ENGINE FACTORY, AVADI

PROCESS SCHEDULE

DESCRIPTION :- CYL. HD. UTD 20 RH & LH ASSY.

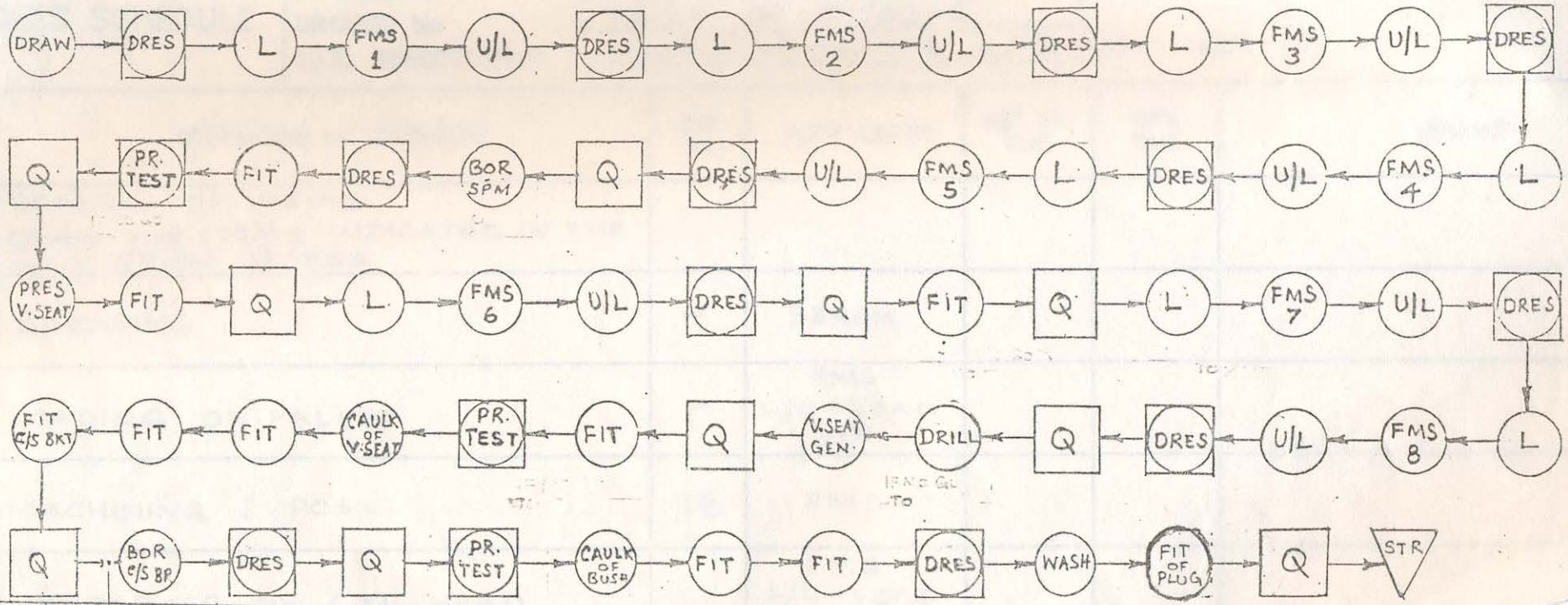
COMPT. No :- SB 20-06-01/02-5

MFG. SHOP :- FMS

REV. NO. 00
DATE 22-10-96

FLOW PROCESS CHART

STORE : CYL. HEAD ASSY RH/LH DRG NO. SB 20-06-01/02-5 END STORE : UTD. 20 ENGINE.



LEGEND | L - LOADING | U/L - UNLOADING | STR - STORE
FMS. FLEXIBLE MANUFACTURING SYSTEM | PR. TEST - PRESSURE TESTING
BOR - BORING | V. SEAT GEN - VALVE SEAT GENERATION
C/S BKT | CAMSHAFT BRACKET | DRAW - DRAWAL OF ITEMS

TEMP. STORAGE	▽	TRANSPORTATION	⇨
OPERATION	○	INSPECTION BY QC	Q
OPERATION CUM INSPECTION	◎	INSPECTION BY SQAE/CQA(ME) Etc.	I
100 % INSPN. BY MFG SEC	□	STORAGE	△

APPROVAL			SECTION	FMS
SIGNATURE & DATE			NO. OF SHEETS	1
PREPARED BY	MFG.	QC	SHEET NO.	1
APPROVED BY				
AUTHORISED FOR ISSUE		22/10/96	ENGINE FACTORY, AVADI, MADRAS-54	

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY.
DRAWING No : SB 20-06-01/02-5
MATL. SPECIFICATION : ALUMINIUM CASTING AA9 - GOST 2685-75

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
010	DRAWAL OF ITEMS DRAW THE ITEMS INDICATED IN THE LIST FROM STORES.					
020	DRESSING	-	BENCH			
030	LOADING ON PALLET	-	FMS L/U-LOAD STN.			
040	MACHINING I POSN.	16	FMS			
050	UNLOADING OF CYL. HEAD		FMS L/U-LOAD STN.			
060	DRESSING		BENCH			
070	LOADING ON PALLET		FMS L/U-LOAD STN.			
080	MACHINING II POSN.	17 TO 21	FMS			

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
SIGN	SIGN	SIGN	
DATE 18/10/96	DATE 22/10/96	DATE 22-X-96	22/10/96
CM-I /PDO	/PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

SHT. No 1 OF 63

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY.
DRAWING No : .....
MATL. SPECIFICATION : .....

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
090	UNLOADING OF CYL. HEAD	—	FMS L/U-LOAD STN			
100	DRESSING	—	BENCH			
110	LOADING ON PALLET	—	FMS L/U-LOAD STN.			
120	MACHINING III POSN.	22 TO 25	FMS			
130	UNLOADING OF CYL. HEAD	—	FMS L/U-LOAD STN.			
140	DRESSING	—	BENCH			
150	LOADING ON PALLET	—	FMS L/U-LOAD STN.			
160	MACHINING IV POSN.	26 TO 28	FMS			

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ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY.
DRAWING No :
MATL. SPECIFICATION :

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
170	UNLOADING OF CYL. HEAD	—	FMS L/U-LOAD STN.			
180	DRESSING	—	BENCH			
190	LOADING ON PALLET	—	FMS L/U-LOAD STN.			
200	MACHINING $\bar{V}$ POSN.	29 & 30	FMS			
210	UNLOADING OF CYL. HEAD	—	FMS L/U-LOAD STN			
220	DRESSING	—	BENCH			
230	INSPECTION	—				
240	BORING & FACING	31	HORIZONTAL BORER HMT AZ-11			

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
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DATE 18/10/96	DATE 22/10/96	DATE 23-X-96	22/10/96
CM-I /PDO	/PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

SHT. No 3 OF 63

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY.
DRAWING No :
MATL. SPECIFICATION :

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
250	DRESSING	–	BENCH			
260	FITTING	32	BENCH			
270	PRESSURE TESTING	33	BENCH			
280	INSPECTION	–				
290	PRESSING	34	HYDRAULIC PRESS			
300	FITTING	35	BENCH			
310	INSPECTION	–				
320	LOADING ON PALLET	–	FMS L/U-LOAD STN.			

