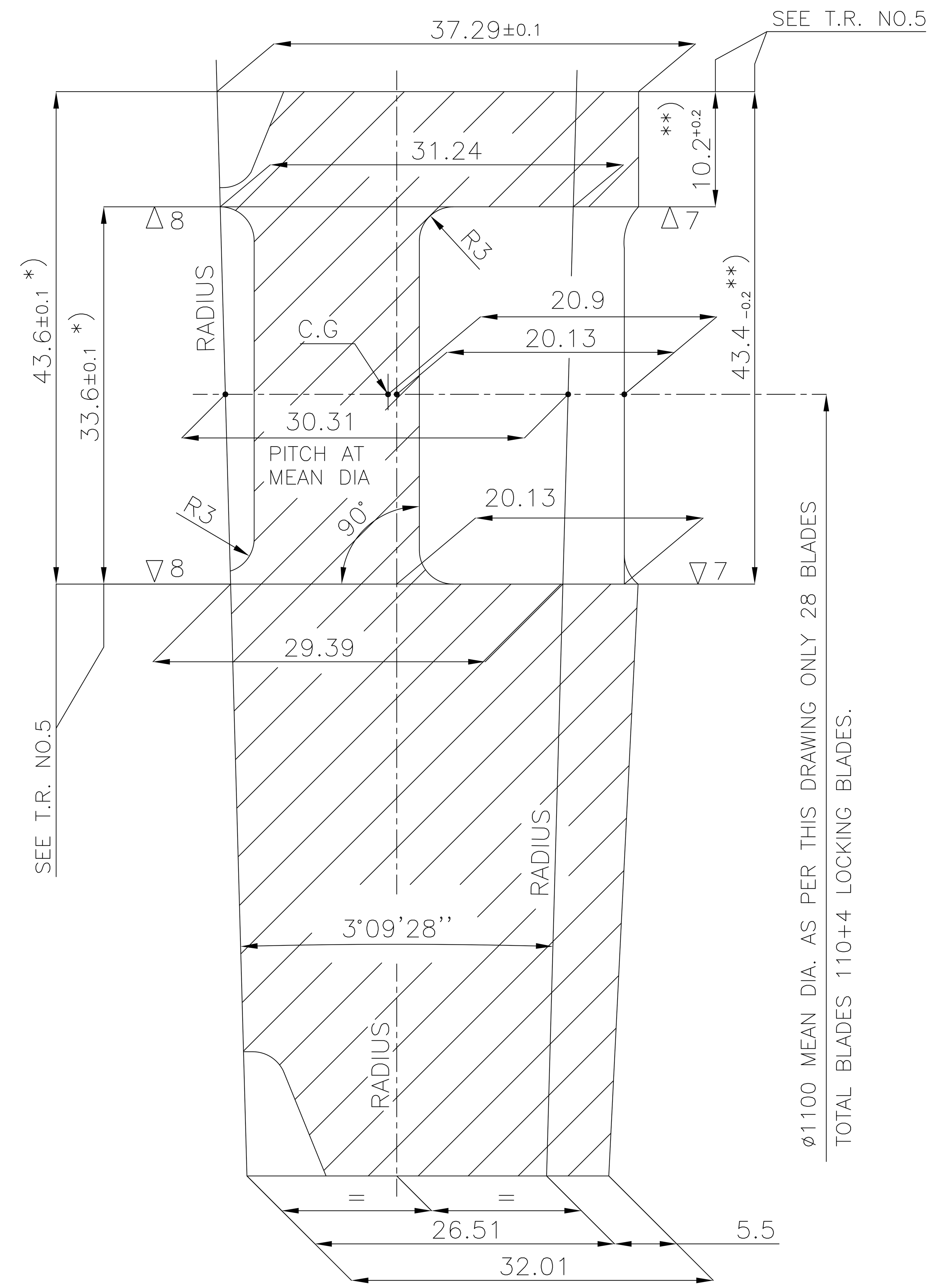
SIZE A2

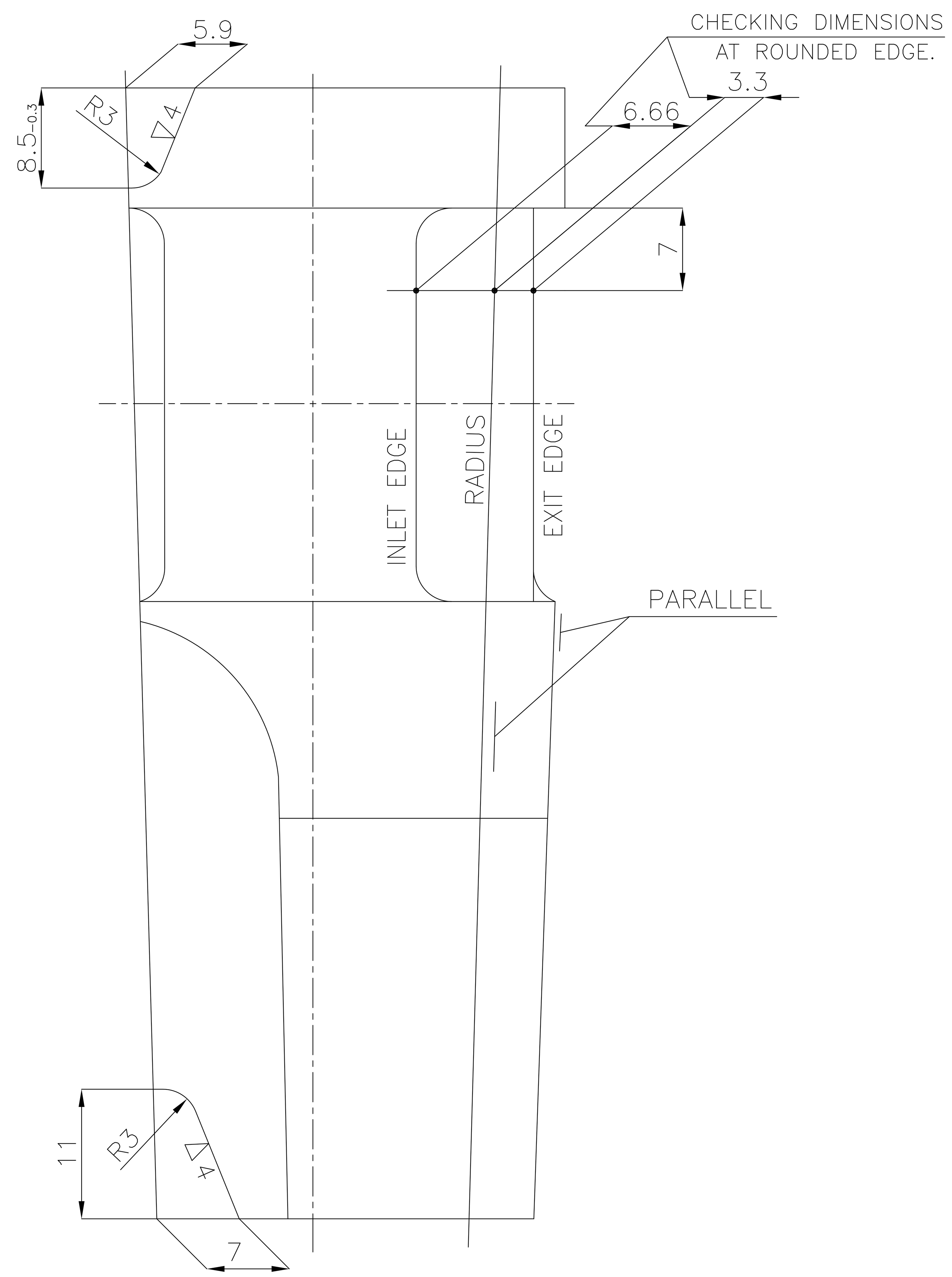
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 44(B)

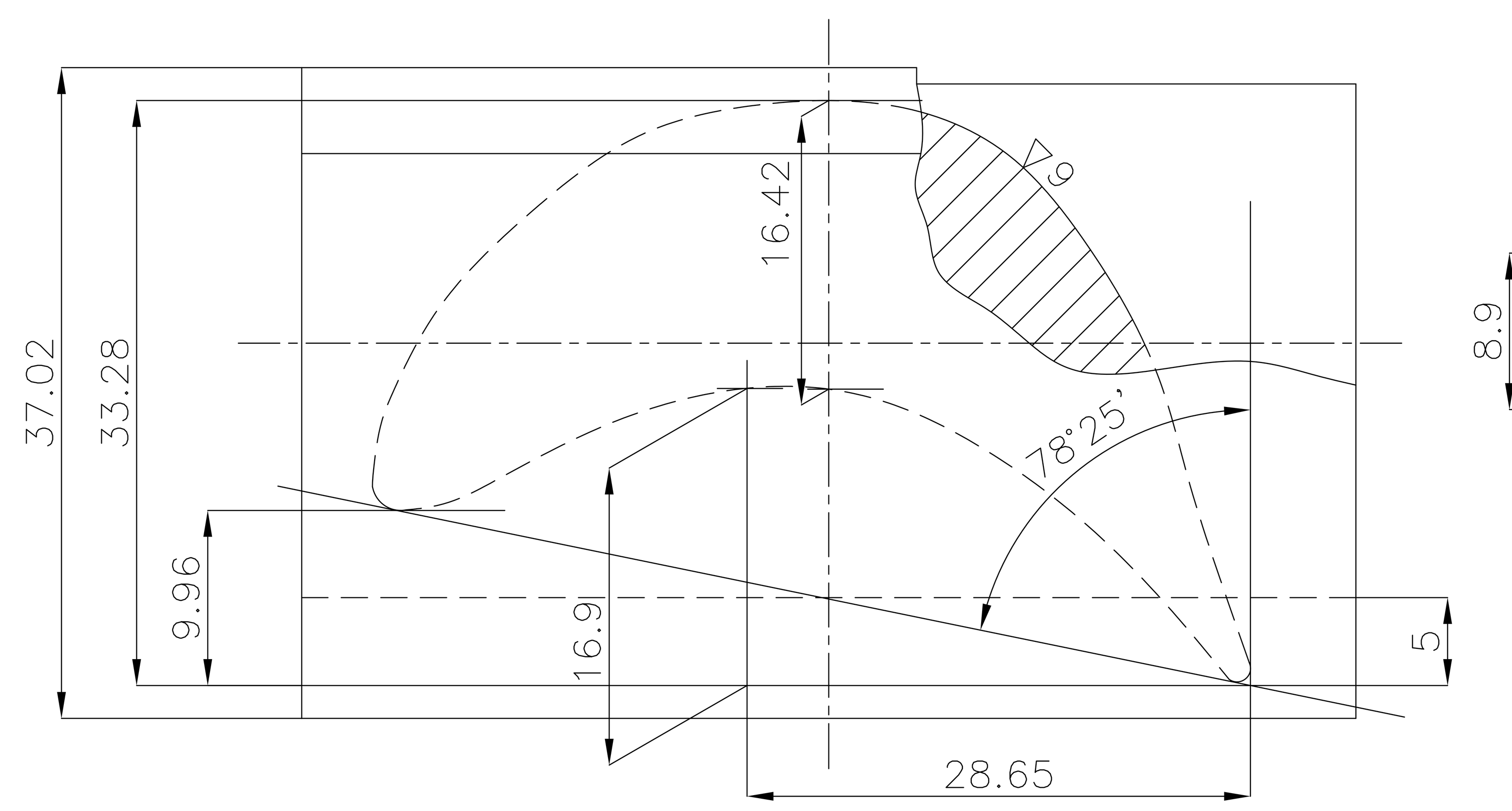
Inventory No.	Sign & Date	Ref.Drawing No>
		B-1183562

