FORM NO EFA/P-047

ENGINE FACTORY, AVADI

PROCESS SCHEDULE

DESCRIPTION :- MASTER CON.ROD.

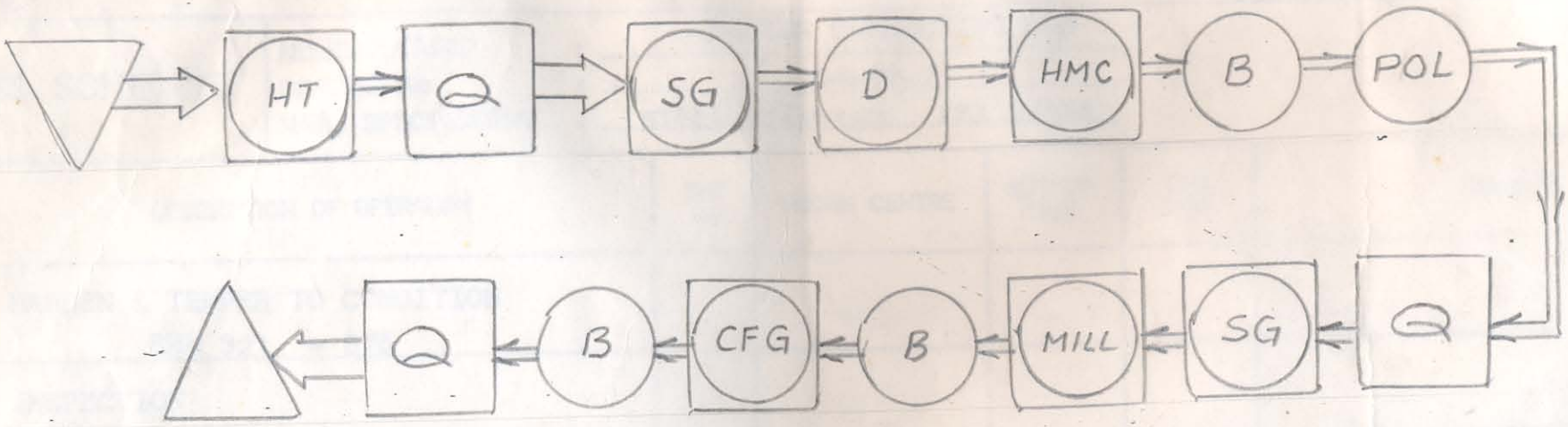
COMPT. No :- 304-12-7

MFG. SHOP :- SPS

REV. NO-00
DATE: 28/10/96

FLOW PROCESS CHART

STORE : DRG. NO.: 304-12-7[illegible] END STORE:



B Bench	C Collection of items	HT Heat treatment		LP Lead Plating	
ASSY ASSEMBLY	CG CYLINDRICAL GRINDING	GD GUN DRILLING		MILL MILLING	
BO BORING	D DRILLING	HMC HORIZONTAL MACHINING CENTRE OPERATION		POL POLISHING	
CD CRACK DETECTION	DA DISASSEMBLY	HP HYDRAULIC PRESS		SG SURFACE GRINDING	
CFG CREEP FEED GRINDING	FB FINE BORING	LAP LAPPING		TUR TURNING	

LEGEND				APPROVAL			SECTION	SPS
TEMP. STORAGE	▽	TRANSPORTATION	⇨	SIGNATURE & DATE			NO. OF SHEETS	1
OPERATION	○	INSPECTION BY QC	Q	PREPARED BY	MGR.	QC —	SHEET NO.	1
OPERATION CUM INSPECTION	□	INSPECTION BY SQAE/CQA(ME) Etc.	I	APPROVED BY			ENGINE FACTORY, AVADI, MADRAS-54	
100 % INSPN. BY MFG. SEC.	□	STORAGE	△	AUTHORISED FOR ISSUE		28/10/96		

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : MASTER CONNECTING ROD
DRAWING No : 304-12-7
MATL. SPECIFICATION : STEEL STAMPING 18X 2H4MA

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
010	HARDEN & TEMPER TO CONDITION BHN 321 - 375					
020	INSPECTION					
030	TRANSPORT					
040	SURFACE GRINDING	6	ALEX Surface grind -ing m/c			
050	DRILLING	7	ACCUMAC Pillar drill- ing m/c			
060	MILLING I SET UP	8	PRAGA HMC-600			
070	MILLING II SET UP	9 TO 13	-do-			
080	MILLING III SET UP	14	-do-			

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
SIGN R.S. Varma	SIGN	SIGN	
DATE 21/10/96	DATE 25.10.96	DATE 28.10.96	28/10/96
C/MAN-II /PDO	Q/M I /PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

SHT. No 1 OF 31

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : MASTER CONNECTING ROD
DRAWING No : 304-12-7
MATL. SPECIFICATION : STEEL STAMPING 18X 2H4MA

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
090	DRESSING		BENCH			
100	POLISHING	15	BENCH			
110	INSPECTION	17 TO 19				
120	SURFACE GRINDING	20	ELB(ROTARY) S/grinding			
130	-do-	21	-do-			
140	MILLING	22	PRAGA HMC - 600			
150	GANG MILLING	23	HMT Horz. Milling m/c			
160	DRESSING		BENCH			

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
SIGN R.S.Varam	SIGN	SIGN	
DATE 21.10.96	DATE 28.10.96	DATE 28.10.96	28/10/96
C/MAN-II /PDO	C/M2 /PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

SHT. No 2 OF 31

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : MASTER CONNECTING ROD
DRAWING No : 304-12-7
MATL. SPECIFICATION : STEEL STAMPING 18X 2H4MA

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
170	CREEP FEED GRINDING	24	MATTISON Creep feed grinding m/c			
180	-do-	25&26	-do-			
190	DEBURRING	27&28	BENCH			
200	DEMAGNETISING & CRACK DETECTION		Magnetic flaw detector			
210	FINAL INSPECTION	29,30 & 31				
220	PRESERVATION					

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
SIGN Q.S.Vasan	SIGN	SIGN	
DATE 21/10/96	DATE 28.10.96	DATE 28-10-96	28/10/96
C/MAN-II /PDO	C/MII /PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