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
SIGN	SIGN	SIGN	
DATE 18/10/96	DATE 22/10/96	DATE 22-X-96	22/10/96
CM-I /PDO	DF /PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

SHT. No 4 OF 63

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY.
DRAWING No :
MATL. SPECIFICATION :

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
330	MACHINING VI POSN.	36	FMS			
340	UNLOADING OF CYL. HEAD	—	FMS L/U-LOAD STN.			
350	DRESSING	—	BENCH			
360	INSPECTION	—				
370	FITTING	37	BENCH			
380	INSPECTION.	—				
390	LOADING ON PALLET	—	FMS L/U-LOAD STN.			
400	MACHINING VII POSN.	38 TO 40	FMS			

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
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DATE 18/10/96	DATE 22/10/96	DATE 22-10-96	22/10/96
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PDO REF	ISSUE	DATE	SIGN

SHT. No 5 OF 63

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY.
DRAWING No : .....
MATL. SPECIFICATION : .....

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
410	UNLOADING OF CYL. HEAD	–	FMS L/U-LOAD STN.			
420	DRESSING	–				
430	LOADING ON PALLET	–	FMS L/U-LOAD STN.			
440	MACHINING OF VIII POSN.	41	FMS			
450	UNLOADING OF CYL. HEAD	–	FMS L/U-LOAD STN.			
460	DRESSING	–	BENCH			
470	INSPECTION	–				
480	DRILLING	42	BENCH			

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DATE 18/10/96	DATE 22/10/96	DATE 22.X-96	22/10/96
EM-I /PDO	AM /PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

SHT. No 6 OF 63

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY.
DRAWING No :
MATL. SPECIFICATION :

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
490	VALVE SEAT GENERATION	43 & 44	SPM - BFW			
500	INSPECTION	—				
510	FITTING	45 & 46	BENCH			
520	PRESSURE TESTING	47	BENCH			
530	CAULKING OF VALVE SEATS	48	BENCH			
540	FITTING OF STUDS	49	BENCH			
550	FITTING	50	BENCH			
560	FITTING OF CALIBRATED WASHERS	51 TO 53	BENCH			

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DATE 18/10/96	DATE 22/10/96	DATE 22.10.96	22/10/96
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PDO REF	ISSUE	DATE	SIGN

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ENGINE FACTORY AVADI

FORM No :EFA/P--038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY
DRAWING No :
MATL. SPECIFICATION :

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
570	INSPECTION	-				
580	FINE BORING	54 TO 56	FINE BORER SPM HMT Y3249			
590	DRESSING	57	BENCH			
600	INSPECTION	-	CMM/ BENCH			
610	PRESSURE TESTING	58	BENCH			
620	CAULKING	59	BENCH			
630	FITTING	60	BENCH			
640	FITTING	61	BENCH			

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
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DATE 18/10/96	DATE 22/10/96	DATE 22-X-96	22/10/96
EM-I /PDO	AFM/PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

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ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER HEAD UTD-20 RH, LH & ASSLY.
DRAWING No : SB 20-06-01/02-5
MATL. SPECIFICATION : .....

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
650	DRESSING	62 & 63	BENCH			
660	WASHING	—	WASHING PLANT			
670	FINAL INSPECTION	—	BENCH			

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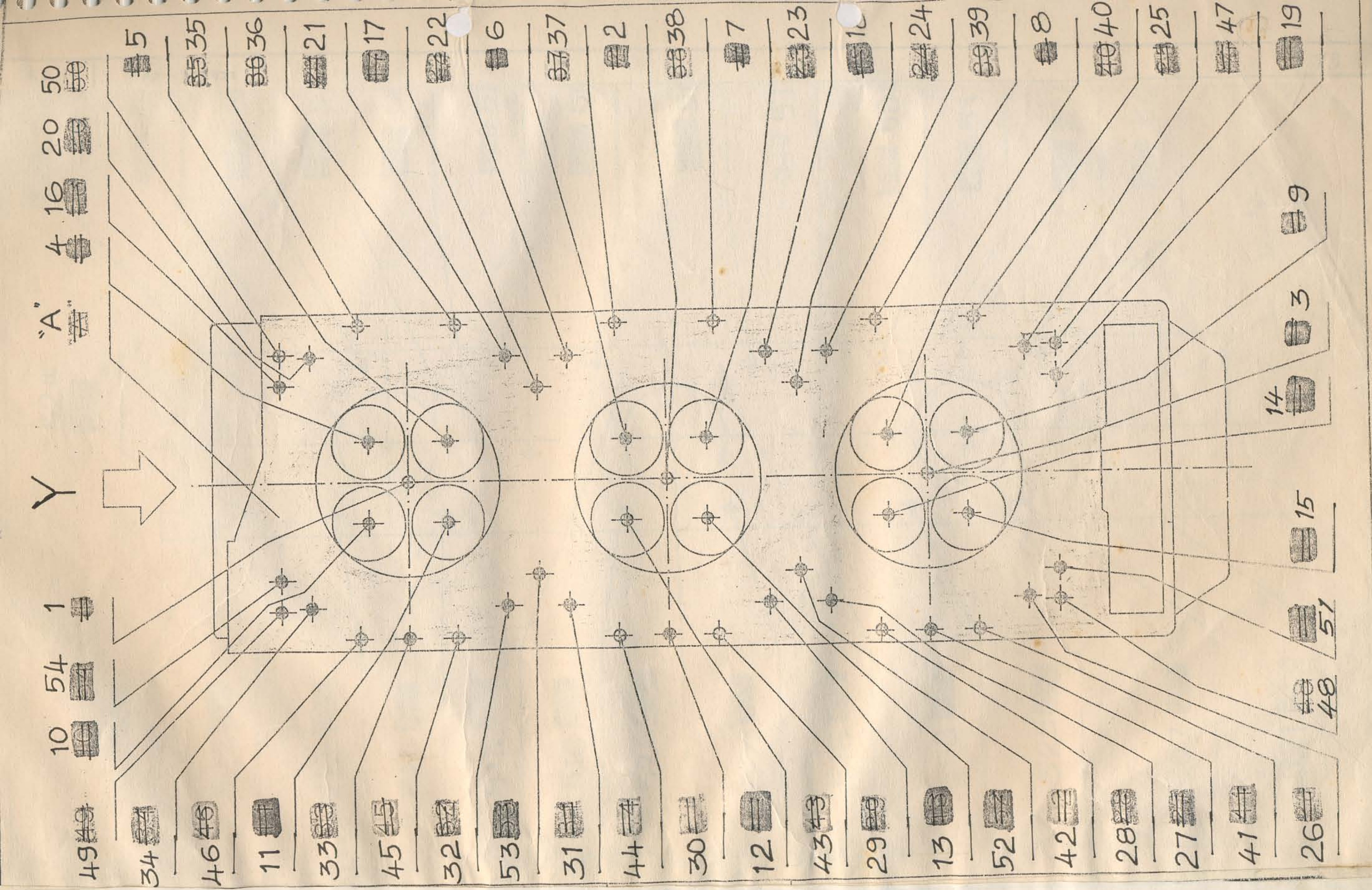
PLANNING SHEET - DETAILS OF PARTS TO BE DRAWN FROM STORES