DRAWING No. 32302052

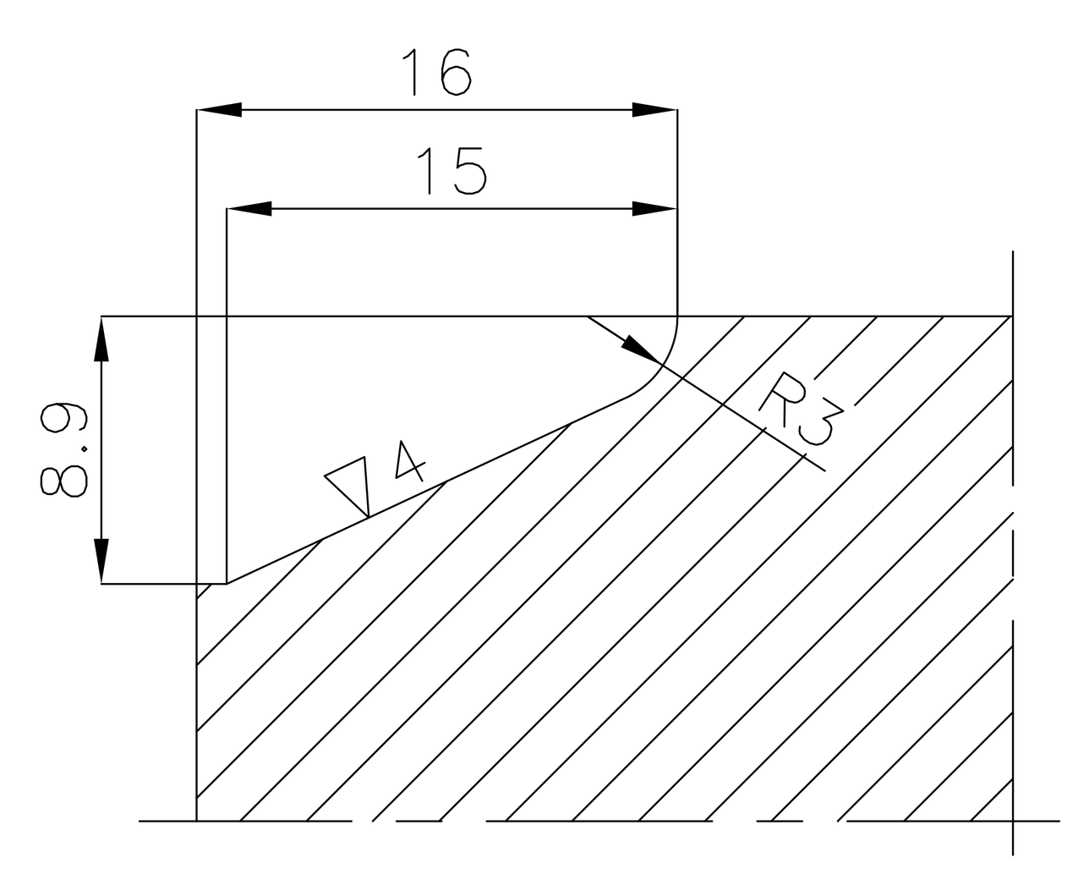




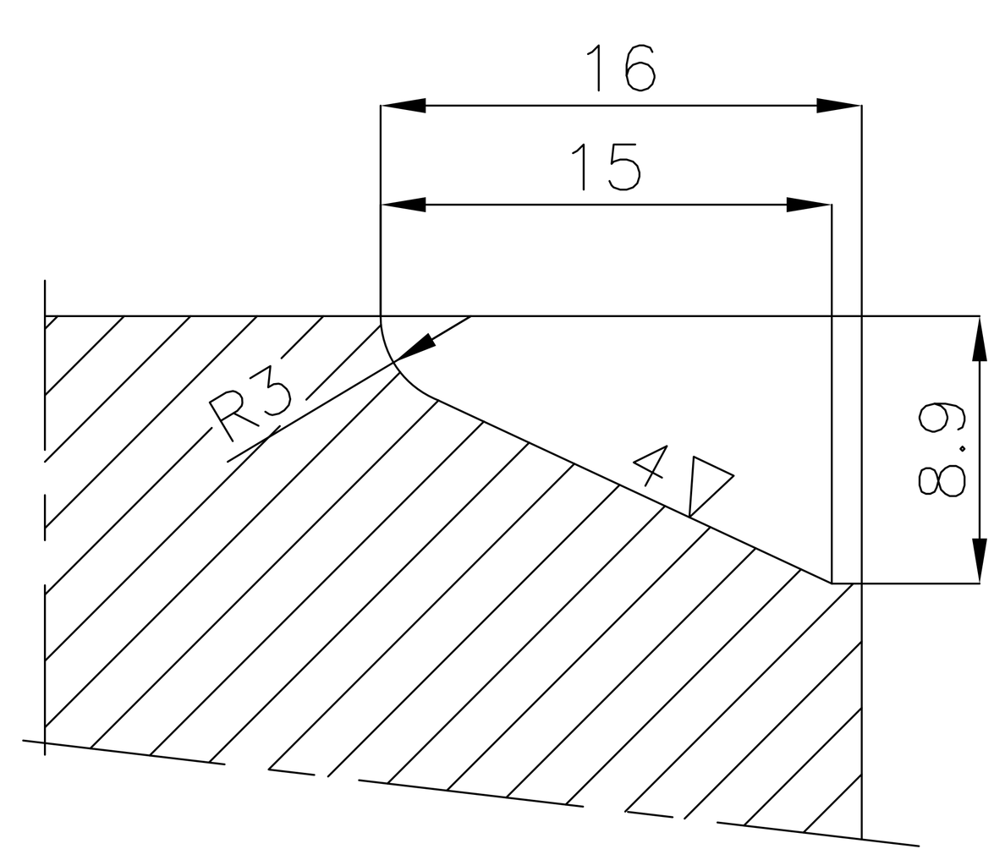




BLADE PROFILE NO.1173 DRG. NO.32302081 (Гу–1137409)
(LEFT ROTATION)



SECTION AA



SECTION BB

TECHNICAL RIQUIREMENTS :

1. PROFILE AND POSITION OF WORKING PART OF BLADE WITH RESPECT TO ROOT IS CHECKED BY TEMPLATE WITH ALLOWABLE CLEARANCE SHOWN ON PROFILE DRAWING.
2. DISPLACEMENT OF INTERNAL PROFILE WITH RESPECT TO EXTERNAL RADIAL SURFACE NOT MORE THAN ±0.2.
3. BLADES OF ONE PACKET SHOULD BE FITTED TOGETHER IN THE BLADE SHOP, PRIOR TO WELDING AS PER POINT ON BLADE PACKET DRAWING.
4. AFTER MANUFACTURING THE BLADE CHECK BY ETCHING FOR ABSENCE OF CRACKS & HAIR CRACKS.
5. *) EXTERNAL DIMENSIONS OF PROFILE ARE FINAL.
   **) INTERNAL DIMENSIONS OF PROFILE WITH ALLOWANCE.
6. DIMENSIONS IN BRACKETS ARE FOR REFERENCE ONLY.

10Cr16Ni14Mo23Nb11
CS22–0500.706
1x16H13M26

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

GRADE OF UNTOL.DIM
M/CG.–Ȼ/M/Ғ AA0230208
WELDING–Ӿ/B/Ȼ/Ø AA0621104
GAS CUTTING–'T3'AA0621101

REV	DATE	ALTERED / CHECKED

~~GMS No.~~/ CBOM No. 00032302000 — STATUS OF DRG U

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	–sd–	05.10.71
STD	M.P.SINGH	–sd–	16.10.71

REV	DATE		
01	13.07.10	ALTERED KAILASH Sd/–	CHECKED P.K.BANSAL Sd/–

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.
(STE–10–F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C–200–130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE
DRN	K.M.SINGHAL	–sd–	17.09.71
CHD	N.B.MATHUR	–sd–	20.09.71
APPD	J.N.KARAN	–sd–	23.10.71

NO. OF VAR: –

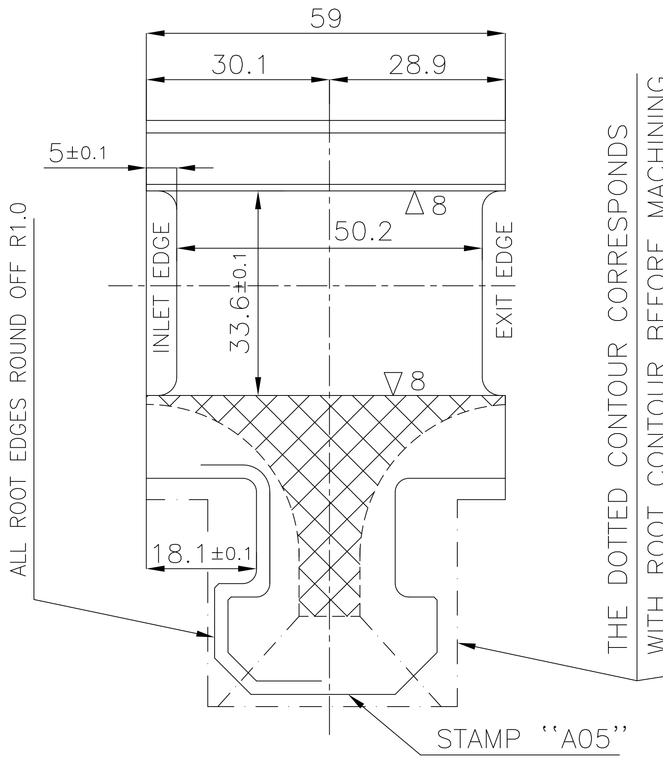
DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE, CODE 4011	2:1	0.77	32302000	–	