SHT. No 3 OF 31

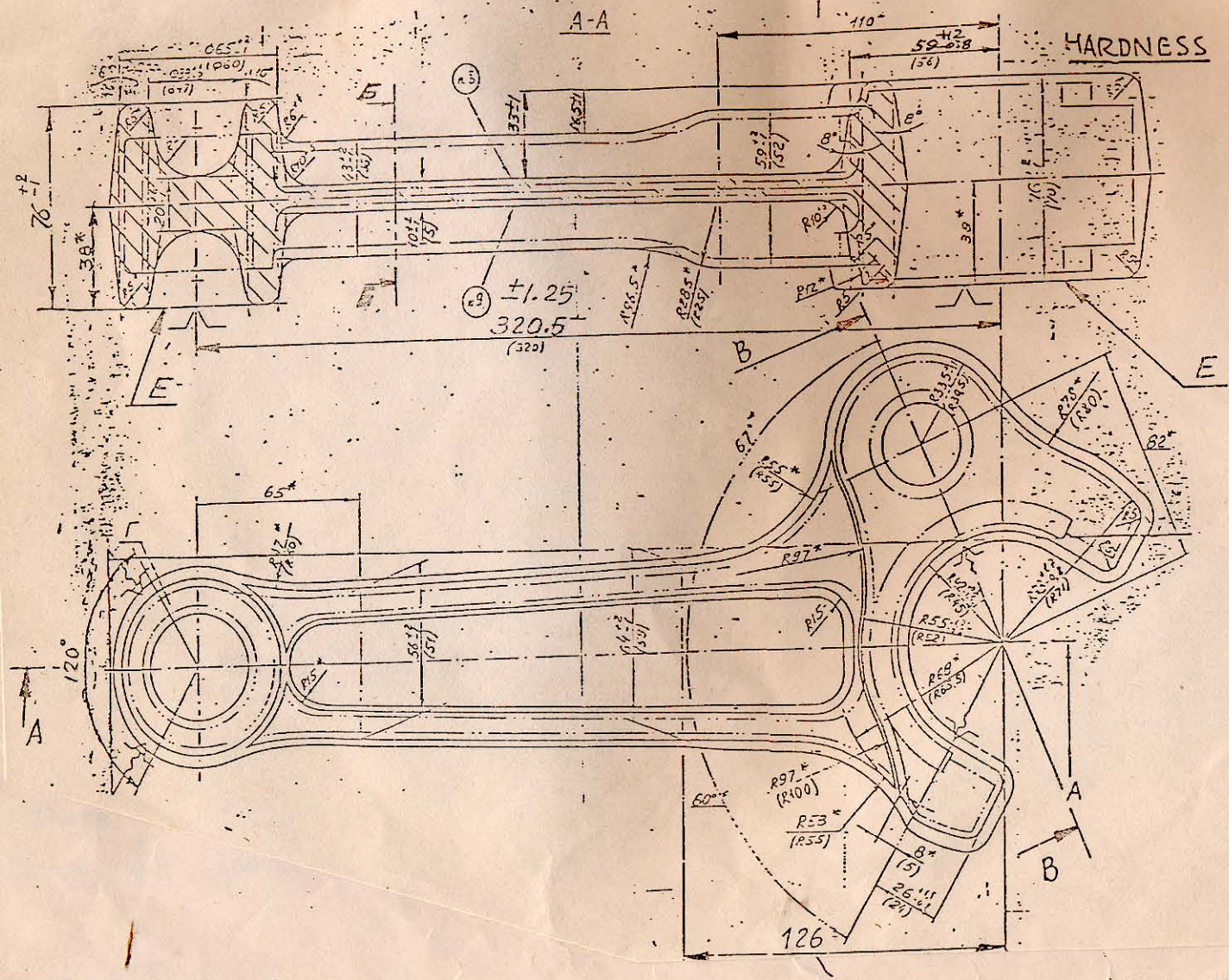
NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		000	FORGING

SHT. 1 OF 2

MATERIAL : STEEL 18X2H4MA.

CONDITION : NORMALISED AND HIGH TEMPERED.

HARDNESS : BHN 255 - 196



PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE
QSV					

PLANNING SHEET - PDO/EFA

NOMENCLATURE	DRAWING.NO TD	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		000	FORGING

MACHINE :

STD.TOOLS&GAUGES

PL.TOOLS & GAUGES

PLANNING SHEET-PDO/EFA

TECHNICAL REQUIREMENTS

(1) Material: Steel 18X2H4MA

(2) Mismatch of axes of dies should not exceed 1.1 mm.

(3) Core bending should not exceed 1.25 mm. Non-flatnes of surfaces 'E' should not exceed 1.2 mm.

(4) The depth of holes and recess of defects should not exceed half of actual machining allowance.

(5) Fin, left out along the die parting line should not exceed 1 mm.

(6) Non-filling of corners along section 120° of small end at ⌐ is not allowed.

(7) Alternate material is Steel 18X2H4BA as per TY. 14-1-381-72.

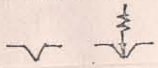
(8) Component no is to be marked.

(9) Heat no and grade of Steel is to be marked when the alternate material is used.

(10) * Dimensions are to be ensured in tool.

(11) Forging is to be normalised and high tempered to condition BHN 255-196 (Ø3.8-4.3)

(12) There should not be scales.

(13)  indicate the datum for first machining.

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

FORM No: EFA/P-039 PLANNING SHEET – PDO/EFA FORM No: EFA/P-03

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7.		040	GRINDING

MACHINE: Surface Grinding machine ALEX

STD.TOOLS&GAUGES

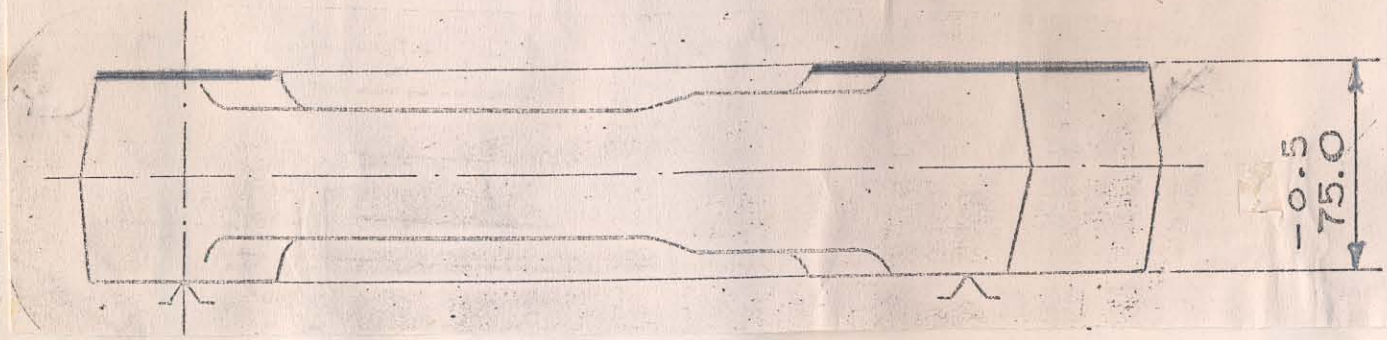
1. Grinding wheel segments 6"x4"x1.5" AA36 J23
2. Depth mic 50-75

SPL.TOOLS & GAUGES

MATERIAL : STEEL 18X2H4MA.

HARDNESS : BHN 321... 375.