ENGINE : UTD-20 ASSY. Nº SB20-06-01-5 SB20-06-02-5 DESCRIPTION : CYLINDER HEAD ASSY- RH/LH

SL.No	PART Nº	NOMENCLATURE	QTY	OPN.Nº.
1	SB20-06-03-1	THRUST BEARING	1	560
2	SB 20-06-04	BEARING	3	560
3	20-06-16-5	CYLINDER HEAD RH	1	030
4	20-06-34-5	—DO— LH	1	030
5	20-06-17-1	GUIDE BUSHING	12	370
6	20-06-24	SCREEN	3	550
7	20-06-56-1	UNION	1	510
8	20-06-68-5	BUSHING	1	300
9	20-06-152	COUPLING STUD	12	630
10	20-50-08	STUD M10X110	2	540
11	20-50-17	STUD M8X50	6	640
12	20-50-25	STUD M10X42	14	540
13	20-53-19	LOCK WASHER	2	560
14	20-55-10 E	PACKING RING	3	260
15	20-55-23	—Do—	2	510,
16	306-19-2	STARTING VALVE BUSHING	3	260
17	306-22-1	INLET VALVE SEAT	6	290
18	306-23-1	EXHAUST VALVE SEAT	6	290

SL.Nº	PART Nº.	NOMENCLATURE	QTY	OPN.Nº.
19	306-25	PLUG	8	300,510
20	350-41-1	STUD M9X38	12	540
21	351-08	NUT M9	12	560
22	351-50	NUT M10	4	560
23	352-22	LOCK PIN 4C$_3$X18	8	560
24	353-15	LOCK WASHER 11	2	560
25	353-21	LOCK WASHER 9	12	560
26	20-55-25	PACKING RING	8	300,510
27	550-103	STUD M6X32	20	640
28	550-106	STUD-M6X21	2	540
29	550-111	STUD M8X30	14	540



CYLINDER HEAD RH/LH SKETCH-'A' 18/10

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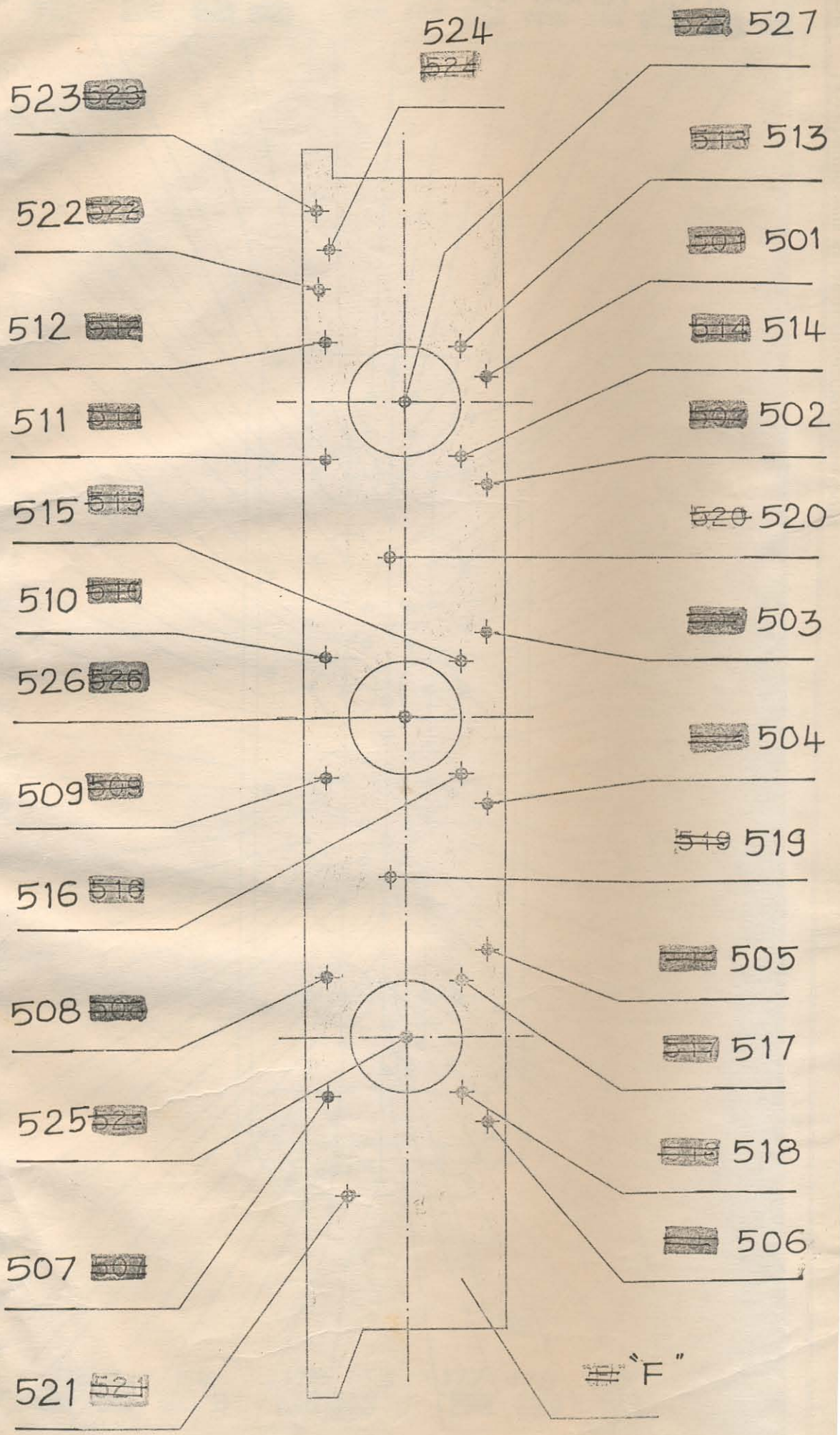
CYLINDER HEAD RH/LH SKETCH 'B'