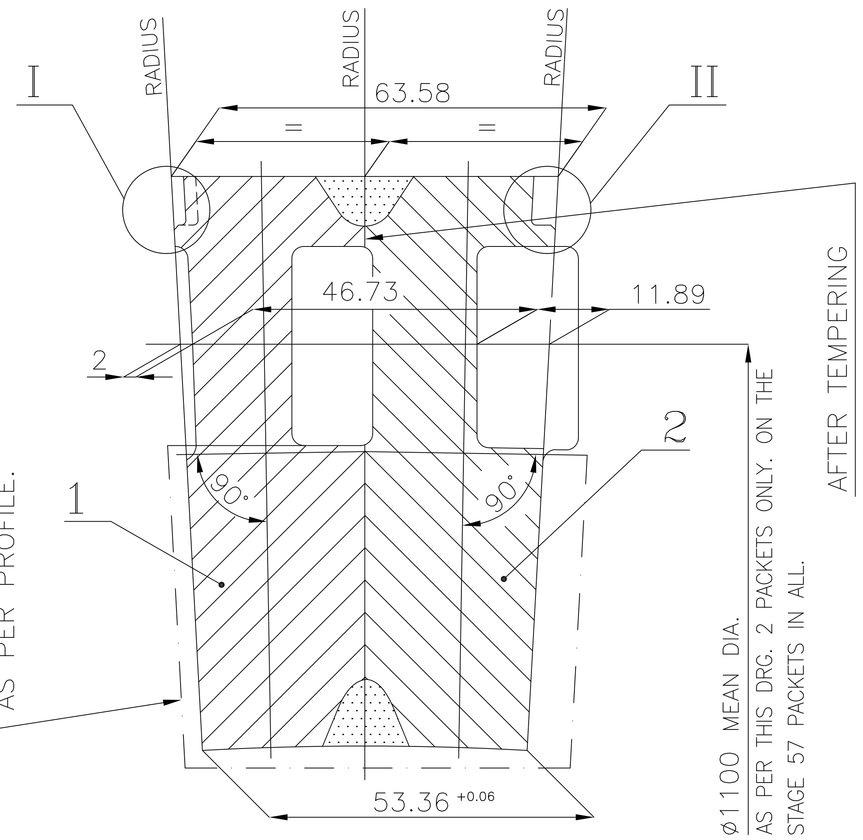
TITLE : BLADE 1st STAGE

CARD CODE 7 — DRAWING NO. 32302052 –

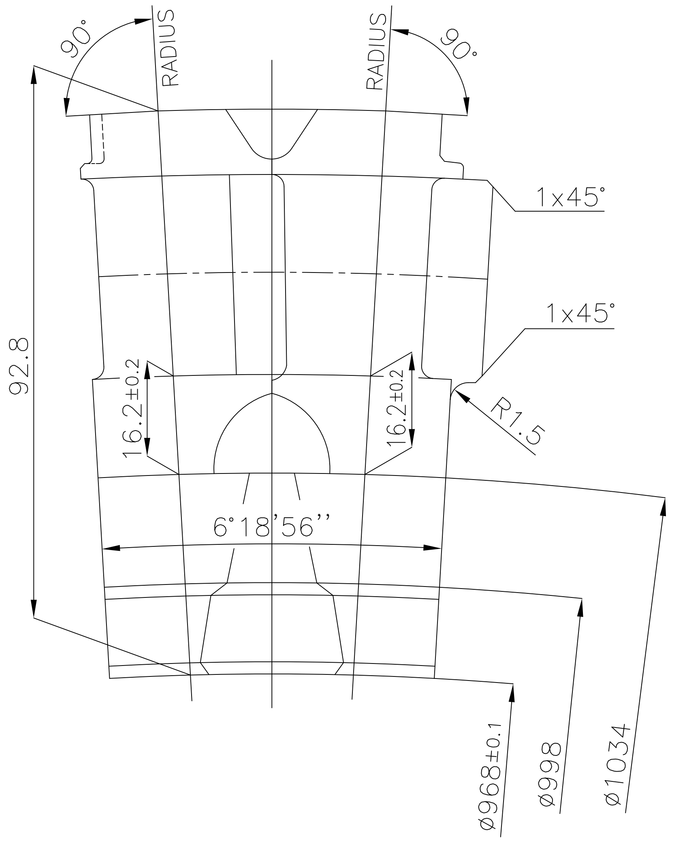
SHEET No. 01 — No. OF SHEETS 01

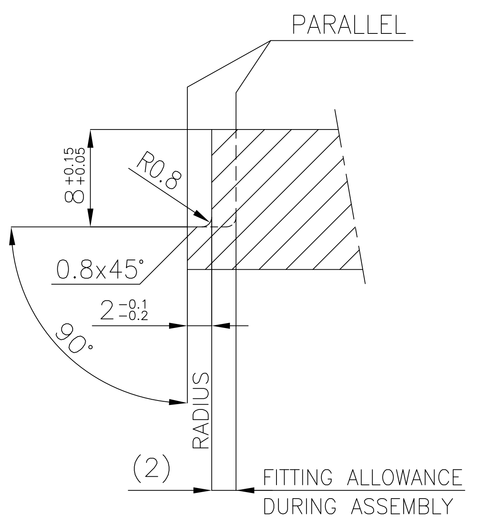
SIZE A2



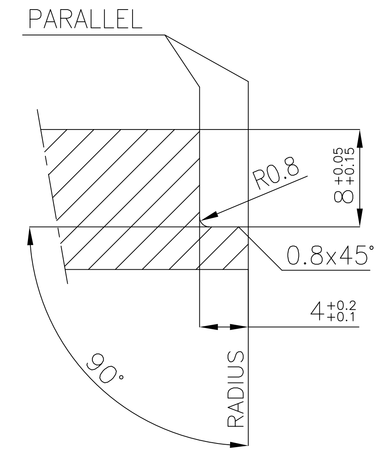


ROOT PROFILE NO.1172-A

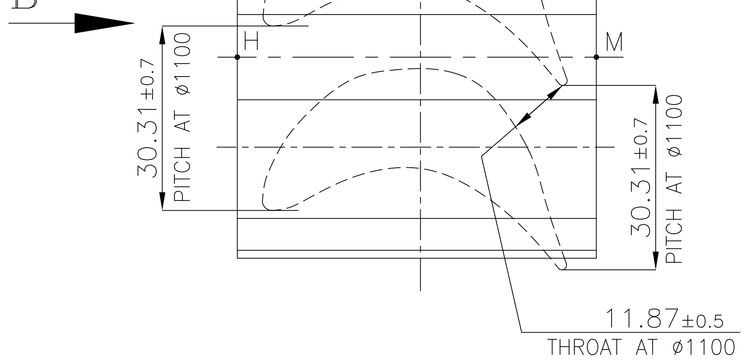


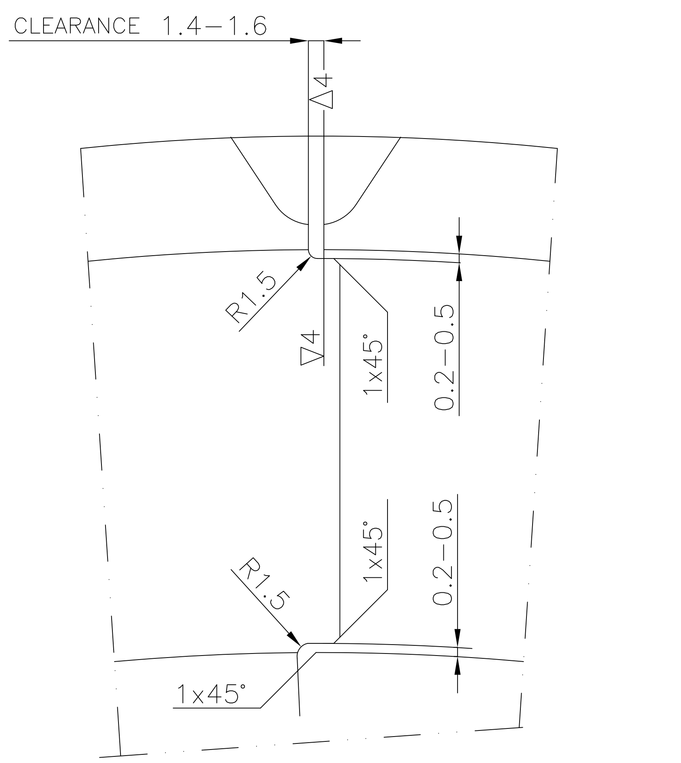


SCALE 2:1
VIEW I



SCALE 2:1
VIEW II





VIEW B

TECHNICAL RIQUIREMENTS :

1. BEFORE WELDING IT IS NECESSARY TO FIT THE BLADES AMONG THEMSELVES IN THE BLADE SHOP IN PAIRS AND SHOULD BE MARKED ON FACE, FOR THIS a) THE BLADE PACKETS MUST BE PLACED, SO THAT, ALONG THE WHOLE LENGTH H-M (SEE PLAN), AS WELL AS FROM SIDES AT ROOT AND AT BANDAGE, THERE ARE NO STEPS. b) THE ROOTS OF BLADES SHOULD BE FITTED BY PAINT. AT THE PLACES OF PAINT (SHOWN BY CROSSED LINES) CLEARANCES ARE NOT ALLOWED. THE FILING OF ROOT IS DONE FROM THE BACK SIDE OF BLADE. c) WHILE FITTING THE ROOTS, THE NON-COINCIDENCE OF THE WORKING PART OF THE BLADES MUST NOT EXCEED ±0.1mm. d) WHILE FITTING THE BLADES IN PAIRS AND ALSO BEFORE WELDING THEM IN PAIRS, THE DIMENSIONS OF THROAT AND PITCH AT INLET AS WELL AS AT EXIT SHOULD BE MAINTAINED AT MEAN DIA WITHIN ALLOWABLE LIMIT (SEE VIEW FROM TOP) AS SUCH THE DIFFERENCE IN PITCHES AT INLET AND OUTLET SHOULD NOT BE MORE THAN 0.5mm.
2. THE BLADES SHOULD BE WELDED IN PAIRS AS PER FITTING IN BLADE SHOP (SEE POINT 1). AFTER WELDING, THE BLADES SHOULD BE HEAT TREATED. WELDING AND HEAT TREATMENT SHOULD BE DONE AS PER SPECIAL INSTRUCTIONS.
3. AFTER TEMPERING, SEAMS TO BE CAREFULLY CLEANED AND SHOULD BE CHECKED BY ETCHING FOR ANY CRACKS. THE CLEANING OF SEAM SHOULD BE DONE ALONG ITS LENGTH AND MAX. 0.5mm MATERIAL SHOULD BE REMOVED FROM BLADE.
4. THE POSITION OF ROOT WITH RESPECT TO INNER WORKING PART OF BLADE IS CHECKED BY TEMPLATE ALLOWING A DEVIAION OF ±0.2.
5. WHILE MACHINING INTERNAL AND EXTERNAL SURFACES OF BLADE PACKET, RADIAL ANGLE SHOULD BE MAINTAINED AS PER TEMPLATE WITH CLEARANCE 0.02 FORM THEORETICAL ANGLE.
6. ADJACENT BLADES SHOULD BE FITTED IN BLADE SHOP AS PER POINT 1 AND IN DOING SO, THE HEIGHT OF CANAL SHOULD BE MAINTAINED 33.6±0.1. EXIT EDGE IN PACKET SHOULD BE FITTED WITH ADJACENT BLADE PACKET AS SHOWN IN VIEW 'B'.
7. PACKET ROOTS ARE TURNED AS PER PROFILE 1172-A DRAWING NO. 32301007 (Гу-1178026), AFTER WHICH BLADES ARE NUMBERED SERIALLY.
8. AFTER TURNING OF ROOTS THE WELD SEAMS ARE AGAIN CHECKED BY ETCHING.
9. IN ALL WELDED BLADE PACKETS AND AS WELL AS BETWEEN ADJACENT PACKETS, THE THROAT AND PITCH SHOULD HAVE DIMENSIONS AS SHOWN (IN TOP VIEW), AT THIS THE DIFFERENCE IN PITCHES AT INLET & OUTLET MUST NOT EXCEED 0.5mm.
10. IN THE WELDED ZONE, STEP IN THE CANAL MORE THAN 0.4mm IS NOT ALLOWED.
11. FOR FINAL MACHINING OF PACKETS AFTER ASSEMBLY ON DISE - SEE FINAL MACHINING DRG. OF TOTOR.

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

GRADE OF UNTOL.DIM
M/CG.-Ø/M/F AA0230208
WELDING-A/B/Ø/D AA0621104
GAS CUTTING-'T3'AA0621101

REV	DATE	ALTERED / CHECKED

~~GMS No.~~ / CBOM No. 00032302000 — STATUS OF DRG: U

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	-sd-	05.10.71
STD	M.P.SINGH	-sd-	16.10.71

REV	DATE		
01	13.07.10	ALTERED KAILASH	Sd/-
		CHECKED P.K.BANSAL	Sd/-

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.

(STE-10-F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C-200-130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE
DRN	K.M.SINGHAL	-sd-	18.09.71
CHD	N.B.MATHUR	-sd-	20.09.71
APPD	J.N.KARAN	-sd-	23.10.71

NO. OF VAR: -

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	1:1	1.75	32302000	-	
CODE 4011					

