ENGINE FACTORY, AVADI

PROCESS SCHEDULE

DESCRIPTION :- CYL. JACKET V46-6 RH, LH & ASSY.

COMPT. No :- SB 303-06-18 & SB 303-05-6
SB 303.03.11 & SB 303.02.16 (ASSY)

MFG. SHOP :- FMS

REV. NO. 00
DATE : 22-10-96

Form No.

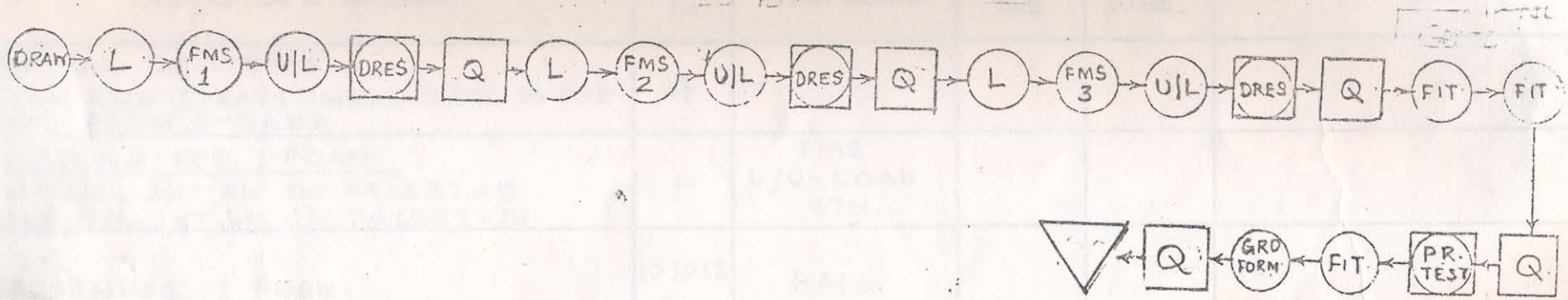
QP. DOC. NO. EFA/P-048

FLOW PROCESS CHART

STORE : CYL JACKET RH/LH

DRG NO. : SB 303-06-18
SB 303-05-06

END STORE : V-46 ENGINE



LEGEND

DRAW - DRAWAL OF ITEMS	FMS - FLEXIBLE MANUFACTURING SYSTEM
L - LOADING.	PR. TEST - PRESSURE TESTING.
U/L - UNLOADING.	GRO FORM - GROOVE FORM.
DRES - DRESSING	

TEMP. STORAGE	▽	TRANSPORTATION	⇨
OPERATION	○	INSPECTION BY QC	Q
OPERATION CUM INSPECTION	⬡	INSPECTION BY SQAE/CQA(ME) Etc.	I
100 % INSP'N. 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 JACKET V46-6 RH & LH AND ASSYS.
DRAWING No : SB 303-06-18 & SB 303-05-6
MATL. SPECIFICATION : ALUMINIUM CASTING AL 9 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	4				
020	LOADING FOR I POSN. LOAD CYL.JKT RH ON PALLET-11 LOAD CYL.JKT LH ON PALLET-18	-	FMS L/U-LOAD STN.			
030	MACHINING I POSN.	10TO12	FMS			
040	UNLOADING OF CYL.JKTS FROM PALLETS	-	FMS L/U-LOAD STN.			
050	DRESSING	-				
060	INSPECTION	-				
070	LOADING FOR II POSN LOAD CYL.JKT RH ON PALLET-11 LOAD CYL.JKT LH ON PALLET-18		FMS L/U-LOAD STN.			
080	MACHINING II POSN.	13TO15	FMS			

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
SIGN	SIGN	SIGN	
DATE	DATE 18/10/96	DATE 20.X.96	22/10/96

SHT. No 1 OF 24

ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE : CYLINDER JACKET V46-6 RH & LH AND ASSYS.
DRAWING No : SB 303-06-18 & SB 303-05-6
MATL. SPECIFICATION : .....