18/10/96



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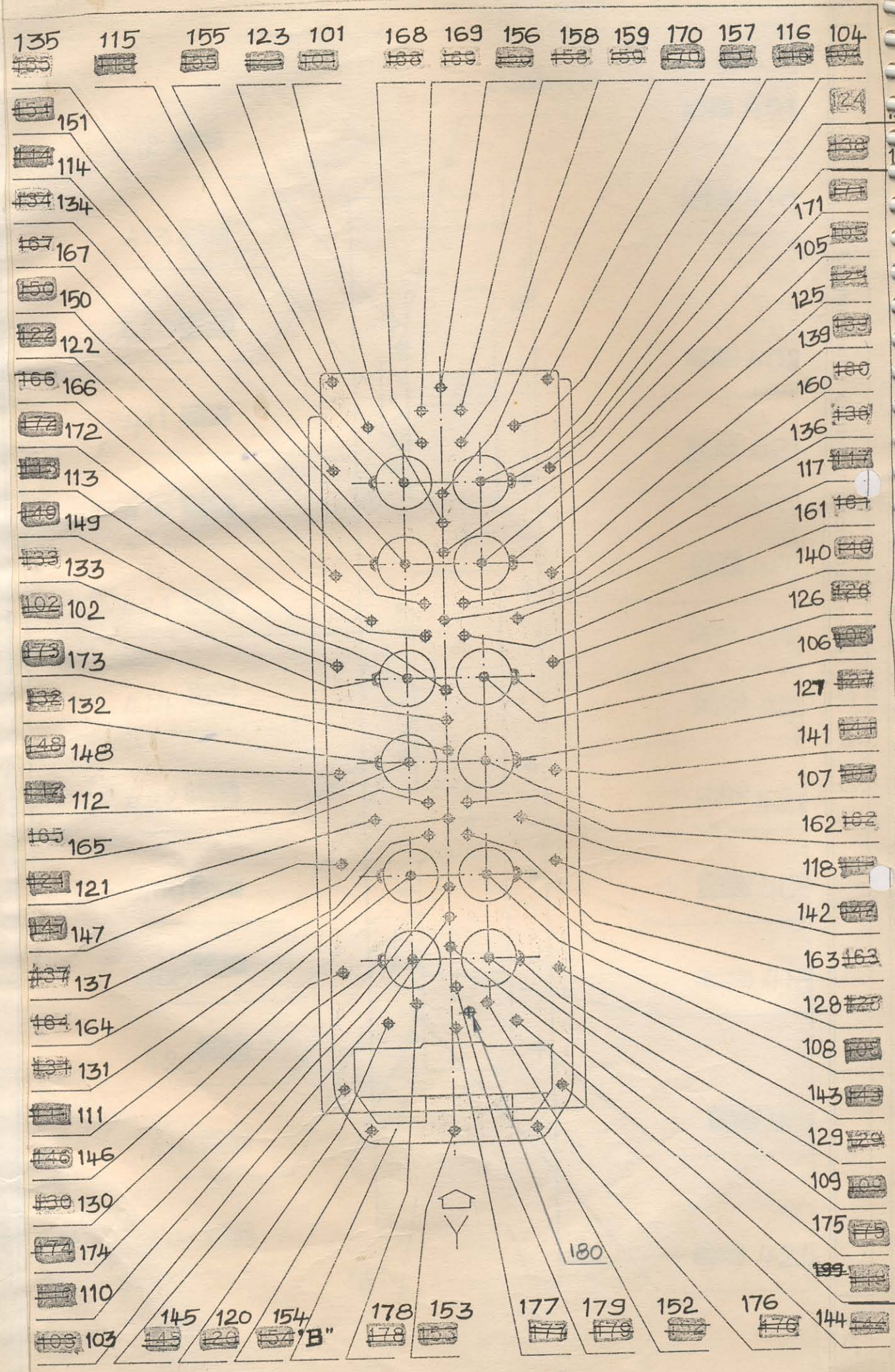
CYLINDER HEAD RH/LH SKETCH-'C'