TITLE : BLADE PACKET 1st STAGE

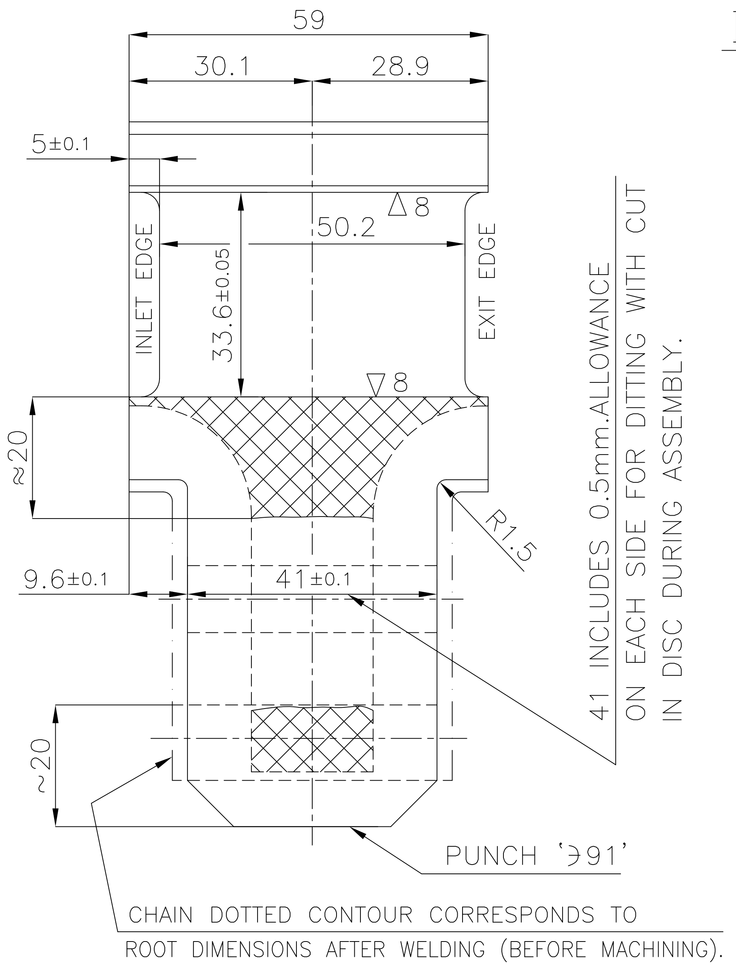
CARD CODE

DRAWING NO. 32302060 -

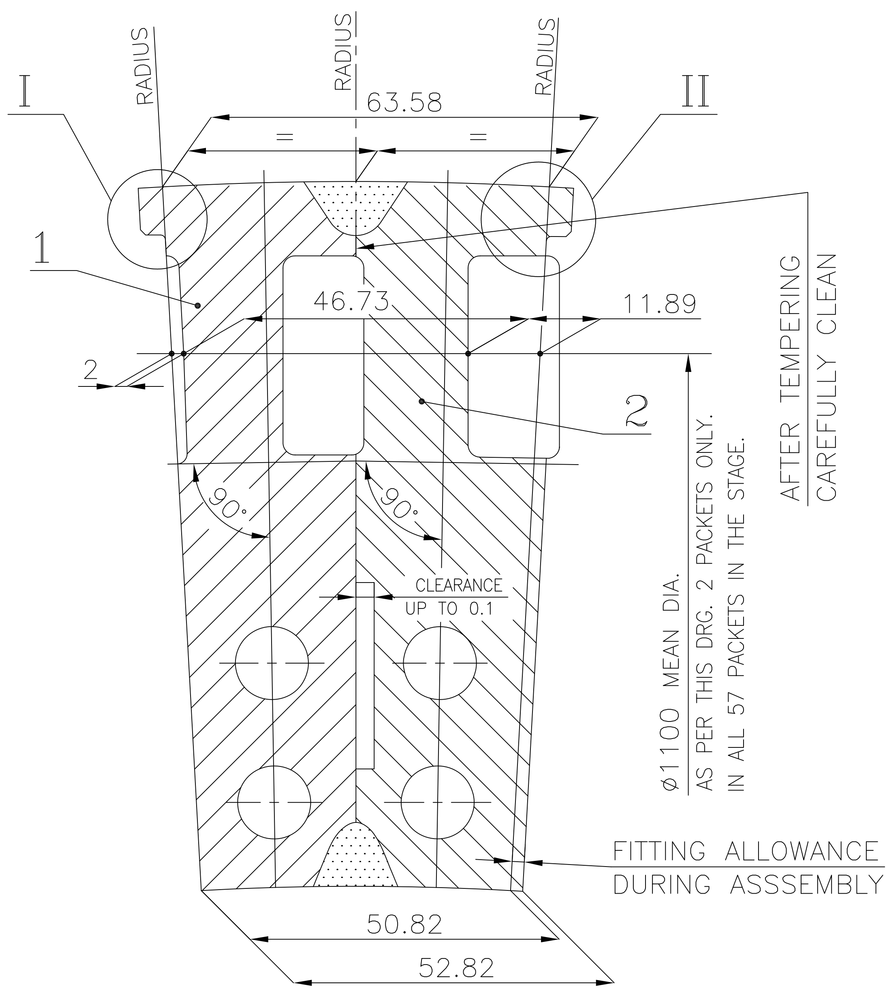
SHEET No. 01 | No. OF SHEETS 01

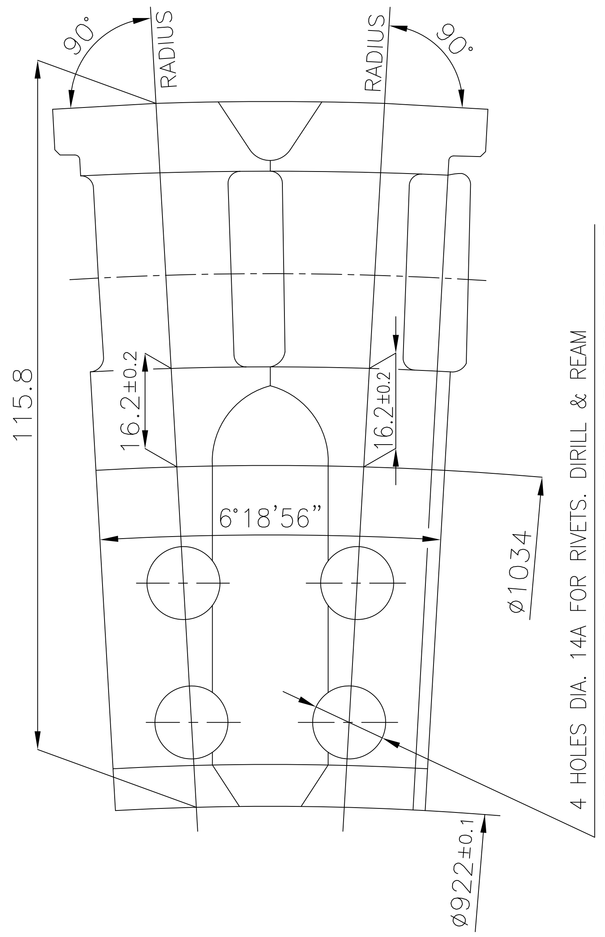
Ref.Drawing No> B-1183569 | Sign & Date | Inventory No.

SIZE A2

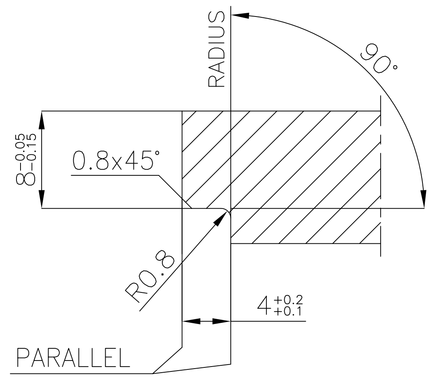


41 INCLUDES 0.5mm.ALLOWANCE ON EACH SIDE FOR DITTING WITH CUT IN DISC DURING ASSEMBLY.



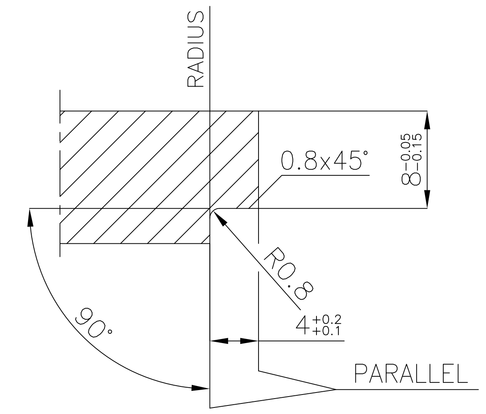


4 HOLES DIA. 14A FOR RIVETS. DRILL & REAM TOGETHER WITH DISC AFTER ASSEMBLY. FOR POSITION OF HOLES, SEE DRG. NO. 32301006 (1145823) FOR CUT FOR LOCKING BLADE.



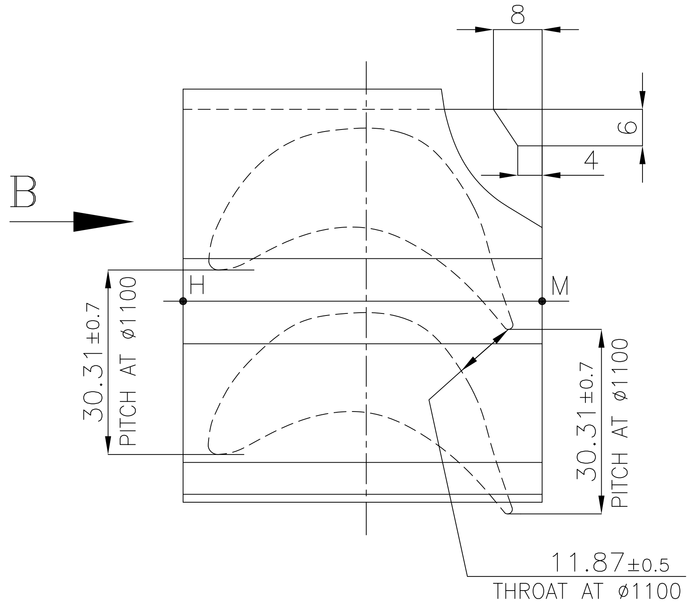
SCALE 2:1

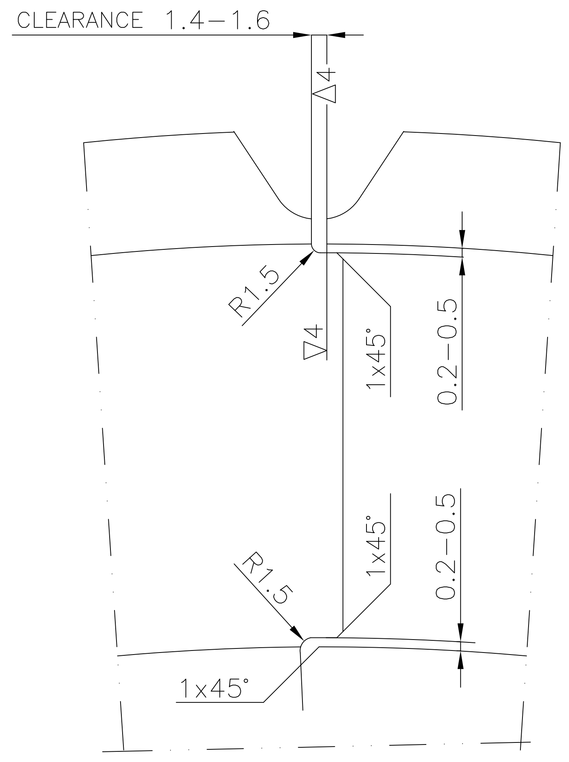
VIEW I



SCALE 2:1

VIEW II





VIEW B

TECHNICAL RIQUIREMENTS :

1. BEFORE WELDING IT IS NECESSARY TO FIT THE BLADES AMONG THEMSELVES IN THE BLADE SHOP IN PAIRS AND SHOULD BE MARKED ON FACE, FOR THIS a) THE BLADE PACKETS MUST BE PLACED, SO THAT, ALONG THE WHOLE LENGTH H–M (SEE PLAN), AS WELL AS FROM SIDES AT ROOT AND AT BANDAGE, THERE ARE NO STEPS. b) THE ROOTS OF BLADES SHOULD BE FITTED BY PAINT. AT THE PLACES OF PAINT (SHOWN BY CROSSED LINES) CLEARANCES ARE NOT ALLOWED. THE FILING OF ROOT IS DONE FROM THE BACK SIDE OF BLADE. c) WHILE FITTING THE ROOTS, THE NON–COINCIDENCE OF THE WORKING PART OF BLADES MUST NOT EXCEED ±0.1mm. d) WHILE FITTING THE BLADES IN PAIRS AND ALSO BEFORE WELDING THEM IN PAIRS, THE DIMEN–SION OF THROAT AND PITCH AT INLET AS WELL AS EXIT SHOULD BE MAINTAINED AT MEAN DIA WITHIN ALLOWABLE LIMITS (SEE VIEW FROM TOP), AS SUCH THE DIFFERENCE IN PITCHES AT INLET AND OUTLET SHOULD NOT BE MORE THAN 0.5mm.
2. THE BLADES SHOULD BE WELDED IN PAIRS AS PER FITTING IN BLADE SHOP (SEE POINT 1). AFTER WELDING, THE BLADES SHOULD BE HEAT TREATED. WELDING AND HEAT TREATMENT SHOULD BE DONE AS PER SPECIAL INSTRUCTIONS.
3. AFTER TEMPERING, SEAM TO BE CAREFULLY CLEANED AND SHOULD BE CHECKED BY ETCHING FOR ANY CRACKS. THE CLEANING OF SEAM SHOULD BE DONE ALONG ITS LENGTH AND MAX. 0.5mm MATERIAL SHOULD BE REMOVED FROM BLADES.
4. LOCKING BLADE PACKETS SHOULD BE FITTED WITH ADJECENT BLADE PACKETS ON BACK AND INNER SIDE AT EDGES AND CANAL HEIGHT AS PER POINT 1 OF THIS T.R. (AS ABOVE), AS SUCH THE CANAL HEIGHT SHOULD BE MAINTAINED 33.6±0.1 EXIT EDGES SHOULD BE FITTED WITH ADJACENT AS SHOWN IN VIEW B.
5. IN WELDED LOCKING BLADE PACKETS, BLADE PITCH AND THROAT MUST HAVE DIMENSIONS, AS SHOWN IN DRG. (VIEW FROM–TOP) AS SUCH IN ONE PACKET THE DIFFERENCE IN PITCH AT INLET & OUTLET MUST NOT EXCEED 0.5mm.
6. IN THE WELDED ZONE, STEP IN THE CANAL MORE THAN 0.4mm IS NOT ALLOWED.
7. FOR FINAL MACHINING OF PACKETS AFTER ASSEMBLY ON DISC – SEE FINAL MACHINING DRG. OF ROTOR.

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

GRADE OF UNTOL.DIM
M/CG.–Ø/M/F AA0230208
WELDING–A/B/Ø/Ø AA0621104
GAS CUTTING–'T3'AA0621101

REV	DATE	ALTERED / CHECKED

~~GMS No.~~ / CBOM No. 00032302000 — STATUS OF DRG U

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	–sd–	05.10.71
STD	M.P.SINGH	–sd–	16.10.71

REV	DATE	ALTERED / CHECKED	
01	13.07.10	ALTERED	KAILASH Sd/–
		CHECKED	P.K.BANSAL Sd/–

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.