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
090	UNLOADING OF CYL. JKTS. FROM PALLETS	-	FMS L/U-LOAD STN			
100	DRESSING	-	BENCH			
110	INSPECTION	-				
120	LOADING FOR III POSN. LOAD CYL. JKT. RH ON PALLET - 11 LOAD CYL. JKT. LH ON PALLET - 18	-	FMS L/U-LOAD STN.			
130	MACHINING III POSN.	16T018	FMS			
140	UNLOADING OF CYL. JKTS. FROM PALLETS	-	FMS L/U-LOAD STN.			
150	DRESSING	-	BENCH			
160	INSPECTION CARRY OUT INSPECTION INCLUDING CLAMPED CONDITION CHECKS.	-				

PREPARED BY	CHECKED BY	APPROVED BY	AUTHORISED BY
SIGN [signature]	SIGN [signature]	SIGN [signature]	[signature] 22/10/96
DATE	DATE 18/10/96	DATE 20.X.96	
/PDO	AF/PDO	HOS/PDO	DO/PDO

PDO REF	ISSUE	DATE	SIGN

PLANNING SHEET - DETAILS OF PARTS TO BE DRAWN FROM STORES

ENGINE: V-46-6 ASSY. Nº SB 303-03-11 / SB 303-02-16 DESCRIPTION: CYLINDER JACKET ASSY. RH/LH

SL.Nº	PART Nº	NOMENCLATURE	QTY	OPN.Nº.
1	SB 303-06-18	CYLINDER JACKET RH	1	030
2	SB 303-05-6	CYLINDER JACKET LH	1	030
3	303-13-4	PLUG	1+1	170
4	303-40	RING	1+1	170
5	350-123	STUD M8X27	4+4	180
6	352-18-1	PIN	4+4	210

SL.Nº	PART Nº.	NOMENCLATURE	QTY	OPN.Nº.