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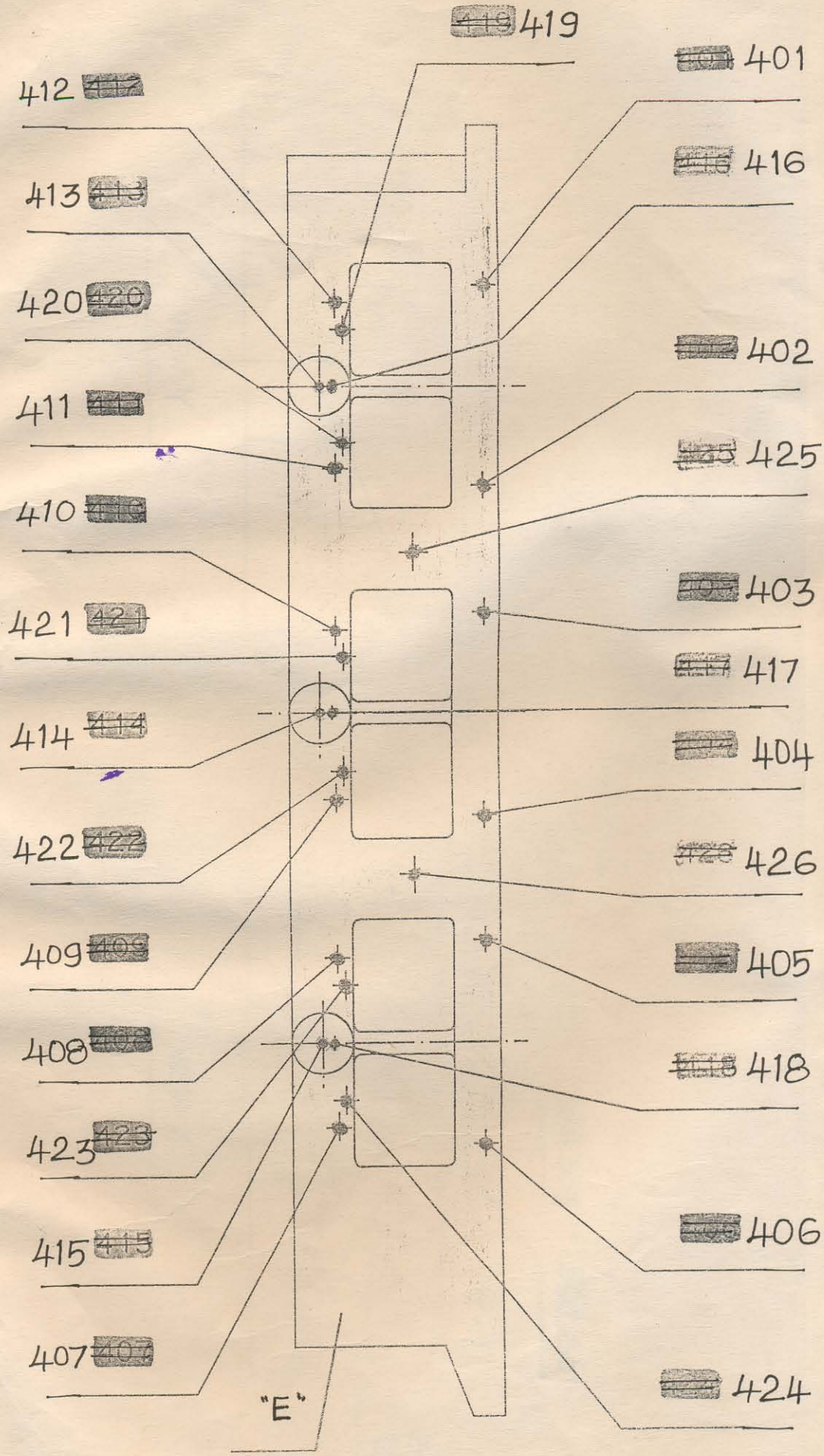
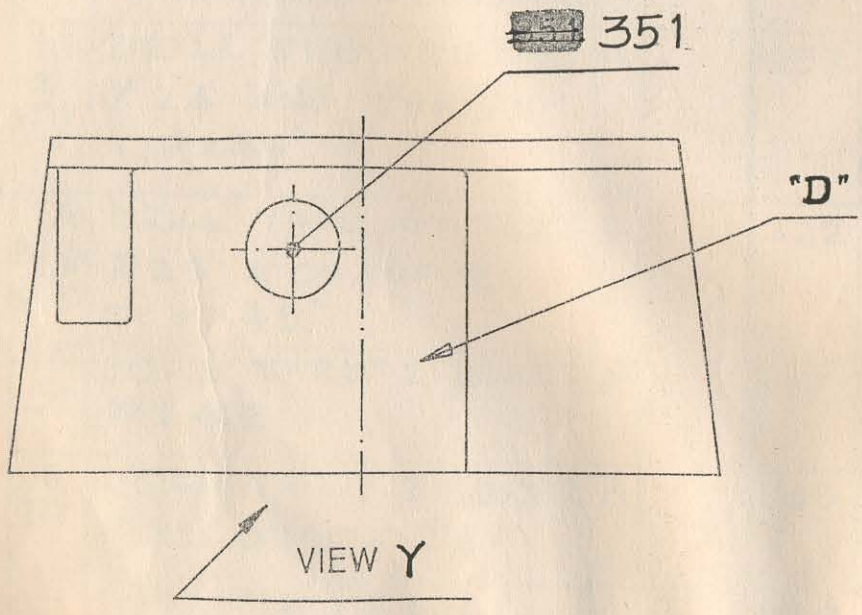
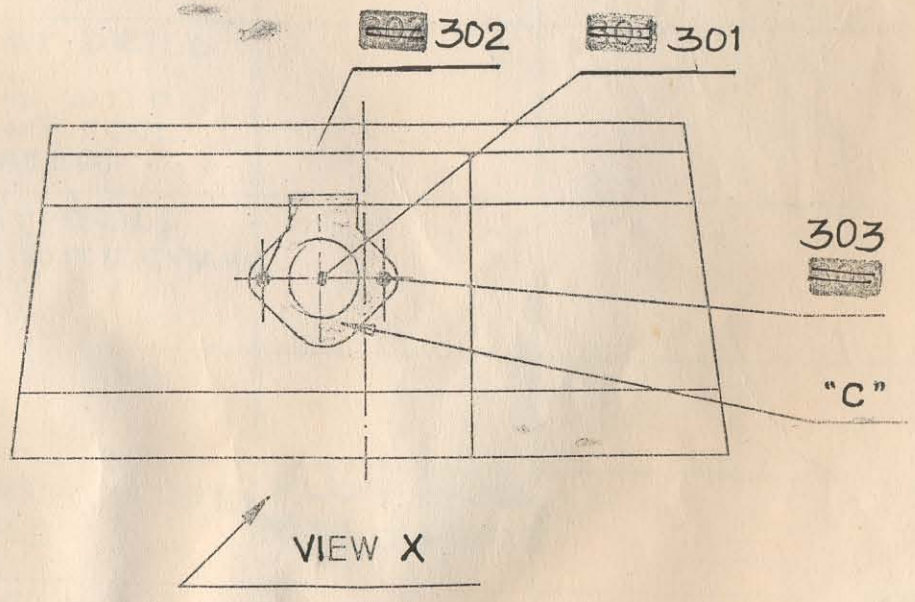
CYLINDER HEAD RH/LH SKETCH-D

SHT. NO: 14







CYLINDER HEAD RH/LH SKETCH-'E'

SHT·NO: 15

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH PROGRAM Nº 1020 & 1021 POSITION : 1
DRAWING Nº : 20-06-16-5 RH 20-06-34-5 LH PALLET : 20 RH 21 LH
FMS M/C : 3

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
040/1	A	–	ROUGH MILL BOTTOM FACE LEAVING 1.0 MACHINING ALLOWANCE	A		019	FACE MILL ϕ250		
040/2	–	16 & 51	DRILL THRU 2HOLES ϕ24 AND CHAMFER 1.5×45°	A		257	TWIST DRILL ϕ24 WITH CHAMF. TOOL (BRAZED)		
040/3	–	17,18 52 & 53	DRILL THRU 4HOLES ϕ25 & CHAMFER 0.5×45°	A		222	TWIST DRILL ϕ25 WITH CHAMF. TOOL.		
040/4	–	16 51	BORE THRU' 2 BORES ϕ24.5	A		107	BORING BAR ϕ24.5		
040/5	–	16 51	REAM THRU 2 BORER ϕ25.0 +0.023	A		505	REAMER ϕ25 H7 +0.023	PLUG GAUGE ϕ25.0 +0.023	
040/6	A	–	SEMI-FINISH MILL FACE 'A' LEAVING MACHINING ALLOWANCE OF 0.5 mm SURFACE FINISH Ra1.6 FLATNESS 0.05 mm	A		010	FACE MILL ϕ250		

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PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH PROGRAM

DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH Nº 1020 & 1021

POSITION : 2
PALLET : 20 RH
21 LH
FMS M/C : 3

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
080/1	B	–	ROUGH MILL TOP FACE LEAVING 1 mm MACHINING ALLOWANCE	C		019	FACE MILL ϕ250		
080/2	C	–	SEMI-FINISH MILL END FACE OF PAD TO DIMN 81	E		019	FACE MILL ϕ250		
080/3	–	116 120	DRILL THRU' 2 HOLES ϕ24 AND CHAMFER 1.5 X 45°	C		257	TWIST DRILL ϕ24 WITH CHAMF. TOOL (BRAZED)		
080/4	–	101 To 103	DRILL 3 HOLES ϕ25.3 X 83 DEEP AND CHAMFER TO ϕ 27X45°	C		224	TWIST DRILL ϕ 25.3 / ϕ27 (CHAMF)		
080/5	–	101 To 103	DRILL THRU' 3 HOLES ϕ14.25	C		225	TWIST DRILL ϕ14.25		
080/6	–	104 To 115	DRILL THRU' 12 HOLES ϕ23	C		240	TWIST DRILL ϕ23		
080/7	–	104 To 115	C/BORE 12 HOLES ϕ 48 X 8 +0.5/-0.2 DEEP	C		034	END MILL ϕ48		
080/18	–	117 To 119 121 To 123	CHAMFER 6 HOLES 0.5 X 45°	C		142	CHAMFERING TOOL ϕ24		