(STE–10–F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C–200–130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE
DRN	K.M.SINGHAL	–sd–	17.09.71
CHD	N.B.MATHUR	–sd–	20.09.71
APPD	J.N.KARAN	–sd–	23.10.71

NO. OF VAR: –

DEPT	CODE	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	4011	1:1	1.92	32302000	–	

TITLE : LOCKING BLADE PACKET 1st STAGE

CARD CODE

DRAWING NO. 32302070 –

SHEET No. 01 | No. OF SHEETS 01

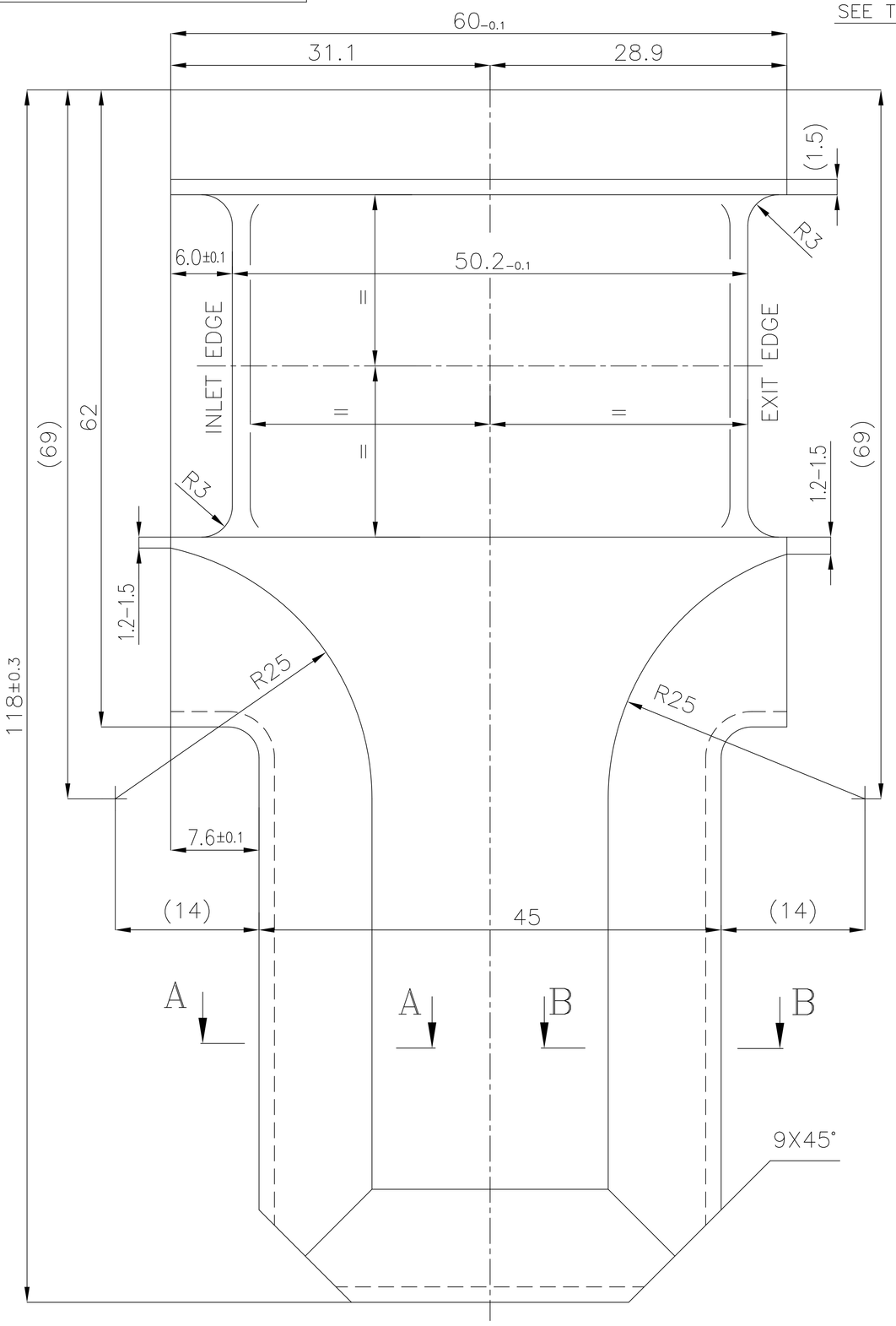
Ref.Drawing No> B–1183570

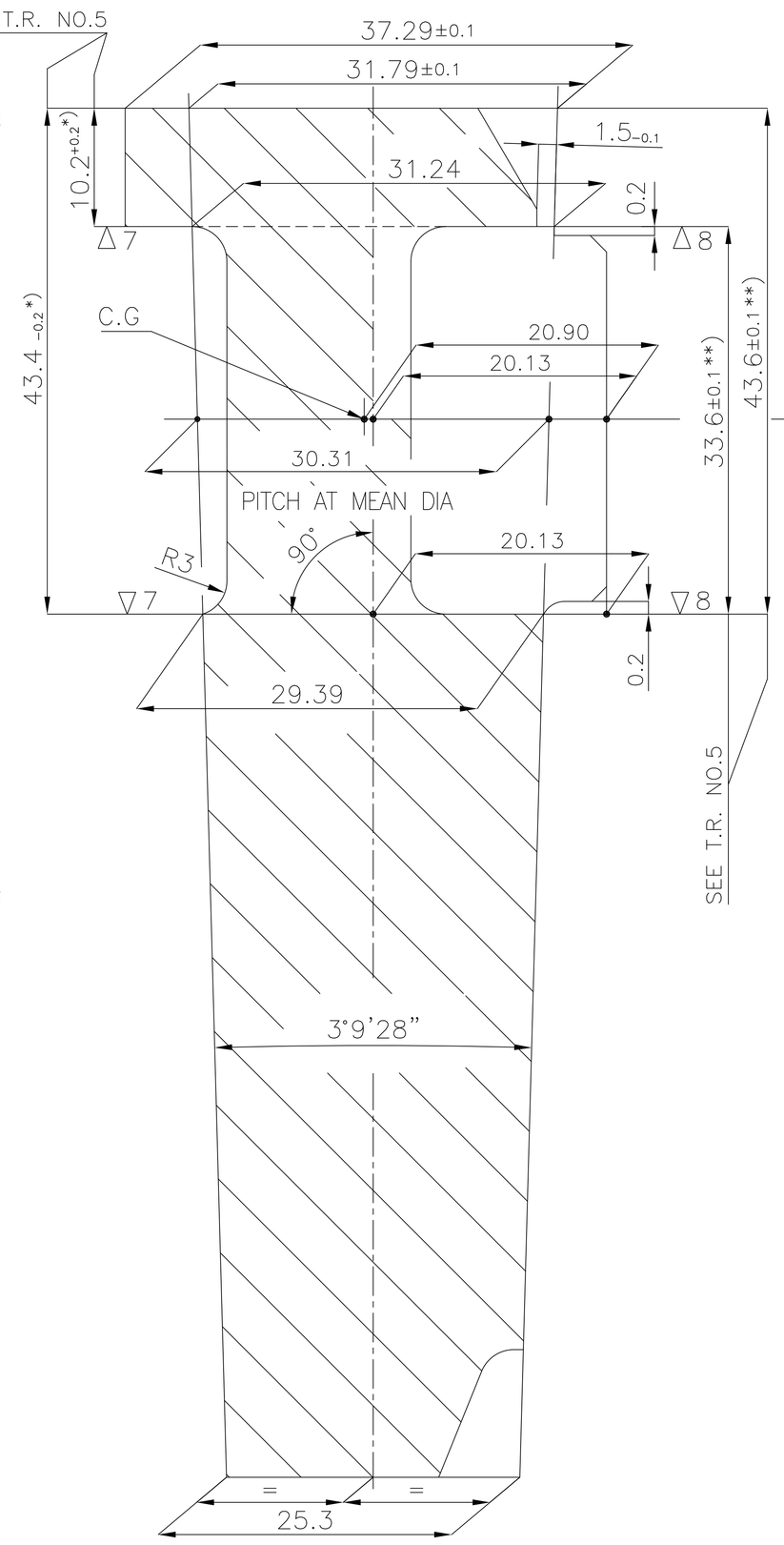
Sign & Date

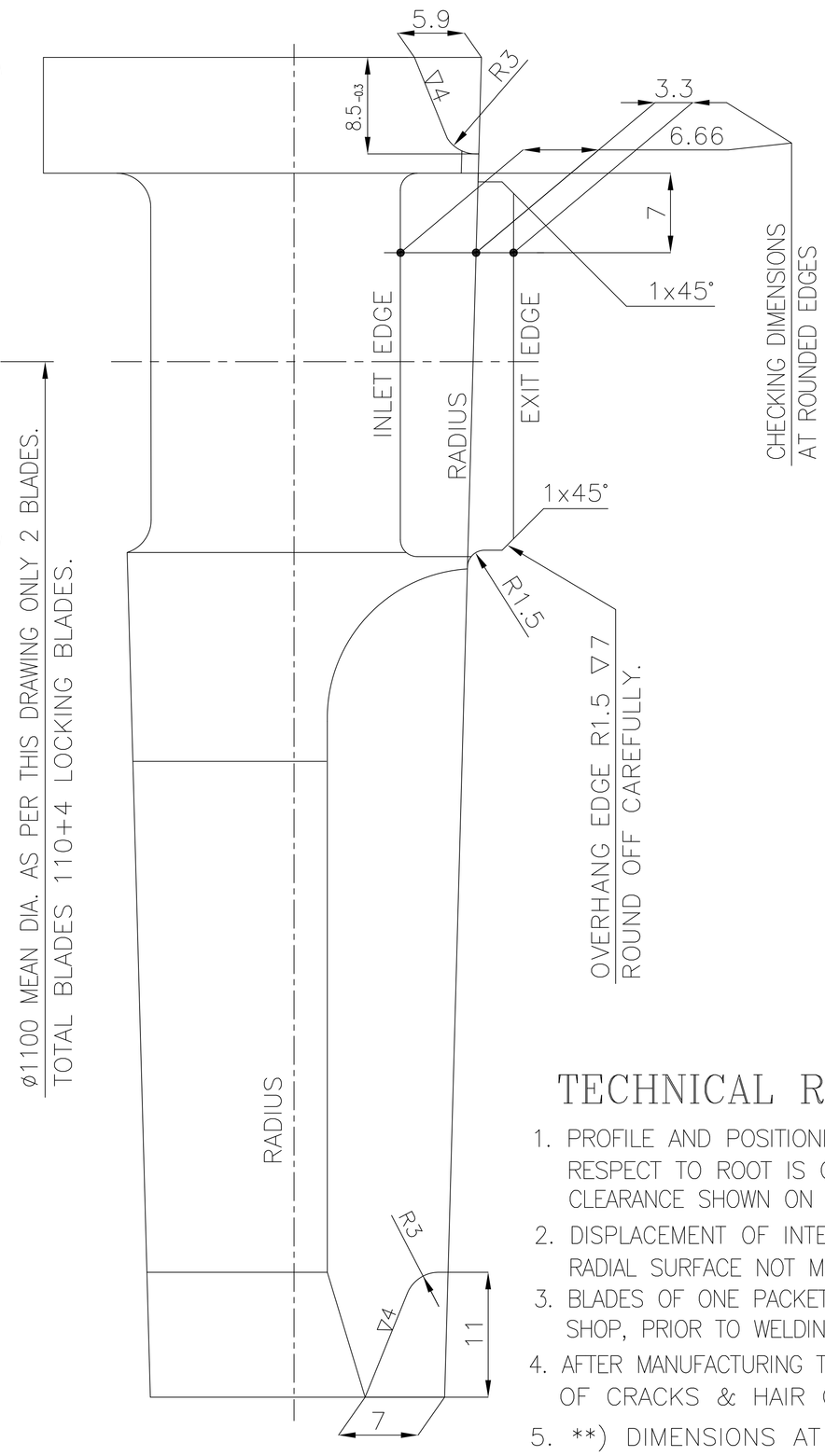
Inventory No.

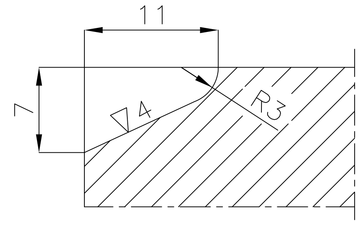
SIZE A2

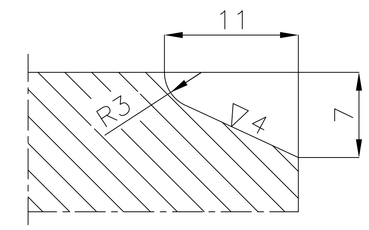
▽6 THE REST

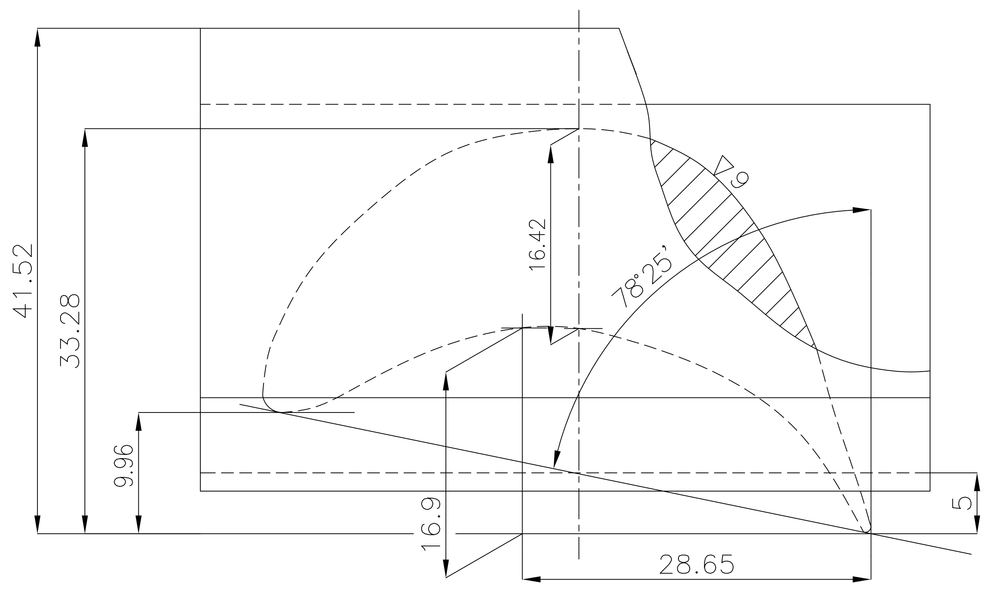












BLADE PROFILE NO.1173 DRG. NO.32302081 (Γy-1137409).
(LEFT ROTATION)

TECHNICAL RIQUIREMENTS :

1. PROFILE AND POSITIONING OF WORKING PART OF BLADE WITH RESPECT TO ROOT IS CHECKED BY TEMPLATE WITH ALLOWABLE CLEARANCE SHOWN ON PROFILE DRAWING.
2. DISPLACEMENT OF INTERNAL PROFILE WITH RESPECT TO EXTERNAL RADIAL SURFACE NOT MORE THAN ±0.2.
3. BLADES OF ONE PACKET SHOULD BE FITTED TOGETHER IN THE BLADE SHOP, PRIOR TO WELDING AS PER POINT 1 ON BLADE PACKET DRAWING.
4. AFTER MANUFACTURING THE BLADE CHECK BY ETCHING FOR ABSENCE OF CRACKS & HAIR CRACKS.
5. **) DIMENSIONS AT INTERNAL PROFILE ARE FINAL.
   *) DIMENSION ON EXTERNAL PROFILE ARE GIVEN TAKING INTO ACCOUNT ALLOWANCE FOR FITTING WITH ADJACENT BLADE. (SEE POINT 4 OF BLADE PACKET DRAWING).
6. DIMENSIONS IN BRACKETS ARE FOR REFERENCE ONLY.