Ra 10

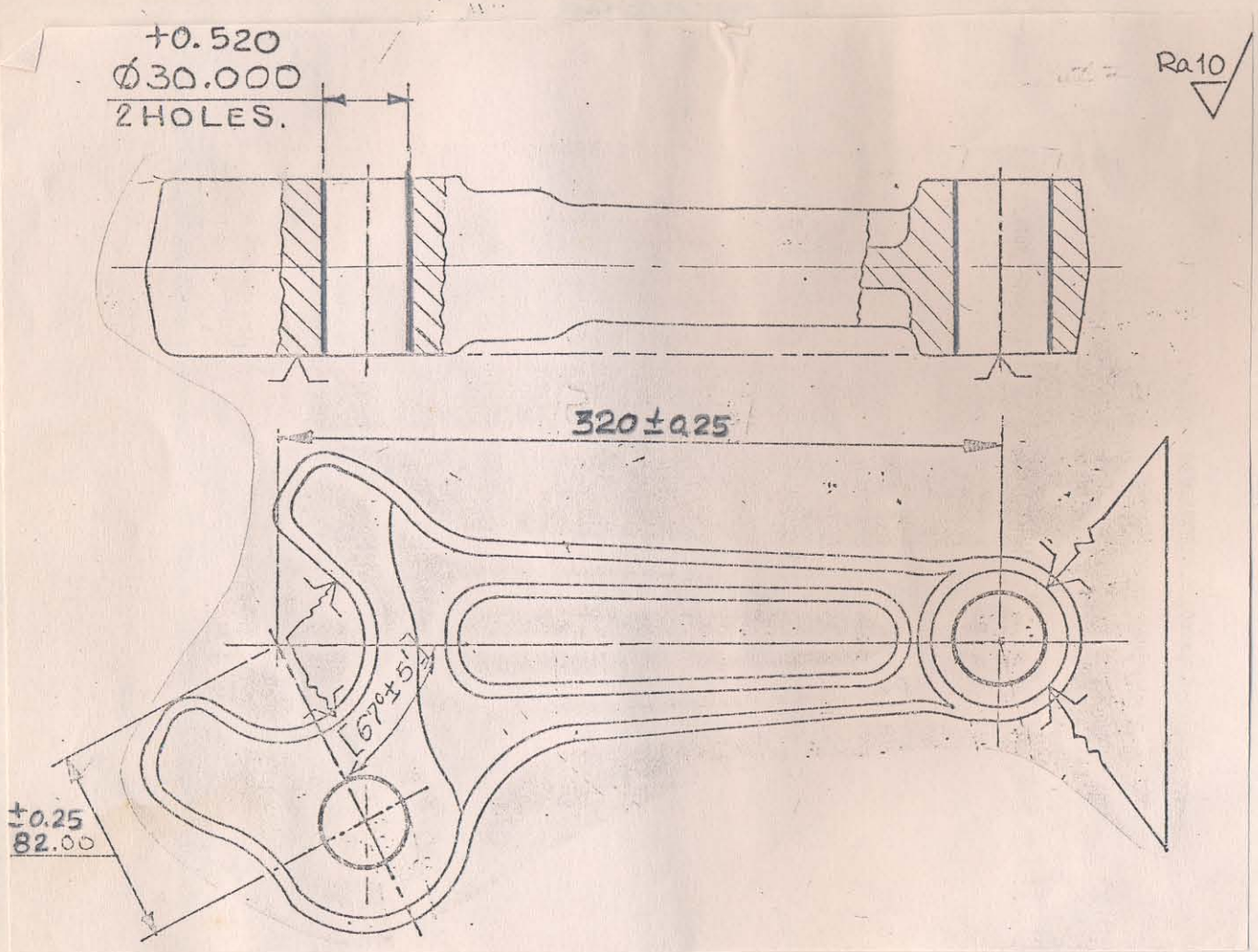


PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

FORM No: EFA/P-039 PLANNING SHEET – PDO/EFA

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		050	DRILLING

MACHINE: Pillar Drilling machine ACCUMAC



STD.TOOLS&GAUGES

1. Quick change collet chucks MT 3
2. -do- MT 4
3. HSS Drill Ø20
4. HSS Drill Ø30

SPL.TOOLS & GAUGES

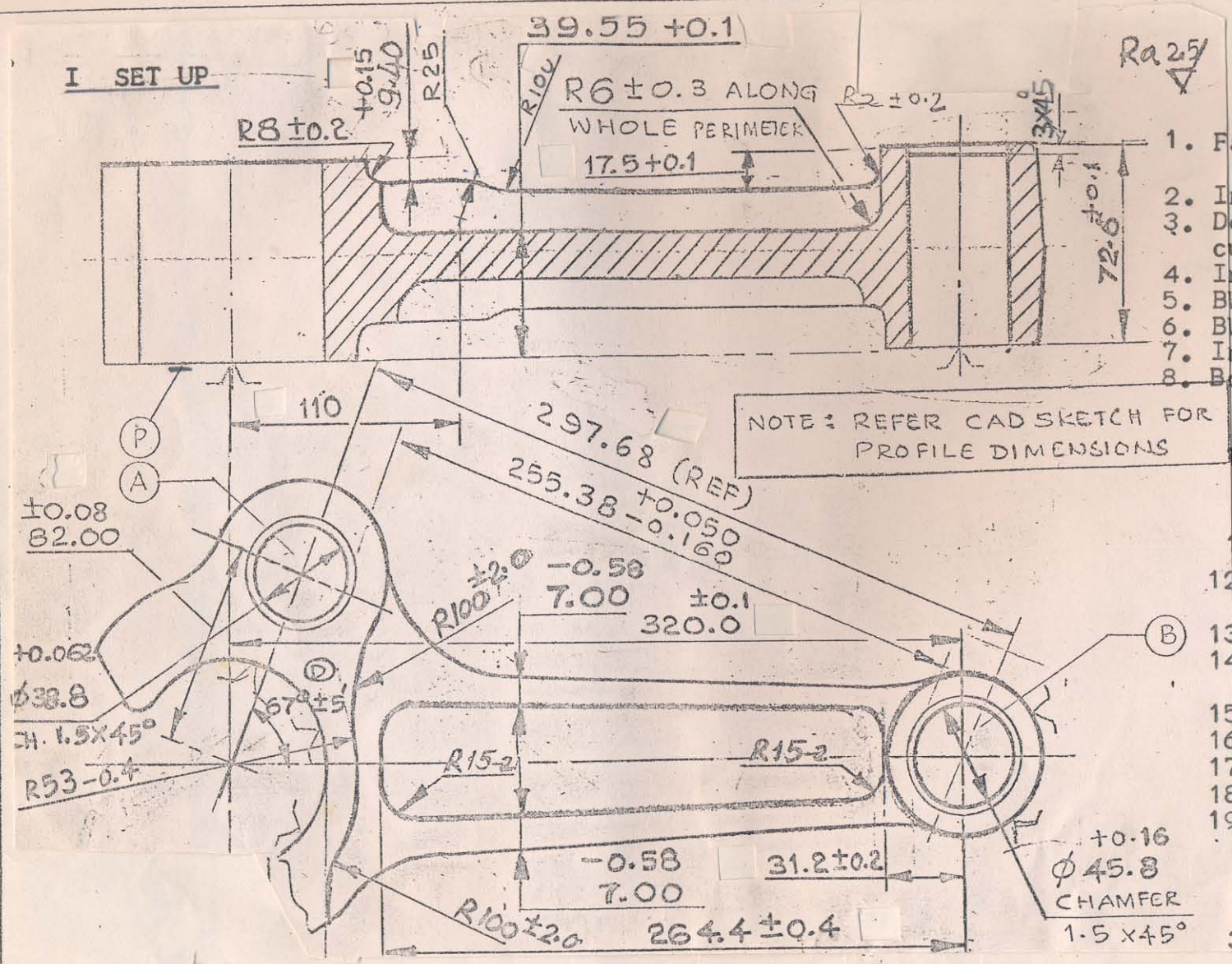
1. JIG

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

FORM No: EFA/P-039 PLANNING SHEET – PDO / EFA FORM No: EFA/P-039

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		060	MILLING

MACHINE: HMC 600



TECHNICAL REQUIREMENTS

1. Slope of middle wall of I-beam along the whole length should not exceed 0.2 mm
2. Non-perpendicularity of bores A & B w.r.t. surface 'P' should not exceed 0.03 mm