PREPARED	CHECKED	APPROVED	[illegible]	PATE REF	ISSUE	DATE

SHT. 17 OF 63

FORM No: EFA/P-039

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH
PROGRAM Nº 1020 & 1021
POSITION : 2
PALLET : 20 RH 21 LH
DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH
FMS M/C Nº.3

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
080/19	–	301	BORE THRU' ONE BORE TO ⌀41.5 AND CHAMFER TO ⌀45.5 X 30°	E		046	END MILL ⌀41.5 WITH CHAMFER 30°		
080/20	–	301	DRILL THRU' ONE HOLE ⌀31 & C/BORE ⌀36 MAINTAINING DIMN. 91	E		242	TWIST DRILL ⌀31/⌀36.		
080/21	–	301	C/BORE ⌀31.43 THRU & C/BORE ⌀36.8 MAINTAINING DIMN. 91	E		416	C/BORING CUTTER ⌀31.43/36.8		
080/22	–	136 137	BORE THRU 2 BORES ⌀31.43 & C/BORE ⌀36.8 X 4.0 DEEP	C		416	C/BORING CUTTER ⌀31.43/36.8		
080/23	–	351	BORE THRU 1 BORE ⌀31.43 & C/BORE ⌀36.8 X 4.5 +0.48 DEEP	E		416	— DO —		
080/24	–	176 To 179	DRILL 4 HOLES ⌀8.35 X 24 +1.5 DEEP & CHAMFER TO ⌀10 X 45°	C		245	TWIST DRILL ⌀8.35/⌀12		
080/25		124 To 135	MILL 6 POCKETS 6X9 TO 8.5 +1 DEEP. NOTE: PROJECTION OF MILLED SURFACE BEYOND C/BORE FACE IS NOT ALLOWED	C		044	END MILL ⌀6		

PREPARED	CHECKED	APPROVED		PATTERN REF	ISSUE	DATE	SHT. 18
PBN							

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH

DRAWING Nº : 20-06-16-5/20-06-34-5

PROGRAM NO :- 1020 & 1021

POSITION : 2
PALLET : 20 RH
21 LH
FMS M/C : 3

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
080/26	–	176 to 179	TAP 4 HOLE M10X1·5To X 20 MIN. DEEP	C		605	TAP M10X1·5To	SCREW PLUG GAUGE 203285	
080/27	–	170 TO 175	DRILL 6 HOLES ϕ6.63 X 24 +1 DEEP & CHAMFER ϕ8 X 45°	C		217	TWIST DRILL ϕ6.63/ϕ10		
080/28	–	302 303	DRILL 2 HOLES ϕ6.63 X 18 DEEP & CHAMF. ϕ8X45°	E		217	—Do—		
080/29	–	302 303	TAP 2 HOLES M8 TO X 15 DEEP	E		632	TAP M8 To	SCREW PLUG GAUGE 203283	
080/30	–	170 To 175	TAP 6 HOLES M8 TO X 20 MIN. DEEP.	C		632	TAP M8 To	—Do—	
080/31	–	136 137	TAP 2 HOLES M33X1·5-5H6H THRU	C		606	TAP M33X1·5-5H6H	SCREW PLUG GAUGE FOR M33X1·5-5H6H	
080/32	–	351	TAP 1 HOLE THRU M33X1.5-5H6H *	E		606	TAP M33X1.5-5H6H	SCREW PLUG GAUGE FOR M33X1.5-5H6H	* TECH. REQT: C/BORE FACE IS TO BE ⊥ W.R.T THREAD PITCH DIA. WITHIN 0.05 UPTO ϕ36
080/33	–	301	TAP ONE HOLE M33X1.5-5H6H X 88.0 + 0.87 DEEP. TECH. REQT: C/BORE FACE IS TO BE SQUARE W.R.T THREAD PITCH ϕ WITHIN 0.05 MM UPTO ϕ 36.	E		606	—Do—	—Do—	

PREPARED	CHECKED	APPROVED		PRTG REF	ISSUE	DATE	
							SHT. 19

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH

PROGRAM NO : 1020 & 1021

POSITION : 2
PALLET : 20-RH
21-LH

DRAWING Nº : 20-06-16-5 / 20-06-34-5

FMSM/C : 3

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
080/34	–	301	C/BORE FACE ϕ68 +0.74 x 1.5 ±0.5 DEEP TR: ⊥ OF C/BORE FACE W.R.T BORE ϕ38 IS TO BE WITHIN 0.020	E		121	BORING BAR ϕ68	GAUGE TO CHECK ⊥	
080/35	–	301	C/BORE ϕ 38.0 +0.027 X 88 DEEP. TECH. REQT: NON-SQUARENESS OF FACE 'C' W.R.T. BORE ϕ38 SHOULD NOT EXCEED 0.1 mm.	E		511	REAMER ϕ38.0 +0.027	PLUG GAUGE ϕ38.0 +0.027	
080/36	–	158 TO 169	DRILL 12 HOLES ϕ7.63 X 24.75 DEEP AND CHAMFER TO ϕ9X45°	C		264	TWIST DRILL ϕ7.63/ϕ9		
080/37	–	158 TO 169	TAP 12 HOLES M9X1.25TO X 20 MIN. DEEP.	C		608	TAP M9X1.25TO	SCREW PLUG GAUGE 203284	
080/38	–	138 To 157	DRILL 14 HOLES (138 TO 151) ϕ4.9 X 16 DEEP. & 6 HOLES (152 TO 157) THRU' AND CHAMFER 6 X 45°	C		203	TWIST DRILL ϕ4.9/9		

PREPARED	CHECKED	APPROVED		P&TC REF	ISSUE	DATE		SHT. 20
P&N								

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH

DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH

PROGRAM NO : 1020 & 1021

POSITION : 2
PALLET : 20 RH
21 LH
FMS M/C : 3

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
080/39	–	138 TO 157	TAP 6 HOLES (152 TO 157) THRU' AND 14 HOLES (138 – 151) 13 DEEP – M6To	C		631	TAP M6To	SCREW PLUG GAUGE M6To 203282	
080/40	–	116 120	BORE THRU' 2 HOLES ϕ 24.5	C		107	BORING BAR ϕ24.5		
080/41	–	116 120	REAM THRU' 2 HOLES ϕ25.0 +0.023	C		505	REAMER ϕ25H7 +0.023	PLUG GAUGE ϕ25.0 +0.023	
080/42	B	–	SEMI-FINISH MILL TOP FACE LEAVING 0.5 MACHINING ALLOWANCE FLATNESS 0.05 SURFACE FINISH Ra 1.6	C		019	FACE MILL ϕ250		
080/43	C	–	FINISH MILL END FACE PAD TO DIMN. 80.5 Ra 5.	C		018	FACE MILL ϕ250		