18Cr11Mo1Ni80V30Nb35
CS60-0500.706
2x11Mø

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

GRADE OF UNTOL.DIM		
M/CG.-Ø/M/F AA0230208		
WELDING-A/B/C/D AA0621104		
GAS CUTTING-'T3'AA0621101		
REV	DATE	ALTERED / CHECKED

~~GMS No.~~ / CBOM No. 00032302000 — STATUS OF DRG U

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	-sd-	05.10.71
STD	M.P.SINGH	-sd-	16.10.71

REV	DATE	ALTERED / CHECKED
01	13.07.10	ALTERED KAILASH Sd/- / CHECKED P.K.BANSAL Sd/-

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.
(STE-10-F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C-200-130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE
DRN	K.M.SINGHAL	-sd-	16.09.71
CHD	N.B.MATHUR	-sd-	20.09.71
APPD	J.N.KARAN	-sd-	23.10.71

NO. OF VAR: -

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	2:1	0.9	32302000	-	
CODE 4011					

TITLE : LOCKING BLADE 1st STAGE

CARD CODE

DRAWING NO. 32302071 -

SHEET No. 01 | No. OF SHEETS 01

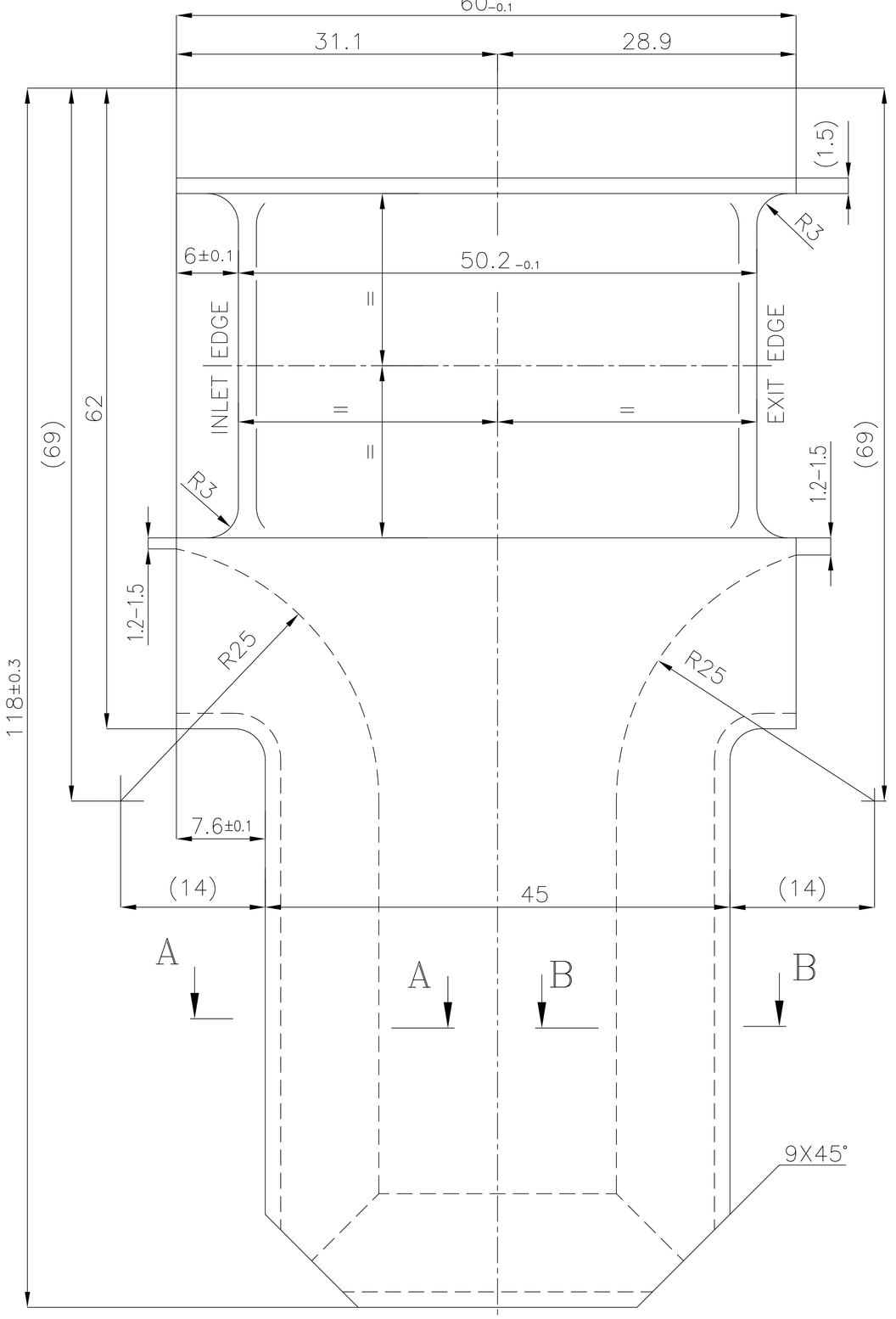
Ref.Drawing No> B-1183565 | Sign & Date | Inventory No.

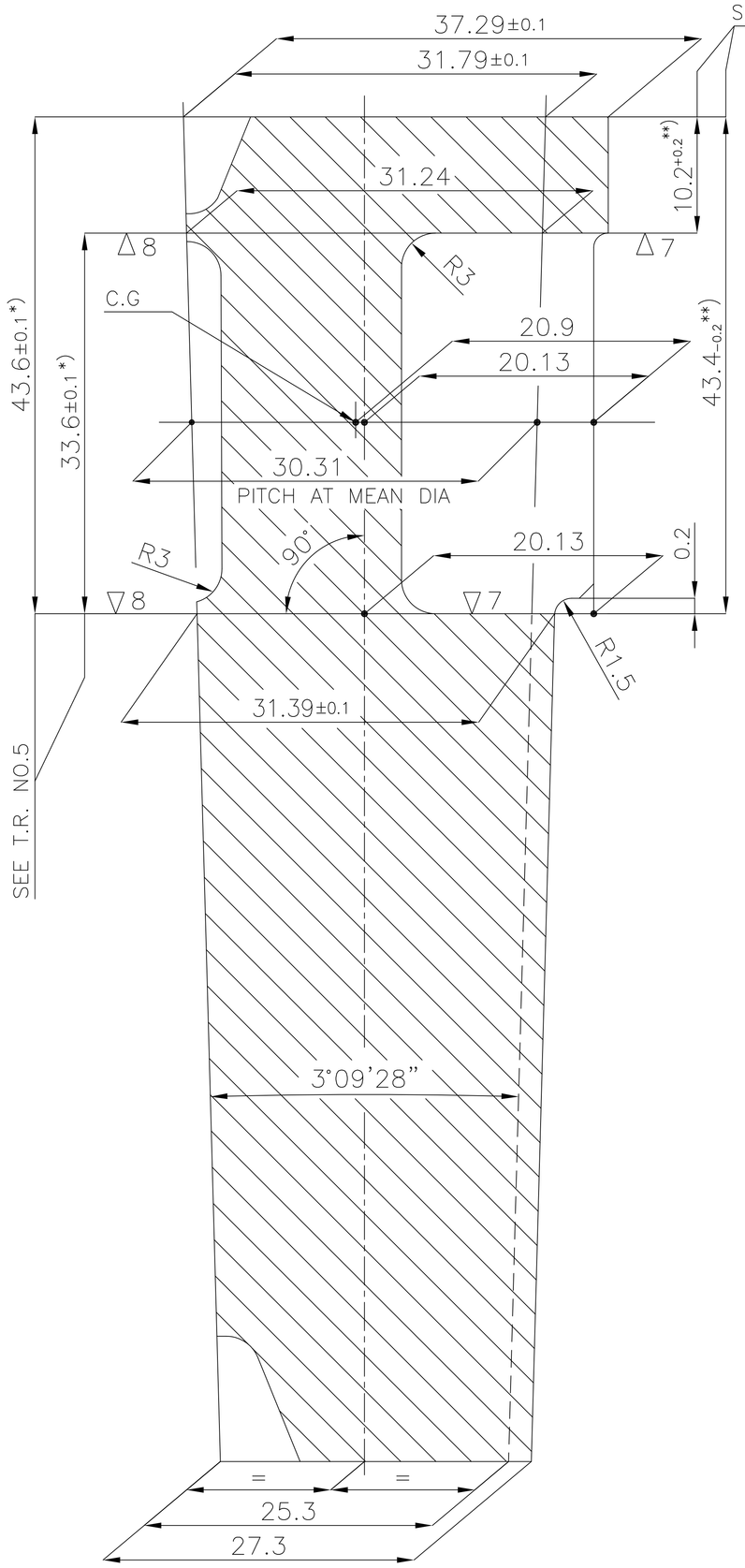
SIZE A2

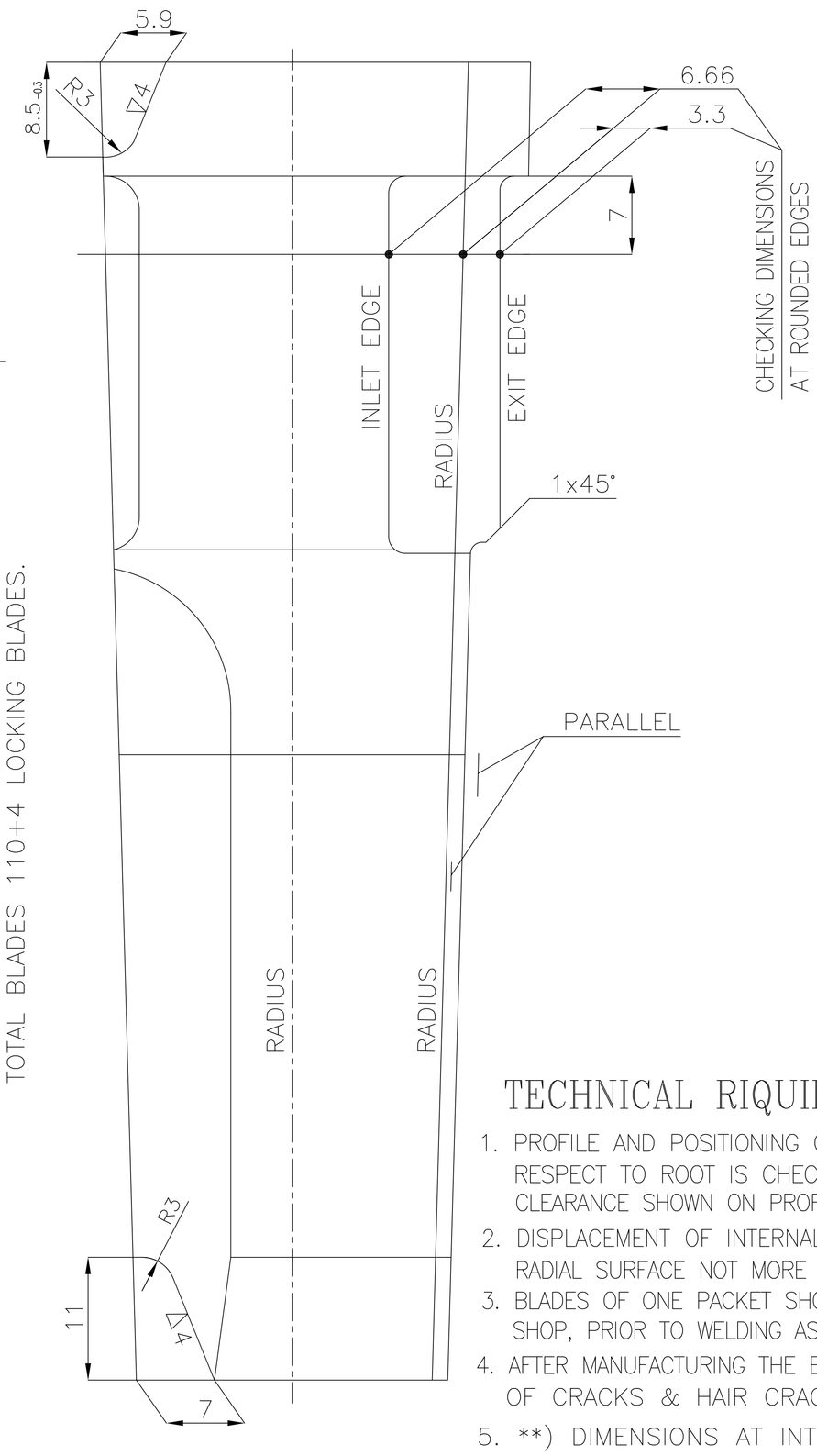
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 44(B)