STD.TOOLS&GAUGES

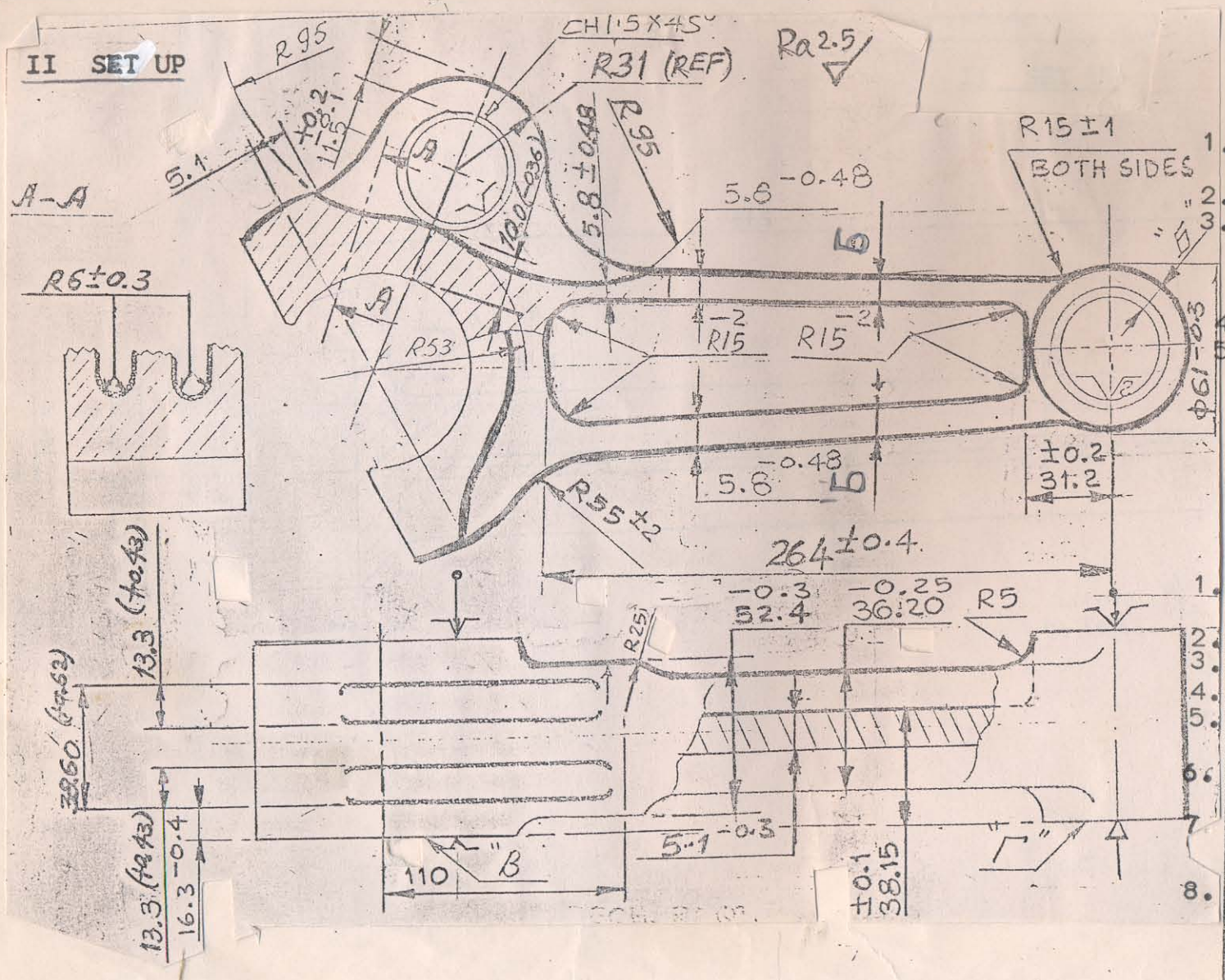
1. Face milling cutter M40 SP15 Ø80
2. Insert: SPKN 1504 TTR EDR
3. Deep shoulder end milling cutter Ø63 CEL 88
4. Insert: SPMW 120408
5. BW core drill Ø36
6. BW core drill Ø42
7. Insert: SCMM 120408
8. Boring bar square shank 10x10 Widia No. 6938785220
9. Insert: CCMM 060204
10. CC end mill Ø25 Widia No. 69396417
11. Insert: TCMT 110204 SCMT 09T308
11a. Shell end mill (insert type) 402233
12. Fine boring tool M5 A2 G40
13. -do- M5 B2 G40
14. Carbide tipped end mill brazed Ø30x5x45 46/00/003
15. -do- Ø36x5x45 46/00/016
16. -do- Ø30 ER 6 46/00/002
17. -do- Ø50x75 46/00/001
18. -do- Ø50 ER8 402233(Alt)
19. C/sink cutter HSS Ø50x90

1. Plug gauge Ø45.8 20/10/9
2. -do- Ø38.8 20/09/19
3. setting rings 94/2, 94/3
4. FIXTURE 401271

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		070	MILLING

MACHINE: HMC 600



STD.TOOLS&GAUGES

1. Deep shoulder end mill Ø63 CEL 88
2. Insert SPMW 120408
3. CC end mill Ø25 Widia No. 69396417 Insert: TCMT 110204 SCMT 09T308
4. S&F cutter M90 TP11 Ø160
5. Insert: TPAN 1103 PPN TTR

1. Outer profile gauge 403001,403008
2. Gap gauge 5.8 025/01/35
3. Spl. gauge 5.1

SPL.TOOLS & GAUGES

1. Carbide tipped end mill brazed Ø30x5x45	46/00/003
2. -do- Ø36x5x45	46/00/016
3. -do- Ø30 ER 6	46/00/002
4. -do- Ø59 75	46/00/001
5. -do- Ø50 ER8	402233
6. FIXTURE	401272
7. S & F cutter (insert type) Ø190xØ40x13.3WxR6 or CT brazed	402236 / 42/00/18
8.	

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

NOMENCLATURE	DRAWING.No	ISSUE	OPN.No	OPERATION
MASTER CONNECTING ROD	304-12-7		070	MILLING

FORM No: EFA/P-039

PLANNING SHEET-PDO/EFA

II SET UP

TECHNICAL REQUIREMENTS

1. Variation in wall thickness 'E' should not exceed 0.3 mm max.
2. Sizes of radii should be checked by outer profile gauges.
3. Out of squareness of milled contour generatrixes relative to datum surfaces 'B' and 'F' should not exceed 0.1 mm over length of 100 mm.
4. Deviation of outer profile of con.rod relative to the gauges may be on I-section ±0.1 mm max. on radius 55 surface ±0.3 mm and rest of the profiles ±0.2 mm max.
5. Parallel displacement of middle wall of I-beam relative to symmetry plane of small end should not exceed 0.2 mm

MACHINE

STD.TOOL & GAUGES

SPL.TOOLS & GAUGES

1. Gap gauge 11.5	403042
2. -do- Ø61	026/01/4
3. Outer profile gauge	403001 403008
4. R53,R100,R31	403011
5. Slip gauge 13.3	403026

PRED.	CHD.	APPD.	PDO. REF	ISSUE	DATE

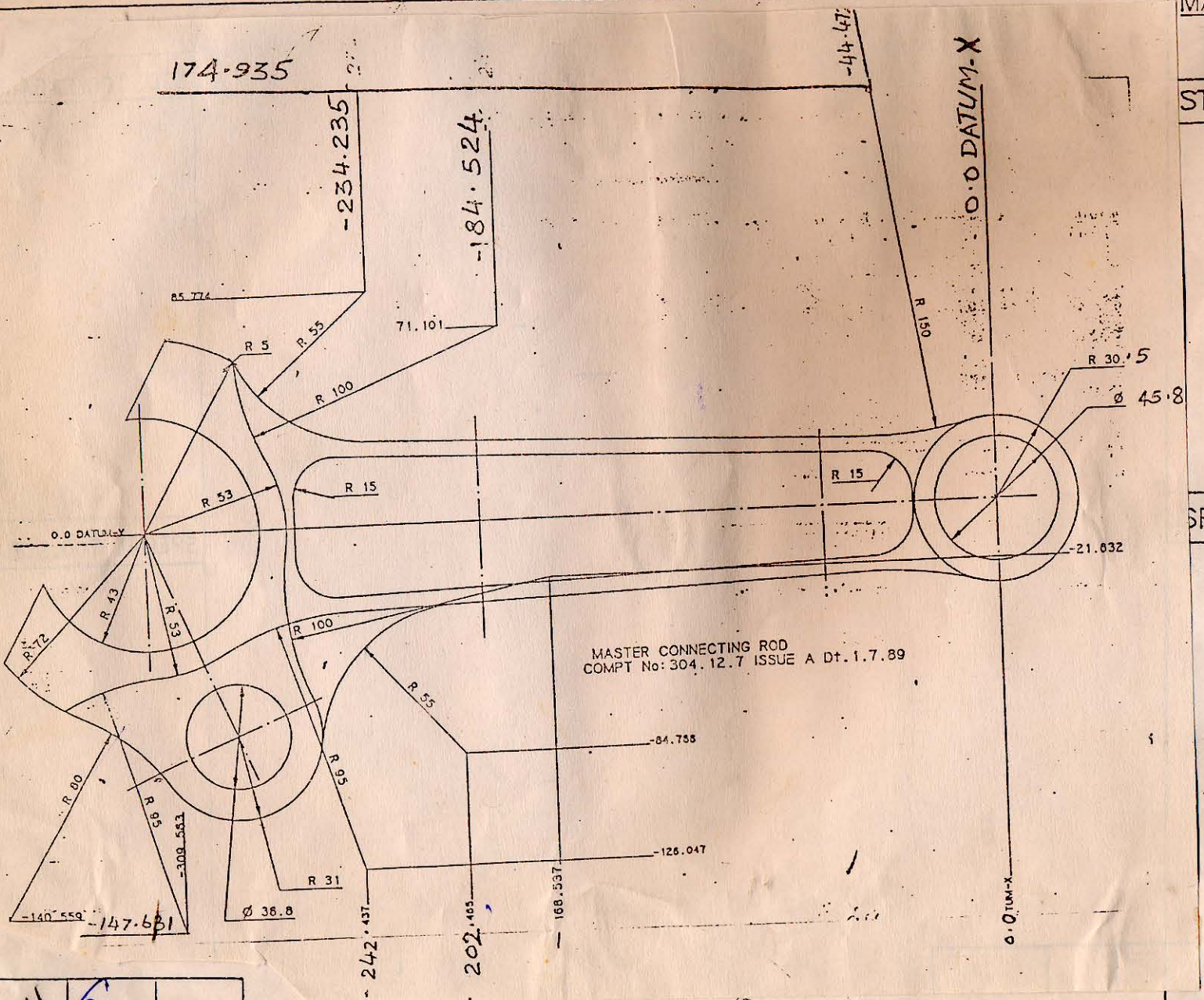
PLANNING SHEET – PDO/EFA FORM No: EFA/P-03