PREPARED	CHECKED	APPROVED		P&TC REF	ISSUE	DATE		SHT. 21

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH
PROGRAM NO ÷ 1020 X1021
POSITION : 3
PALLET : 20 RH / 21 LH
FMSM/C : 3

DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
120/1	–	19 54	CHAMFER BORE TO 0.5 X 45°	A		142	BORING BAR ϕ24 WITH CHAMFERING TIP		
120/2	–	35 TO 46	DRILL 12 HOLES ϕ8.35 X 26 ±1 DEEP AND CHAMFER TO ϕ10 X 90°	A		245	TWIST DRILL ϕ8.35/12		
120/3	–	1 TO 3	C/BORE TO ϕ145 AT 3 PLACES TO 5 ±0.1 DEEP. Ra 1.6 TECH. REQT. : ALIGNMENT OF COMBUSTION CHAMBERS W.R.T COMMON VERTICAL PLANE IS TO BE WITHIN 0.1 mm.	A		021	END MILL ϕ60		
120/4	–	1 TO 3	C/BORE ϕ158.5 X 4.2 ±0.2 DEEP. Ra 2.5 TECH. REQT : AS ABOVE	A		108	BORING BAR ϕ158.5		
120/5	–	4 TO 9	BORE 6 BORES ϕ48 +0.62 THRU.	A		145	BORING BAR ϕ24.2/ϕ48/ϕ52		
120/6	–	4 TO 9	BORE THRU' 6 BORES TO ϕ23.5. C/BORE ϕ54.9 & ϕ63.5 TO DIMN. 21.0 +0.25/−0.1 & 8.5 +0.25/−0.1	A		146	BORING BAR ϕ23.5/ϕ54.9/ϕ63.5		

PREPARED	CHECKED	APPROVED	AUT	P&TC REF	ISSUE	DATE
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SHT. 22

COMPONENT : UTD-20 CYLINDER HEAD RH/LH

DRAWING Nº : 20-00-14-5 RH / 20-00-34-5 LH

PROGRAM NO ÷ 1020 & 1021

POSITION : 3

PALLET : 20 RH 21 LH

FMS M/C : 3

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
120/7	–	10 TO 15	BORE 6 BORES ϕ45 +0.62 THRU'	A		144	BORING BAR ϕ24.2/ϕ45/ϕ48		
120/8	–	10 TO 15	BORE THRU' 6 BORES ϕ23.5. C/BORE ϕ50.5 & ϕ59.5 TO DIMN. 21 +0.25/−0.1 & 8.0 +0.25/−0.1	A		117	BORING BAR ϕ23.5/ϕ50.5/ ϕ59.5		
120/9	–	20 TO 34	FORM CENTRE TO ϕ14 ×90° FOR 15 HOLES	A		212	TWIST DRILL ϕ16×90°		
120/10	–	20 TO 25 27, 30 & 33	DRILL THRU 9 HOLES ϕ8	A		258	TWIST DRILL ϕ8		
120/11	–	26, 28, 29, 31, 32 34	DRILL THRU 6 HOLES ϕ7	A		234	TWIST DRILL ϕ7		
120/12	–	20 TO 34	C/BORE ϕ12 +0.43× 5.0 +0.5 DEEP IN 15 HOLES.	A		411	C/BORING TOOL ϕ12		
120/13	–	50	DRILL ONE HOLE ϕ16 ×55.5 DEEP			246	TWIST DRILL ϕ16		

PREPARED	CHECKED	APPROVED		DWG REF	ISSUE	DATE		SHT. 23

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH
PROGRAM NO ÷ 1020 & 1021
POSITION : 3
PALLET : 20 RH
21 LH
FMS M/C 3

DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
120/14	–	50	C/BORE ϕ19.5 +0.28 ×5 ±0.5 DEEP AND CHAMFER 0.5×45°	A		410	C/BORING TOOL ϕ19.5 WITH CHAMF. TIP.		
120/15	–	35 TO 46	TAP 12 HOLES M10X1.5 TO × 26 +1 DEEP	A		605	TAP M10X1.5 TO	SCREW PLUG GAUGE 203285	
120/16	–	4 TO 9	REAM THRU 6 BORES ϕ24.0 +0.023 AND FORM TAPER 1:5 WITH ϕ55.4 +0.03 WITH R0.5 TO 20.5 +0.25/-0.1 DEEP. TECH. REQT.: ① TAPER OF VALVE SEAT IS TO BE CHECKED BY BLUEING. THE IMPRINT SHOULD BE UNIFORM AND COVER 80% OF TAPER SURFACE. ② SQUARENESS OF ϕ24 HOLE TO BOTTOM FACE 'A' IS TO BE WITHIN 0.03 MM IN LONGITUDINAL DIRECTION & 0.08 MM IN TRANSVERSE DIRECTION OVER 100 MM HEIGHT.	A		512 534	REAMER ϕ24 & ϕ55.4 WITH 1:5 TAPER REAMER ϕ24H7	TAPER PLUG GAUGE 203297 SPECIAL GAUGE 203299 GAUGE TO CHECK ⊥	

PREPARED	CHECKED	APPROVED	AUTHORISED	DATE REF	ISSUE	DATE

SHT. 24

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH

PROGRAM NO ÷ 1020 & 1021

POSITION : 3

DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH

PALLET : 20 RH

FMS M/C : 3 21 LH

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
120/17		10 To 15	REAM THRU' 6 BORES ϕ24.0 +0.023 AND REAM TAPER 1:5 WITH ϕ51.4 +0.03 WITH R0.5 TO 20.5 +0.25/−0.1 DEEP. TECH. REQTS: THE SAME AS GIVEN IN OPN. Nº 130/16	A		506	REAMER ϕ24 & ϕ51.4 WITH 1:5 TAPER	TAPER PLUG GAUGE 203296	
						534	REAMER ϕ24 H7	SPECIAL GAUGE 203298	