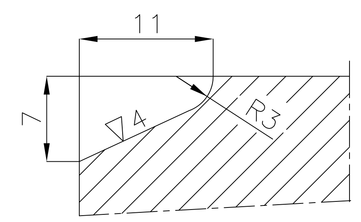
DRAWING No. 32302072

▽6 THE REST

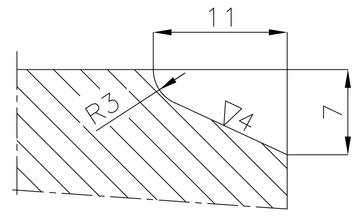








SECTION AA

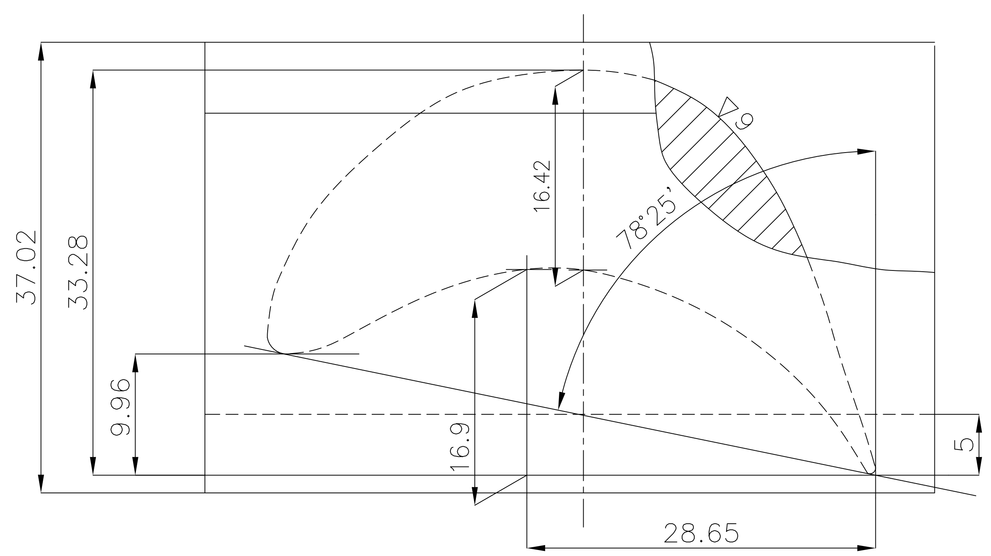


SECTION BB

ø1100 MEAN DIA. AS PER THIS DRAWING ONLY 2 BLADES.
TOTAL BLADES 110+4 LOCKING BLADES.

TECHNICAL RIQUIREMENTS :

1. PROFILE AND POSITIONING OF WORKING PART OF BLADE WITH RESPECT TO ROOT IS CHECKED BY TEMPLATE WITH ALLOWABLE CLEARANCE SHOWN ON PROFILE DRAWING.
2. DISPLACEMENT OF INTERNAL PROFILE WITH RESPECT TO EXTERNAL RADIAL SURFACE NOT MORE THAN ±0.2.
3. BLADES OF ONE PACKET SHOULD BE FITTED TOGETHER IN THE BLADE SHOP, PRIOR TO WELDING AS PER POINT 1 ON BLADE PACKET DRAWING.
4. AFTER MANUFACTURING THE BLADE CHECK BY ETCHING FOR ABSENCE OF CRACKS & HAIR CRACKS.
5. **) DIMENSIONS AT INTERNAL PROFILE ARE FINAL.
   *) DIMENSION ON EXTERNAL PROFILE ARE GIVEN TAKING INTO ACCOUNT ALLOWANCE FOR FITTING WITH ADJACENT BLADE. (SEE POINT 4 OF BLADE PACKET DRAWING).
6. DIMENSIONS IN BRACKETS ARE FOR REFERENCE ONLY.



BLADE PROFILE NO.1173 DRG. NO.32302081 (Гy-1137409).
(LEFT ROTATION)

18Cr11Mo1Ni80V30Nb35
CS60-0500.706
2x11MØ

SUPERSEDES OLD DRAWING UNDER THE SAME NUMBER WITHOUT ANY CHANGE

GRADE OF UNTOL.DIM
M/CG.-Ø/M/F AA0230208
WELDING-A/B/C/D AA0621104
GAS CUTTING-'T3'AA0621101

REV	DATE	ALTERED / CHECKED

~~GMS No.~~ / CBOM No. 00032302000

AGREED DEPT	NAME	SIGN	DATE
STT	BANSAL	-sd-	05.10.71
STD	M.P.SINGH	-sd-	16.10.71

STATUS OF U DRG

REV	DATE	ALTERED / CHECKED	NAME	SIGN
01	13.07.10	ALTERED	KAILASH	Sd/-
		CHECKED	P.K.BANSAL	Sd/-

THIS DRAWING SUPERSEDES OLD DRG. UNDER THE SAME NUMBER. REVISED DRG. DEPOSITED IN WRENCH SERVER.

(STE-10-F0165)

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE C-200-130

BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR

	NAME	SIGN	DATE
DRN	K.M.SINGHAL	-sd-	17.09.71
CHD	N.B.MATHUR	-sd-	20.09.71
APPD	J.N.KARAN	-sd-	23.10.71

NO. OF VAR: —

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	2:1	0.92	32302000	—	
CODE 4011					

TITLE : LOCKING BLADE 1st STAGE

CARD CODE

DRAWING NO. 32302072 —

SHEET No. 01 | No. OF SHEETS 01

Ref.Drawing No> B-1183566 | Sign & Date | Inventory No.

SIZE A2

FORM DG-49

PLANT PURCHASING SPECIFICATION

HEEP - HARDWAR

HW 10676

PAGE 1 OF 8

590N/mm^2 MINIMUM 0.2% PROOF STRESS HEAT RESISTANT ALLOY STEEL BAR FOR STEAM TURBINE BLADES

1. GENERAL : This specification governs the quality of hot-rolled and forged bars of steel grade 18Cr11Mo1Ni80V30Nb35.

2. APPLICATION : Bars are required for machining of moving blades for Steam Turbine.

3. CONDITION OF DELIVERY : Bars shall be supplied in heat treated condition.

4. DIMENSIONS AND TOLERANCES :
   - 4.1 Bars shall be supplied to the dimensions specified on the Purchase Order.
   - 4.2 Tolerances on the bars shall be as per Annexure I.

5. MANUFACTURE : Steel shall be manufactured by basic electric furnace & subsequently subjected to electro-slag refining or such other process in order to obtain steel of turbine blade quality.

6. HEAT TREATMENT :
   - 6.1 The bars shall be heat-treated to get desired mechanical properties as specified in this specification. Hardening shall be done at a temp. of 1100 to 1140°C in air and tempering at 750°C.
   - 6.2 Minimum possible residual stresses shall be aimed at, with slow cooling and longer duration during tempering treatment.
   - 6.3 If the bars need be straightened after the heat treatment, the bars shall be stress relieved, after the straightening operation, at a temperature, 30°C below the actual tempering temperature.

7. FREEDOM FROM DEFECTS :
   - 7.1 The bars shall be free from cracks, lamination, traces of shrinkage porosity and other harmful defects. The surface of bars shall be free from scab, laps, cracks and inclusions.

SUPERSEDES INVENTORY NO.

SIGN & DATE

INVENTORY NO. P-2512

AGREED DEPTT	NAME	SIGN & DATE
QAX	S.K.GUPTA	

	NAME	SIGN & DATE
DRAWN		
WORKED	H SHARMA	H Sharma
CHECKED	K.K.GUPTA	
SUPERVISED	K.K.GUPTA	

REVISION

Approved PLANT STANDARDIZATION COMMITTEE

PS 2.60

Prepared	Issued	DATE
N. CHANDRA. PRAKASH SINGH STE	STANDARDS DIVISION	15-7-82

FORM DG-50

PLANT PURCHASING SPECIFICATION

HEEP - HARDWAR

HW 10676

7.2 Decarburization and other material defects shall not exceed the dimensional tolerances and the machining allowances.

8. FINISH: The surface of the bar shall be smooth. Dent, roll marks or scratches are permissible if their depths do not exceed half the tolerances.

9. CHEMICAL COMPOSITION: The chemical composition of the material shall conform to the following:-

Element	% Min	% Max.
Carbon	0.15	0.21
Silicon	-	0.60
Manganese	0.60	1.00
Chromium	10.00	11.50
Nickel	0.50	1.00
Molybdenum	0.80	1.10
Vanadium	0.20	0.40
Niobium	0.20	0.45
Sulphur	-	0.015
Phosphorous	-	0.020

Small deviations in the chemical composition may be referred to BHEL for acceptance, provided that the specified properties of the material are not influenced.

10. SELECTION OF TEST SAMPLES: Test samples for determination of mechanical properties, shall be taken at 1/3rd below the surface of bars having maximum and minimum hardness from each melt and each heat-treatment batch.

0.2% Proof stress and tensile strength are to be checked from each cross-section.

11. MECHANICAL PROPERTIES: 11.1 The mechanical properties of the bars shall conform to the following values at room temperature in longitudinal direction:

0.2% Proof Stress : 590 - 710 N/mm^2

Tensile Strength : 755 N/mm^2 Min.

SUPERSEDES INVENTORY NO. | SIGN & DATE

INVENTORY NO. P 252 | SIGN & DATE

Revision :

WORKED BY	H SHARMA	Hsharma	5.2.82
CHECKED BY	K K GUPTA		11.6.82

		% Elongation	: 14% Min.
		% Reduction in area	: 50% Min.
		Notch impact value	: 47J Min.
		Hardness	: 235-255 HB.

11.2 Tensile Test

The tensile test piece shall conform to the gauge length $L = 5.65\sqrt{S_o}$ in accordance with IS: 1608.

11.3 Impact Test

The impact test shall be carried out on standard test piece on 2 mm U notch as per IS : 1499.

11.4 Hardness Test (Brinell)

The hardness test shall be cafried out according to IS:1500.

12. NON DESTRUCTIVE TEST:

12.1 All the bars shall be ultrasonically tested according to pulse echomethod with frequency 2 MHz.

12.2 DGS method shall be used for evaluation of the indications.

12.3 The following indications shall not be permissible.

12.3.1 Individual indications scattered at random with an equivalent flaw size greater than 2 mm dia.

12.3.2 All individual indications with more than 10% loss in back echos.

12.3.3 All the indications linear or globular forming cluster irrespective of sizes of individual indications.

13. NON-METALLIC INCLUSIONS: 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 tested as per ASTM standard E45, the acceptance norms, as per plate III of thin series shall be as follows:

A Sulphide type 1

B or D	Globular type oxide	1
C	Silicate type	1

However, the permissible inclusion rating of anyone of the above can be allowed upto 1.5 provided the other two do not exceed 1 each.

14. ELEVATED TEMPERATURE PROPERTIES: The supplier shall manufacture this steel taking all factors into consideration to ensure the elevated temperature properties specified in Annexure-2.

15. INSPECTION AT SUPPLIERS' WORKS: Test and inspection are to be conducted in the presence of customer's representative. The representative shall have free access at all times, while the work on the contract is being performed, at all parts of the supplier's works. The supplier shall offer the purchaser's representative all reasonable facilities without charge to satisfy the later that the material is being furnished in accordance with this specification. The supplier shall prepare and provide necessary test specimen for testing to be carried out at his premises. If facilities do not exist at his works, the supplier shall make necessary arrangements for carrying out the prescribed tests elsewhere.

16. TEST CERTIFICATES: The supplier shall supply four copies of test certificates unless stated on the order otherwise. The test certificates shall bear the following information:-

16.1 BHEL Reference

Specification number

Order number

Identification.