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		070	MILLING

MACHINE: HMC 600

STD.TOOLS&GAUGES

SPL.TOOLS & GAUGES



PRED.	CHD.	APPD.	DATE	ISSUE	DATE

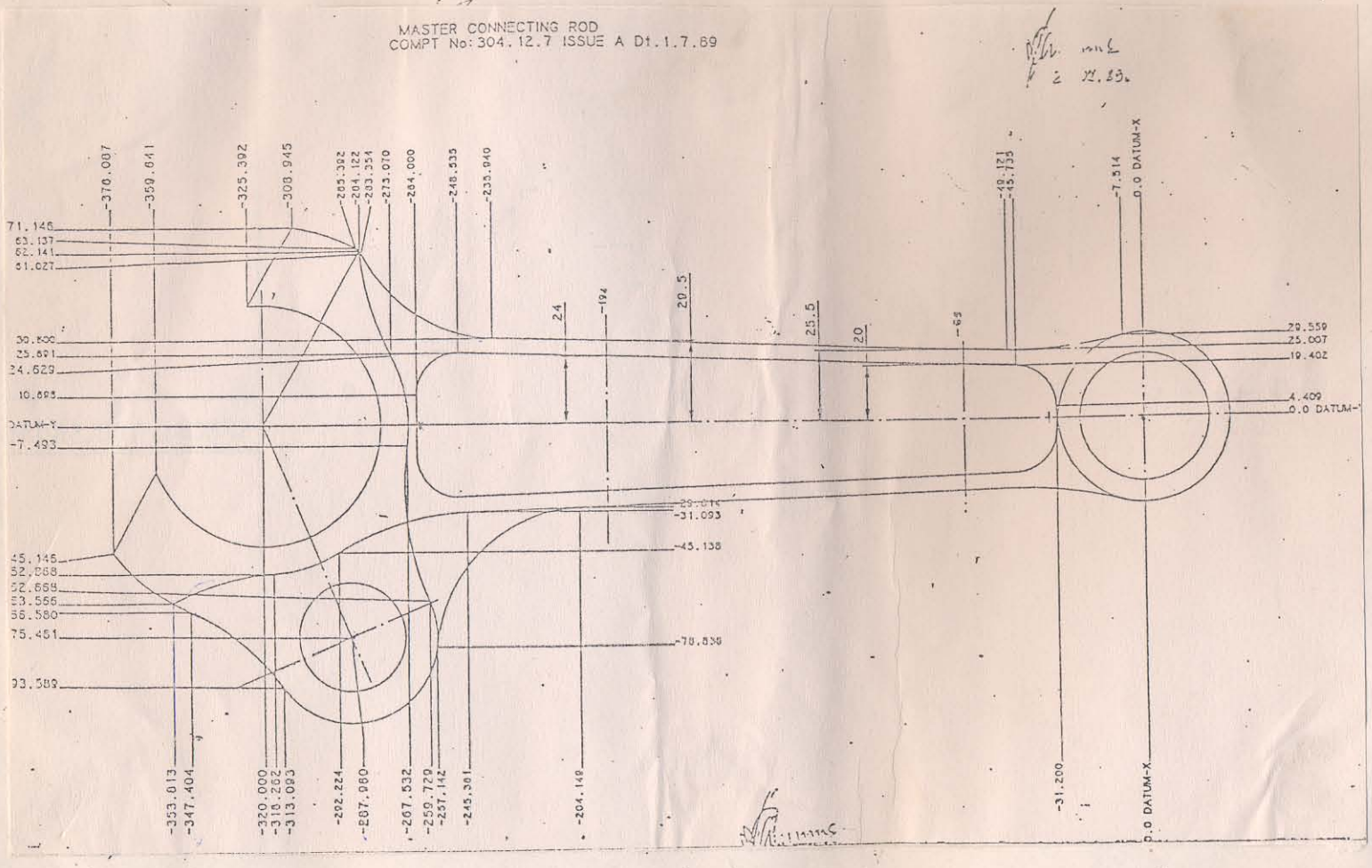
PLANNING SHEET – PDO / E.F. FORM No: EFA/P-039