PREPARED	CHECKED	APPROVED	P&TC REF	ISSUE	DATE

SHT. 25

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH

DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH

PROGRAM NO : 1020 & 1021 FMS / M/C : 3

POSITION : 4
PALLET : 20 RH
21 LH

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
160/1	F	–	ROUGH & SEMI-FINISH MILL EXHAUST FACE LEAVING 0.5 MACHINING ALLOWANCE	B		019	FACE MILL ϕ250		
160/2	–	521	DRILL ONE HOLE ϕ25.3 X 21 DEEP	B		224	TWIST DRILL ϕ25.3/ϕ27		
160/3	–	521	ENLARGE ONE HOLE TO ϕ30 x21 DEEP.	B		035	END MILL ϕ30/ϕ43		
160/4	–	521	C/BORE ϕ31.43 x 21 DEEP & ϕ33.7 x 3.2 +0.5 DEEP.	B		414	C/BORING CUTTER ϕ31.43/ϕ33.7		
160/5	–	519 520	BORE THRU 2 HOLES ϕ31.43 AND C/BORE ϕ36.8 X 4.0 +0.75 DEEP.	B		414	C/BORING CUTTER ϕ31.43/ϕ36.8		
160/6	–	524	DRILL ONE HOLE ϕ10X 20 DEEP & C/BORE ϕ12.2X 8.5 ±0.2 DEEP. CHAMFER 0.5X45° IN ϕ10	B		243	TWIST DRILL ϕ10/ϕ12.2		
160/6	–	524	C/BORE ϕ23 x 2.3 +0.25 DEEP	B		036	END MILL ϕ23		
160/7	–	525 To 527	BORE 3 BORES TO ϕ67.5 WITH R1.5 X 12 +1 DEEP. CHAMFER 1.5 –0.5 X 30°			116	BORING BAR ϕ67.5 WITH CHAMF. TIP		

PREPARED	CHECKED	APPROVED	AUTHD	PATT REF	ISSUE	DATE

SHT. 26

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH
DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH
PROGRAM NO : 1020 & 1021
POSITION : 4
PALLET : 20 RH 21 LH
FMS M/C : 3

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
160/8	–	501 TO 511	DRILL 11 HOLES ⌀8.35 X 21 DEEP AND CHAMFER TO ⌀10 X 90°	B		244	TWIST DRILL ⌀8.35/⌀12		
160/9	–	512	DRILL 1 HOLE ⌀8.35 X 25.5 +1 DEEP AND CHAMFER TO ⌀10 X 90°	B		245	TWIST DRILL ⌀8.35/⌀12		
160/10	–	27 30 33	MAKE 3 HOLES ⌀6.0 AT 40° TO 18 +1 DEEP	A		044	END MILL ⌀6		
160/11	–	513 TO 518	DRILL THRU 6 HOLES ⌀3	B		236	END MILL ⌀3		
160/12	–	501 TO 512	TAP 12 HOLES M10X 1.5 TO X 21 MIN. DEPTH	B		605	TAP M10X1.5 TO	SCREW PLUG GAUGE 203285	
160/13	–	519 520 521	TAP 3 HOLES M33X1.5-5HGH X 18 DEEP.	B		606	TAP M33X1.5-5HGH	SCREW PLUG GAUGE FOR M33X1.5-5HGH.	
160/14	–	522 523	DRILL 2 HOLES ⌀4.9X 12 ±0.35 DEEP AND CHAMFER 1±0.5X45°	B		207	TWIST DRILL ⌀4.9/⌀9		
160/15	–	522 523	TAP 2 HOLES M6 TO X 10 DEEP	B		631	TAP M6 TO	SCREW PLUG GAUGE M6 TO 203282	
160/16	–	525 TO 527	FINISH BORE ⌀68.00 +0.06 WITH R1.5±0.5X 12 +1.0 DEEP. Ra2.5			148	BORING BAR ⌀68 +0.06	PLUG GAUGE ⌀68.0+0.06	

PREPARED	CHECKED	APPROVED		PARTS REF	ISSUE	DATE	
							SHT. 27

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH
DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH
PROGRAM NO : 1020 & 1021
FMS M/C : 3
POSITION : 4
PALLET : 20 RH, 21 LH

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
160/17	–	F	FINISH MILL EXHAUST FACE. R2 20 TECH. REQTS. 1) FLATNESS 0.2 2) DISPLACEMENT OF SURFACE RELATIVE TO ANCHOR STUD HOLES SHOULD NOT EXCEED 0.5	B		018	FACE MILL ϕ250		

PREPARED	CHECKED	APPROVED	PATTERN REF	ISSUE	DATE	SHT. 28

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH PROGRAM NO : 1020 & 1021 POSITION : 5

DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH PALLET : 20 RH

FMS M/C : 3 21 LH

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
200/1	E	–	ROUGH & SEMI-FINISH MILL INLET FACE LEAVING 0.5 MACHINING ALLOWANCE	D		019	FACE MILL ϕ250		
200/2	–	425 426	BORE THRU 2 HOLES ϕ31.43 AND C/BORE ϕ36.8 X 4.0 +0.75 DEEP	D		415	C/BORING CUTTER ϕ31.43/ϕ36.8		
200/3	–	413 TO 415	DRILL 3 HOLES ϕ22.43 X15 +0.43 DEEP. C/BORE ϕ24 X 2 +0.5 DEEP & ϕ30 X 1+0.4 DEEP	D		045	END MILL ϕ22.43/ ϕ24/ϕ30		
200/4	–	413 TO 415	TAP 3 HOLES M24X 1.5 CT TO 9 MIN. DEEP TECH.REQT : PERPENDICULARITY OF C/BORE ϕ30 FACE W.R.T THREAD AXIS IS TO BE WITHIN 0.05 mm	D		607	TAP M24X1.5CT	SCREW PLUG GAUGE 203290 GAUGE TO CHECK ⊥	
200/5	–	401 TO 412	DRILL 12 HOLES ϕ6.63 X 13.5 DEEP & CHAMFER 1X45°	D		220	TWIST DRILL ϕ6.63/ϕ9		
200/6	–	419 TO 424	DRILL 6 HOLES ϕ3 (TO OPEN OUT THREADED HOLE FROM SIDE)	D		236	TWIST DRILL ϕ3		

PREPARED	CHECKED	APPROVED		DATE REF	ISSUE	DATE

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : UTD-20 CYLINDER HEAD RH/LH PROGRAM NO : 1020 & 1021 POSITION : 5
DRAWING Nº : 20-06-16-5 RH / 20-06-34-5 LH PALLET : 20 RH
FMS M/C : 3 21 LH

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
200/7	-	401 TO 412	TAP 12 HOLES M8 TO X 12 MIN. DEEP	D		632	TAP M8 TO	SCREW PLUG GAUGE 203283	
200/8	-	425 426	TAP 2 HOLES M33X 1.5-5HGH. TECH.REQT : PERPENDICULARITY OF C/BORE ⌀36.8 FACE W.R.T THREAD AXIS IS TO BE WITHIN 0.05 mm UPTO ⌀36	D		606	TAP M33X1.5-5HGH	SCREW PLUG GAUGE FOR M33X1.5-5HGH	
200/9	E	-	FINISH MILL INLET SIDE MAINTAINING DIMN. 220 ON BOTTOM FACE AND 205.8 ON TOP FACE. R2 20. TECH.REQT: 1) FLATNESS 0.2 mm. 2) DISPLACEMENT OF SURFACE RELATIVE TO ANCHOR STUD HOLES SHOULD NOT EXCEED 0.5	D		018	FACE MILL ⌀250		

PREPARED	CHECKED	APPROVED	[illegible]	PATTERN REF	ISSUE	DATE