16.2 Supplier's Reference

Name of the supplier

Material Identification

Details of steel melting process

Melt number and heat-treatment batch.

16.3 Results of testing

Melt analysis, mechanical test results

(all single values are to be given), Brinell hardness, results of ultrasonic test of individual characteristics, non-metallic inclusion rating, complete details of heat-treatment (cooling medium, time-temperature sequence etc.).

17. CLEARANCE FOR DELIVERY: The total results of the tests carried out are the deciding factor for clearance for delivery. BHEL evaluates the total results taking into consideration the intended use of the material and examines accordingly the permissibility of deviations (if any) from the specified properties.

The clearance, however, does not relieve the supplier of his responsibility for the hidden non-permissible defects which are found later.

BHEL must be informed immediately of the difficulties which may cause delay in delivery schedule.

18. PACKING AND MARKING: All the bars are to be marked with supplier's symbol, material designation, the melt No. and identification number given on the order. The above details are to be clearly stamped and encircled by oil colour.

All the bars shall be suitably packed to protect them against corosion and damage during transportation.

The hardest and softest bars of the heat shall be painted and their hardness values shall be punched at both ends of the bar.

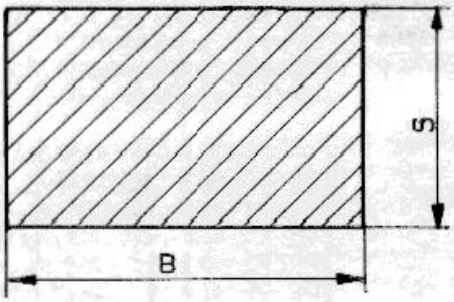
FORM DG-50

PLANT PURCHASING SPECIFICATION

HEEP - HARDWAR

HW 10676

ANNEXURE-1



B, Width across flats mm.	Allowable deviation on B mm	S, thickness	Allowable deviation on S mm
Upto 35	+1.5	Upto 20	+1
Over 35 and upto 75.	+2	Over 20 and upto 40	+2
Over 75	+3	Over 40	+3

INVENTORY NO. P-2512 SIGN & DATE

Revision :

WORKED BY	H.SHARMA	H Sharma	5.2.82
CHECKED BY	K.K GUPTA		11.6.82

PLANT PURCHASING SPECIFICATION
HEEP - HARDWAR

HW10676

PAGE ~~8~~ 7 OF ~~8~~ 7

(a)

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
a	8	TSX(MTG) -93-415	1 to 7		9.9.93						

DISTRIBUOITN OF PRINTS

DEPTT.	TGE	STE	AME	DME	HGE	HTE	ACE	HXE	MTE	~~MPX~~ CPX	IN-SUL SYS	HLE	TSX	THC	PPX	MCX	CSX
	✓	✓						✓	✓	✓			✓		✗	✓	✗
DEPTT.	AIX	MSX	CCX	FAX	TFX	TLX	TIX	TTX-ST	TTX-HT	TTX-EM	WT	OAX	CCX	PCM	WC 202	WC 205	WC 227
								✓			✓	✓	✓	✓			
DEPTT.	FBM BL II	HTM	STM	WC 632	ACM	CIM	FBM BLV	SUM	WWM	FBM BL VIII	WEX	ESX					
	✓		✓														

REVISON								DRAWN			
								WORKED	H.SHARMA	H.Sharma	5.2.82
								CHECKED	H.SHARMA	H.Sharma	8.2.82

INVENTORY NO. P-2512

SIGN & DATE

SUPERSEDES INVENTORY NO.

SIGN & DATE

HEAT RESISTANT ALLOY STEEL BAR FOR STEAM TURBINE BLADES 0.2 % PROOF STRESS – MIN 215 N/MM^2

1.0 GENERAL:

The specification governs the quality of hot-rolled and forged bars of steel grade 10Cr16Ni14Mo23 Nb-11.

Alternatively grade X8CrNiNb1613, Material number 1.4961 as per EN10302, is also acceptable.

2.0 APPLICATION:

Bars are required for machining of moving blades for steam turbine.

3.0 CONDITION OF DELIVERY:

Bars shall be supplied in quenched and aged condition.

4.0 DIMENSION AND TOLERANCES:

The dimension shall be supplied to the dimensions specified in Purchase order.

Tolerance shall be as per Annexure-1.

5.0 MANUFACTURING:

Steel shall be manufactured by basic electric furnace and subsequently subjected to refining or such other process in order to obtain a steel of turbine blade quality. Actual process of melting shall be given in the offer by the supplier.

6.0 HEAT TREATMENT:

Grade 10Cr16Ni14Mo23Nb-11 bars shall be heat treated to get desired properties as specified in this specification.

Solution Annealing : 1100 – 1130^{0}C / Air

Tempering/Ageing : 750^{0}C for 10 to 12 hours

Grade X8CrNiNb1613 should be heat treated as per EN 10302 Table B.1.

7.0 FREEDOM FROM DEFECTS:

The bars shall be free from cracks, lamination, traces of shrinkage porosity and other harmful defects.

The surface of the bars shall be free from scab, laps, cracks and linear inclusion.

Decarburization and other material defects shall not exceed the dimensional tolerances and Machining allowances.

The melt must be inter-crystalline corrosion resistant when tested as per ASTM A262 copper-copper Sulphate –sulphuric acid Test.

8.0 FINISH:

The surface of the bar shall be smooth. Dent, roll marks or scratches are permissible if their depths do not exceed half the tolerances.

				नाम NAME	हस्ताक्षर एवं दिनांक SIGNATURE & DATE
TSX	B. CHOUDHARY	16/1/13			
PSC	V. K. CHAUHAN	16.1.13			
QAX	S. AGARWAL	15/1/13	अनुवादक TRANSLATED BY		
STE	B.P.SINGH	16/01/13	निर्माणकर्ता WORKED BY	DEVDUTT SINGH	12-01-13
			जांचकर्ता CHECKED BY	ASHISH RANJAN	12.01.13
सहमत विभाग AGREED DEPTT.	नाम NAME	दिनांक एवं हस्ताक्षर DATE & SIGNATURE	पर्यवेक्षणकर्ता SUPERVISED BY	GOPAL KRISHNAN	12.1.13

स्वीकृति : संस्थान मानक समिति

APPROVED : PLANT STANDARDS COMMITTEE

Gr. No. 2.60

REV 02	SUPERSEDES		निर्माण PREPARED : MTE	जारी : मानक विभाग ISSUED : STANDARDS DIVISION	दिनांक DATE :04.06.1982
16.01.2013					

हस्ताक्षर एवं दिनांक SIGN & DATE 12/1/13

सामग्री सूची संख्या INVENTORY NO. P 2530

9.0 CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Either of the below mentioned Cases; Case 1 or Case 2 is acceptable.

9.1 Case 1

9.1.1 CHEMICAL COMPOSITION (Grade – 10Cr16Ni14Mo23Nb-11)

The chemical composition of the material shall confirm to the following:-

C	0.06 – 0.12	**Si**	0.00-0.80	**Mn**	≤ 1.00
P	≤ 0.025	**S**	≤ 0.020	**Cr**	15.00 – 17.00
Nb	0.90 -1.30	**Ni**	12.00-14.50	**Mo**	2.00-2.50
Cu	≤ 0.030				

Small deviation in the chemical composition should be referred to BHEL for acceptance , provided that the specified propertied of the material are not influenced.

9.1.2 MECHANICAL PROPERTIES (Grade – 10Cr16Ni14Mo23Nb-11)

The following properties shall be reached in the longitudinal direction at room temperature:

0.2% proof Strength (N/mm^2)	Tensile Strength (N/mm^2)	% Elongation ($l_0 = 5d$)	Impact Energy * (Joule)	Hardness (HB)
≥ 215	≥ 550	≥ 40	≥ 94	111-156

*Average of 3 Charpy 2 mm U-notch specimens.

9.2 Case 2

9.2.1 CHEMICAL COMPOSITION (Grade – X8CrNiNb1613)

The chemical composition of the material shall confirm to the following:-

C	0.04 – 0.10	**Si**	0.30-0.60	**Mn**	≤ 1.50
P	≤ 0.035	**S**	≤ 0.015	**Cr**	15.00 – 17.00
Nb	10X %C -1.20	**Ni**	12.00-14.00		

Small deviation in the chemical composition should be referred to BHEL for acceptance , provided that the specified propertied of the material are not influenced.

9.2.2 MECHANICAL PROPERTIES (Grade – X8CrNiNb1613)

The following properties shall be reached in the longitudinal and transverse direction at room temperature:

0.2% proof Strength (N/mm^2)	Tensile Strength (N/mm^2)	% Elongation ($l_0 = 5d$) (min)		Impact Energy * (min) , Joule		Hardness (HB)
		L	T	L	T	
≥ 205	510 - 690	35	22	65	45	155 - 220

*Average of 3 Charpy V-notch specimens.

निर्माणकर्ता WORKED BY	Devdutt Singh		12.01.13
जांचकर्ता CHECKED BY	Ashish Ranjan		12.01.13

10.0 SELECTION OF TEST SAMPLES

Test sample for determination of mechanical properties , shall be taken at 1/3rd below the surface of bars having minimum and maximum hardness from each melt and each heat treatment batch.
0.2 % proof stress and tensile strength are to be checked from each cross- section.

11.0 NON - DESTRUCTIVE TEST

Bars shall be subjected to Ultrasonic Testing to ensure that no harmful defects are present as per Clause 7.0. Supplier has to take NDT procedure approval from BHEL before taking up production.

12.0 INSPECTION AT SUPPLIER'S WORKS

Test and inspection are to be conducted in the presence of customer's representative. The representative shall have free access at all times, while the work on the contract is being performed, at all parts of supplier's works. The supplier shall offer the purchaser's representative all reasonable facilities without charge to satisfy the later that the material is being furnished in accordance with the specification. The supplier shall prepare and provide necessary test specimen for testing to be carried out at his premises. If facilities do not exist at his works, the supplier should make necessary arrangements for carrying out the prescribed tests elsewhere.

13.0 DOCUMENTATION

The supplier shall supply four copies of test certificates unless stated on the order otherwise. The test shall bear the following information :-

- Specification no.
- Purchase Order no.
- Name of the supplier
- Material identification
- Heat Number, heat treatment batch ,heat analysis and steel melting method
- Complete information of all heat treatments performed (Cooling Medium, time temperature sequence etc.)
- Results of Mechanical Testing
- Results of Hardness
- Results of Non - destructive testing
- Confirmation of inter-crystalline corrosion resistance
- Confirmation of the material identification check
- Confirmation of the dimensional and visual check

14.0 CLEARANCE FOR DELIVERY:

The total results of the tests / checks carried out are the deciding factor for clearance for delivery, and hence shall be intimated to BHEL in advance. In case of nonconformance, BHEL evaluates the total results taking into consideration intended use of the material and examines accordingly the acceptability of deviation (if any). No material shall be delivered, if deviated, without acceptance by BHEL. The clearance, however, does not relieve the supplier of his responsibility for the hidden / unreported non-permissible defects which are found later.
BHEL must be informed immediately of the difficulties which may cause delay in delivery schedule.

15.0 PACKING AND MARKING

All the bars to be marked with supplier's symbol, material designation, the melt No and identification number given on order. The above details are to be clearly stamped and encircled by oil colour.

All the bars shall be suitably packed to protect them against corrosion and damage during transportation.

The hardest and softest bars of the heat should be painted and their hardness values shall be punched at both ends of the bar.

The marking of the material shall be such that heat no., heat treatment batch no., specification no. or material grade & manufacturer name / identification are legible.

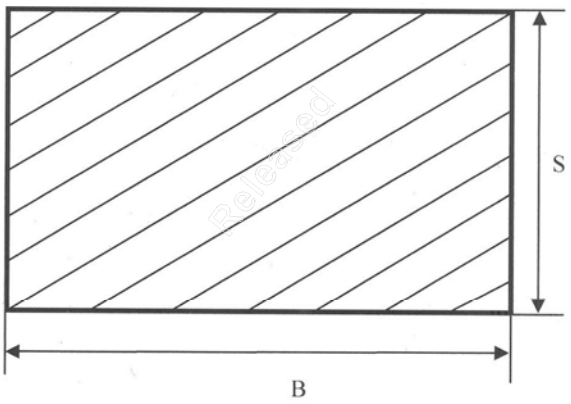
16.0 DEVIATIONS:

Deviations from this Purchase Specification, which arise during manufacturing, may be submitted to BHEL in writing, giving full details of the deviation. Acceptance of concession request will be at the sole discretion of BHEL.

17.0 CROSS REFERRED STANDARDS:

EN 10088 ,ASTM A262 , EN 10302

Annexure - 1



B ,width across flats ,mm	Allowable deviation on B , mm	S , thickness , mm	Allowable deviation on S , mm
≤ 35	+1.5	≤ 20	+1.0
35 < B ≤ 75	+2.0	20 < S ≤ 40	+2.0
>75	+3.0	>40	+3.0