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		070	MILLING

MACHINE: HMC 600

STD.TOOLS&GAUGES

SPL.TOOLS & GAUGES



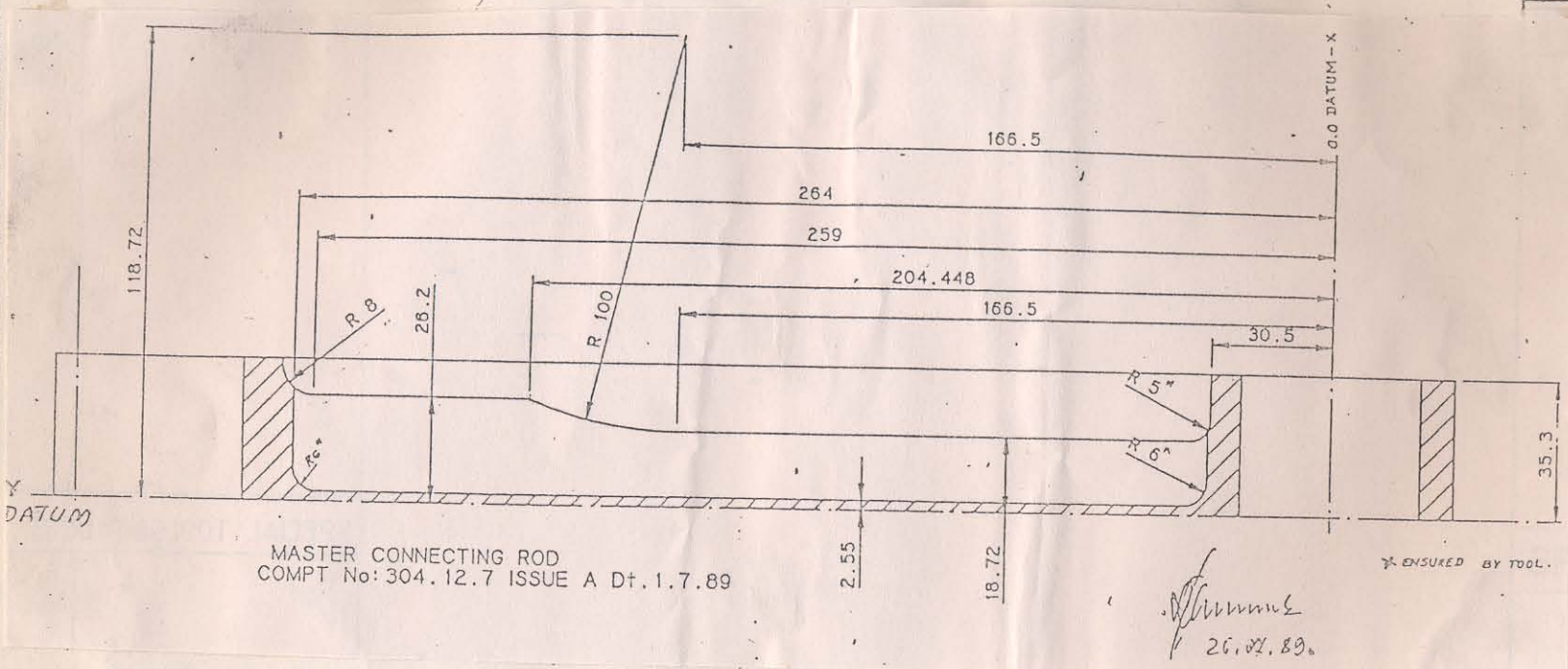
PRED.	CHD.	APPD.	DATE	ISSUE	DATE
QSV					

PLANNING SHEET – PDO/EFA

FORM No: EFA/P-023

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		070	MILLING

MACHINE: HMC 600



MASTER CONNECTING ROD
COMPT No: 304.12.7 ISSUE A Dt. 1.7.89

26.07.89.

D.TOOLS&GAUGES

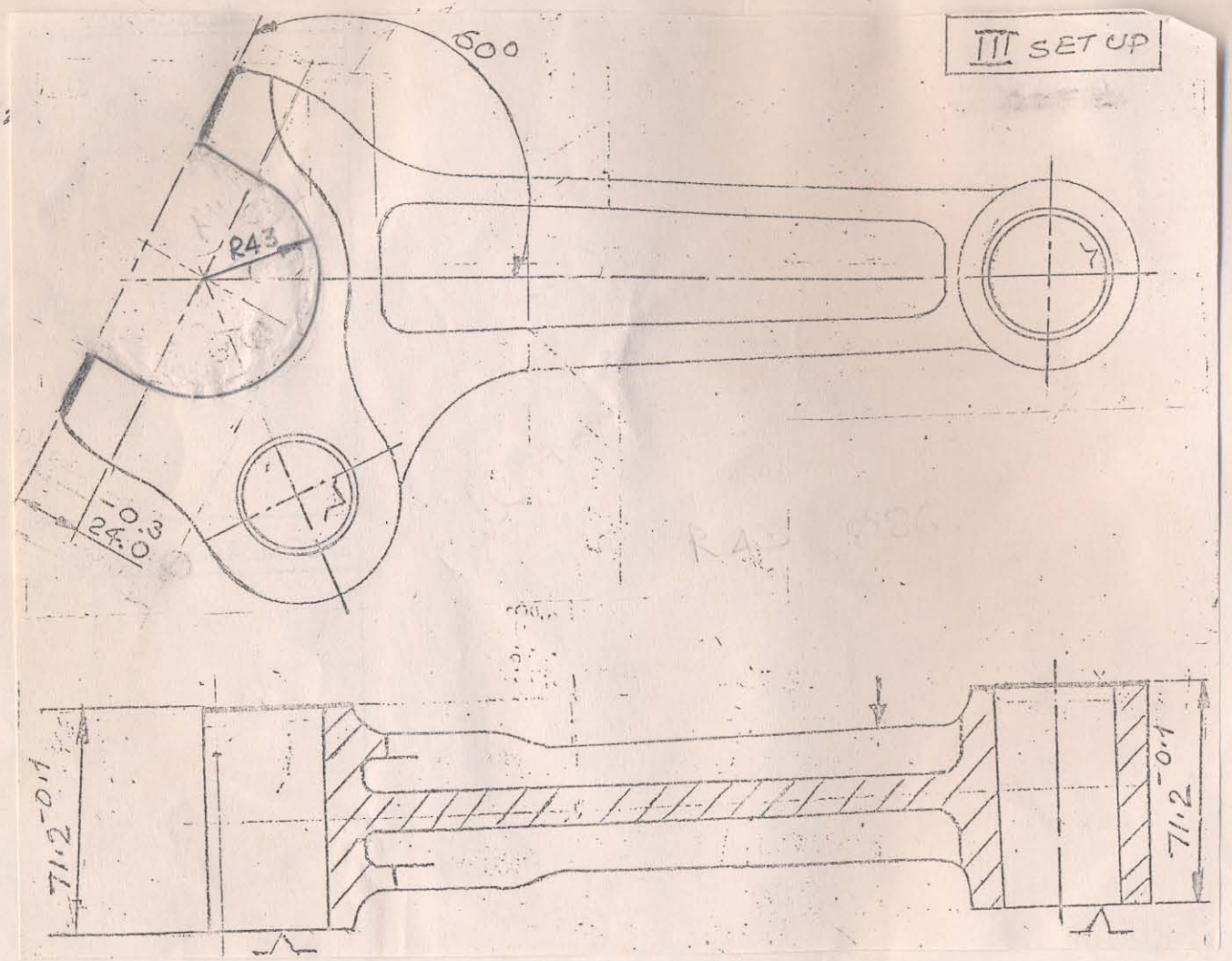
L.TOOLS & GAUGES

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

PLANNING SHEET – PDO / EFA FORM No: EFA/P-02

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		080	MILLING

MACHINE: HMC 600



STD.TOOLS&GAUGES

1. Face milling cutter M40 SP 15 Ø80
2. Insert: SPKN 1504 TTR EDR
3. Deep shoulder end mill Ø63 CEL 88
4. Insert: SPMW 120408
5. Depth gauge 21.7
6. -do- 67
7. Gap gauge 94.5 +0.1

SPL.TOOLS & GAUGES

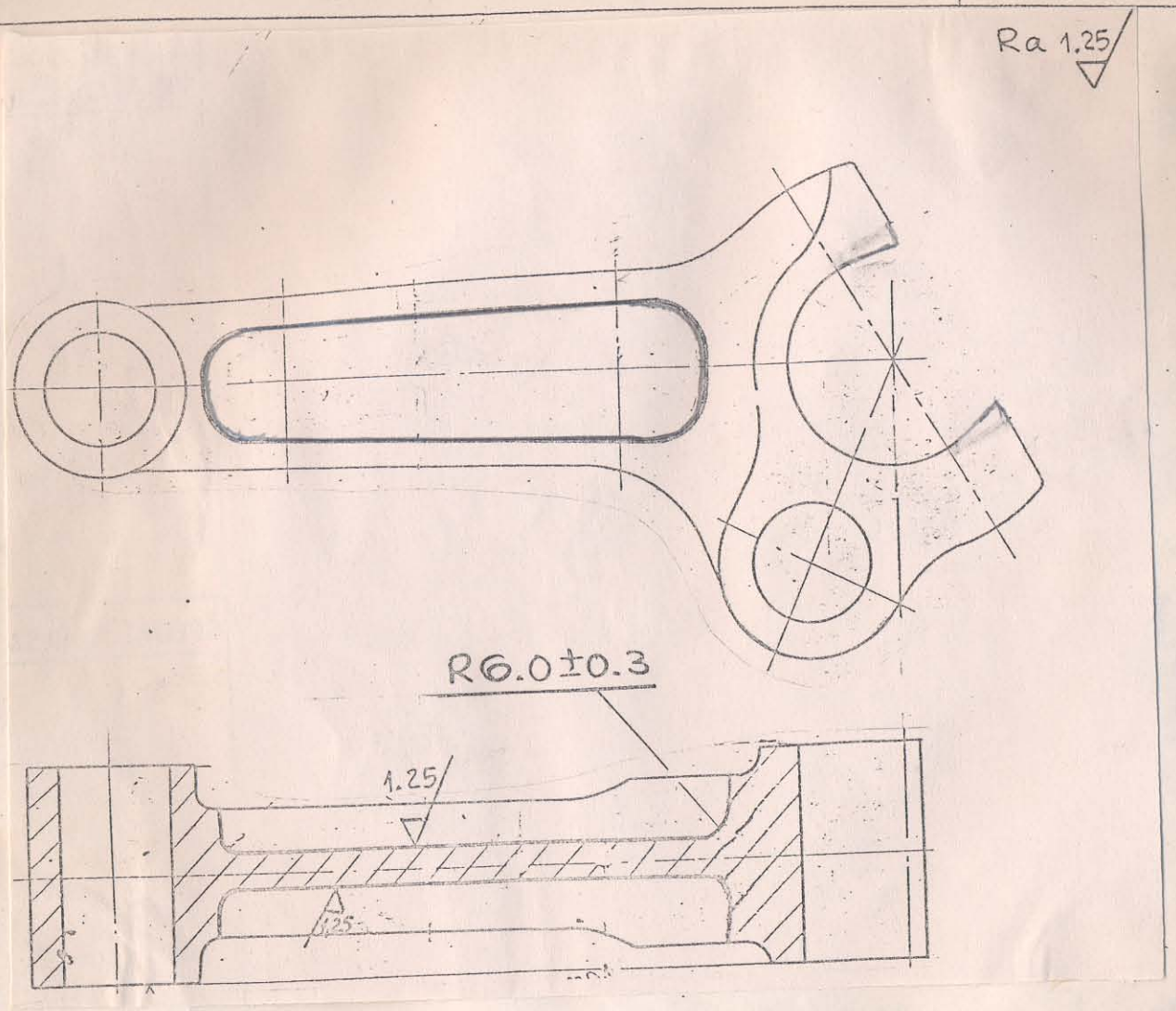
1.	Carbide tipped brazed end mill Ø50	75	46/00/001
2.	-do- Ø40		46/00/018
3.	Fixture		401273

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

PLANNING SHEET - PDO/EFA/40AM No: EFA/P-039

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPER
MASTER CONNECTING ROD	304-12-7		100	POLISHING

MACHINE: BENCH



NOTE: No tool marks are allowed in pocket

STD.TOOLS&GAUGES

1. Pneumatic Grinder	
2. Polishing wheel	69/00/001 69/00/002
3. Emery sheets	
4. Rubber bit	400606
5. Mounted points	
6. Safety Goggles	
7. Safety shield	
8. Safety apron	

SPL.TOOLS & GAUGES

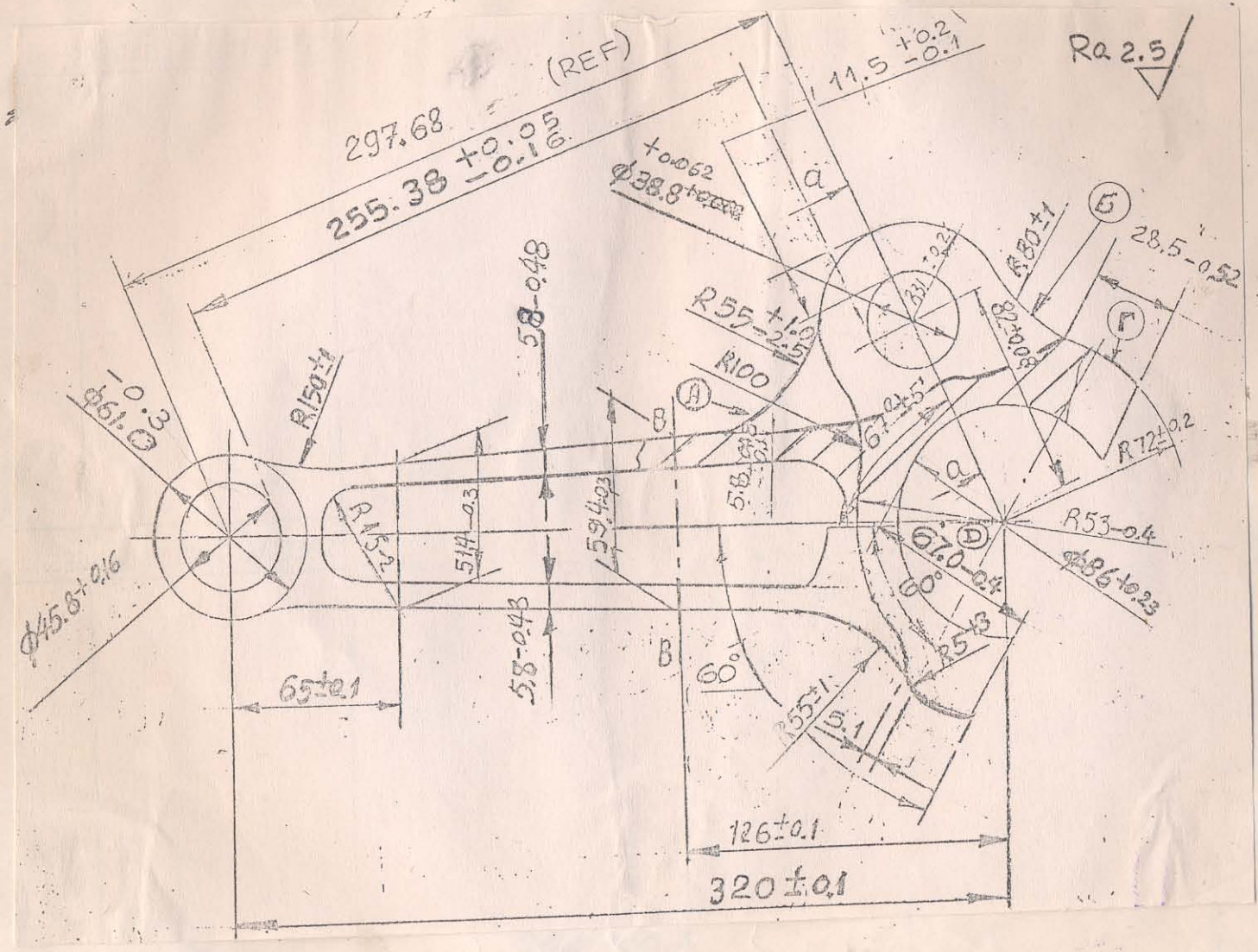
7. HR file 150 mm	
8. Mandrel	401676
9. Engraving m/c	

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE
BSV					

PLANNING SHEET – PDO / EFA FORM No: EFA/P-03

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		110	INSPECTION

MACHINE:



STD.TOOLS&GAUGES

1. Out side mic 25 - 50
2. Bore dial indicator 25 - 50
3. Digital height master
4. Digital Vernier caliper 0 - 300 mm

SPL.TOOLS & GAUGES

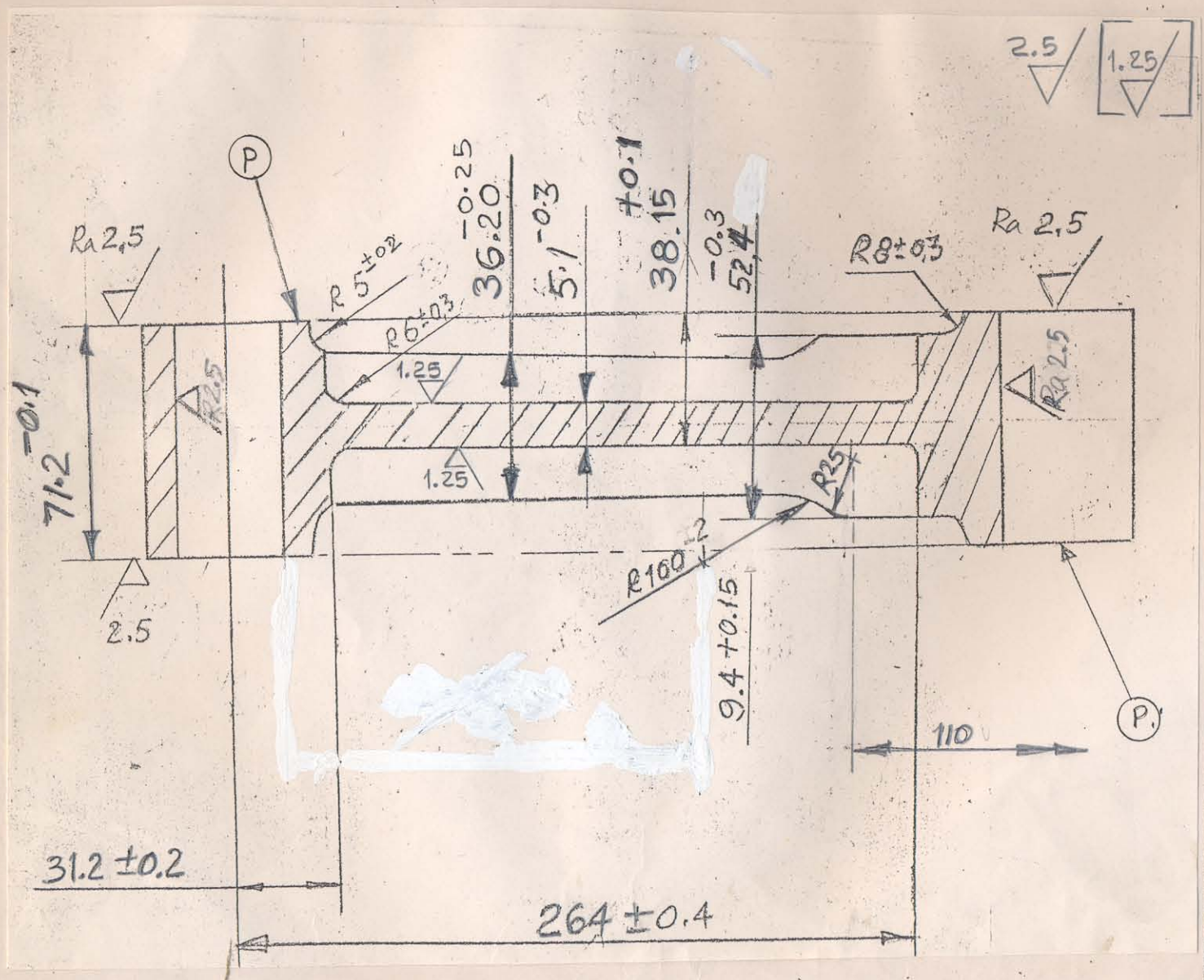
1.	Plug gauge Ø38.8	020/09/19
2.	-do- Ø86	403019
3.	-do- Ø45.8	020/10/9
4.	Gauge to check 255.38	403043
5.	-do- 69	403002
6.	-do- 59.4,51.4	403006
7.	-do- R100,R53	403011
8.	Profile gauge	403001

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

NOMENCLATURE	DRAWING.NO	SUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		110	INSPECTION

MACHINE:

STD.TOOLS&GAUGES



SPL.TOOLS & GAUGES

9.	Radius gauge R5	403004
10.	Gap gauge	026/01/91
11.	Radius gauge	
	R8	403012
	R100	403024
	R6	403003
	R15	403005
12.	Gap Gauge Ø61 -0.3	026/01/4
13.	Slip gauge 13.3 +0.43	403026
14.	Distance Gauge 38.6	403027
15.	Gap gauge 16.3 -0.4	025/02/138
16.	Fixture for checking position of Holes	401095

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

PLANNING SHEET - PDO / EF

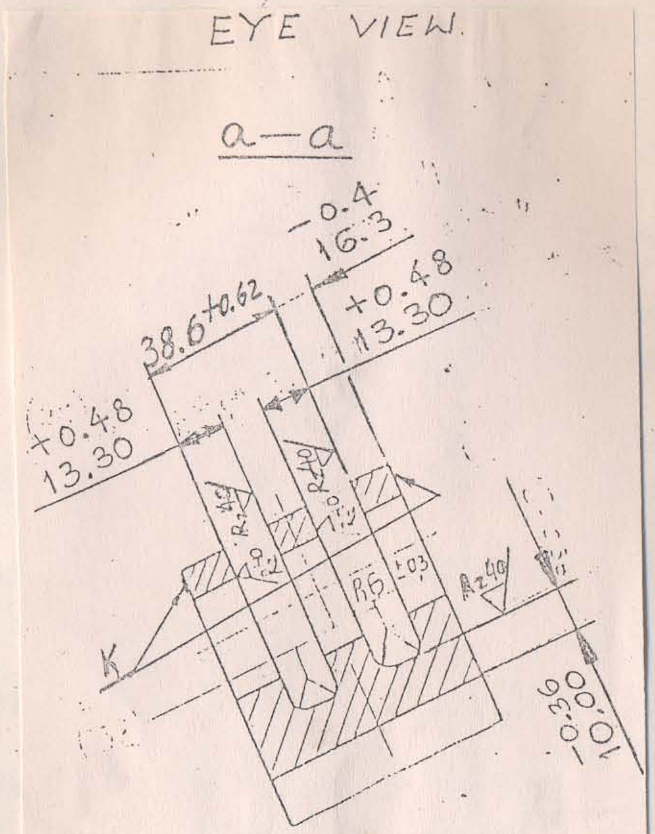
FORM No: EFA/P-0

NOMENCLATURE	MASTER CONNECTING ROD	304-12-		110	INSPECTION

MACHINE:

STD.TOOLS&GAUGES

SPL.TOOLS & GAUGES



PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE

SHEET 18 OF 31

PLANNING SHEET – PDO/EFA FORM No: EFA/P-05

NOMENCLATURE	DRAWING.NO	ISSUE	OPN.NO	OPERATION
MASTER CONNECTING ROD	304-12-7		110	INSPECTION

MACHINE:

TECHNICAL REQUIREMENTS

1. Parallel displacement of middle wall & faces of 'I' beam flanges relative to symmetry plane of end faces should not exceed 0.2mm.
2. Slope of middle wall and faces of 'I' beam flanges on the whole length should not exceed 0.2mm.
3. Deviation of connecting rod contour from out line template is allowed not morethan ±0.1mm. along the 'I' beam section of rod, ±0.3mm along surface 'A', ±0.2mm along surfaces "F" & "G".
4. Variation in wall thickness of small end is allowed not more than 0.3mm.
5. Non-parallelism and misalignment of axes of holes at small end and eye end should not exceed 0.3mm over a length of 200mm.
6. Size 71.2 -0.1mm should not be checked at "K".
7. Non-perpendicularity of bores Ø45.8 +0.16mm and Ø38.8 +0.062mm.with reference to surface "P" should not exceed 0.03mm.
8. Weight of the component should not exceed 5760 gms.
9. Mark the component number and serial number using electrograph method.

PRED.	CHD.	APPD.	P&TE REF	ISSUE	DATE