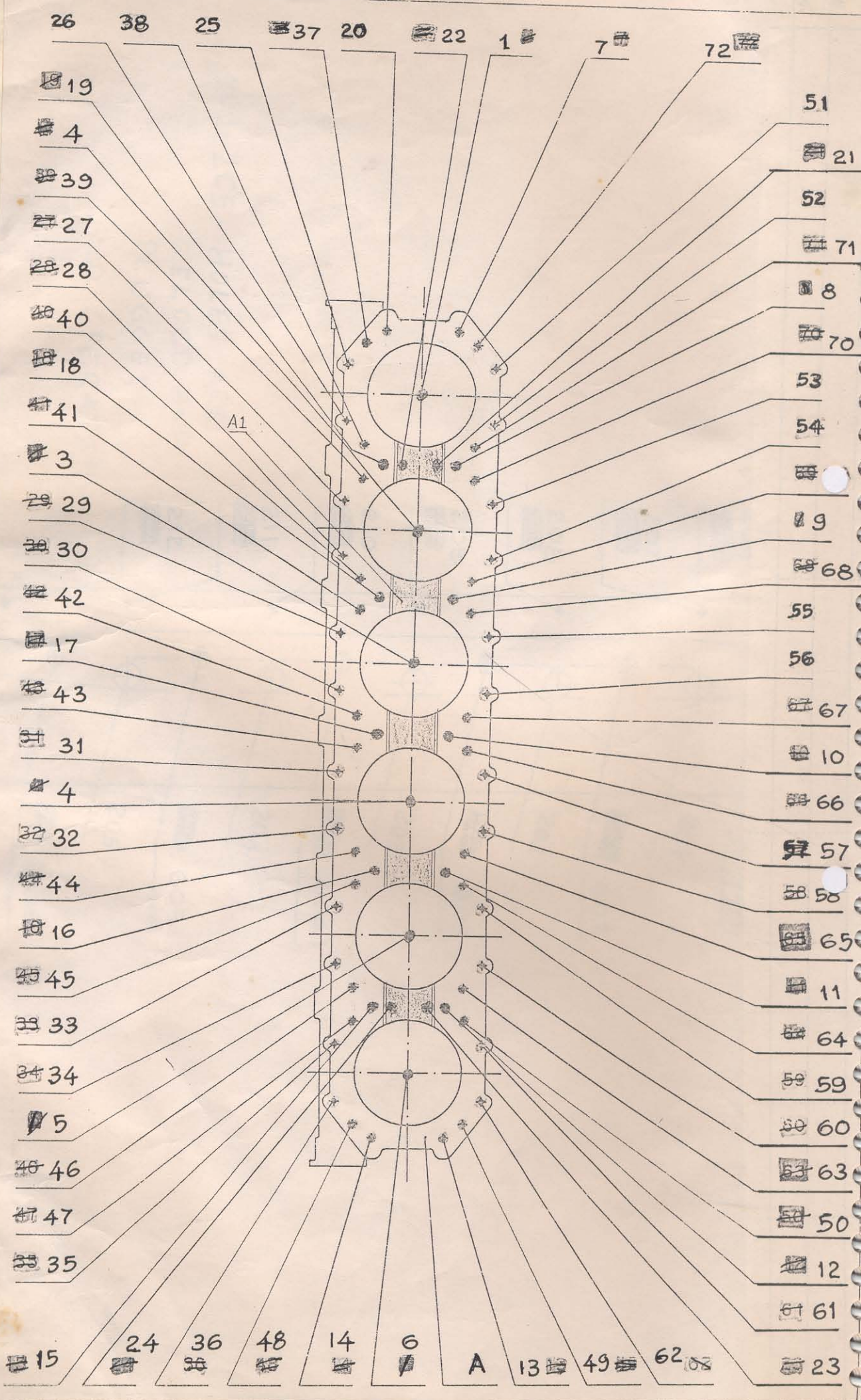
SHT. 4 OF 24

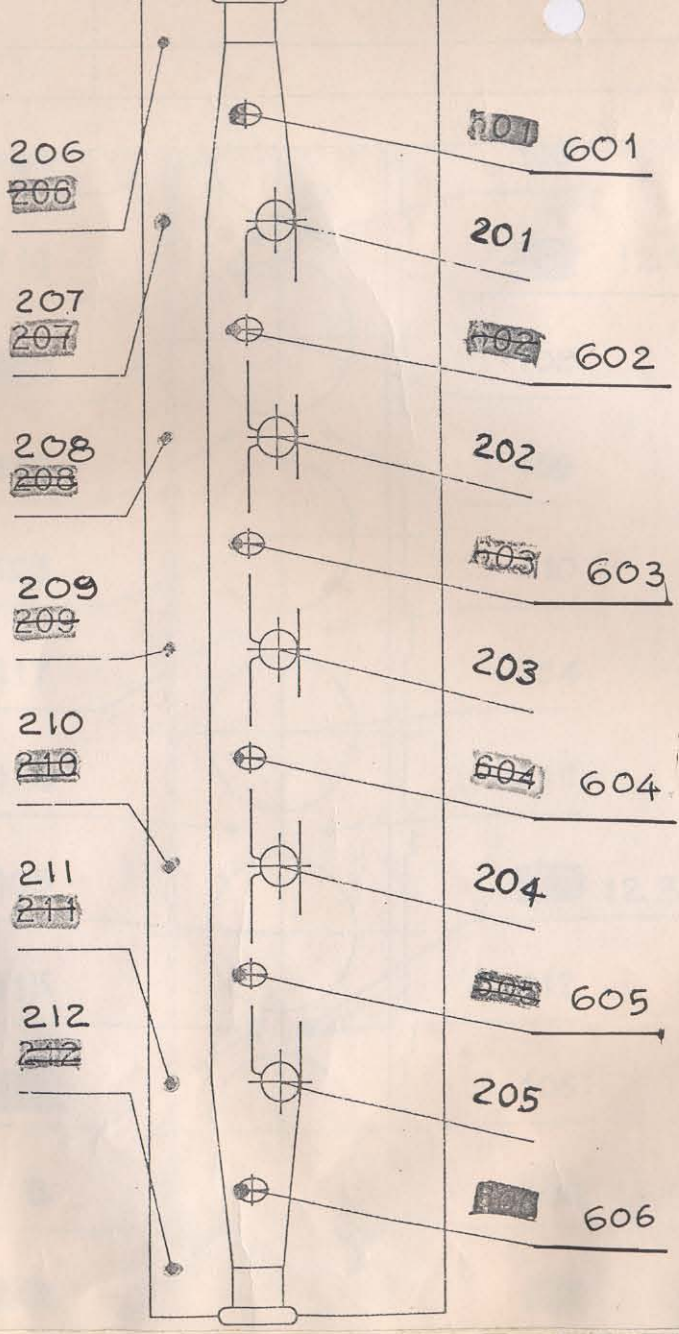
FORM No: EFA/P-039

CYLINDER JACKET RH/LH

SKETCH A

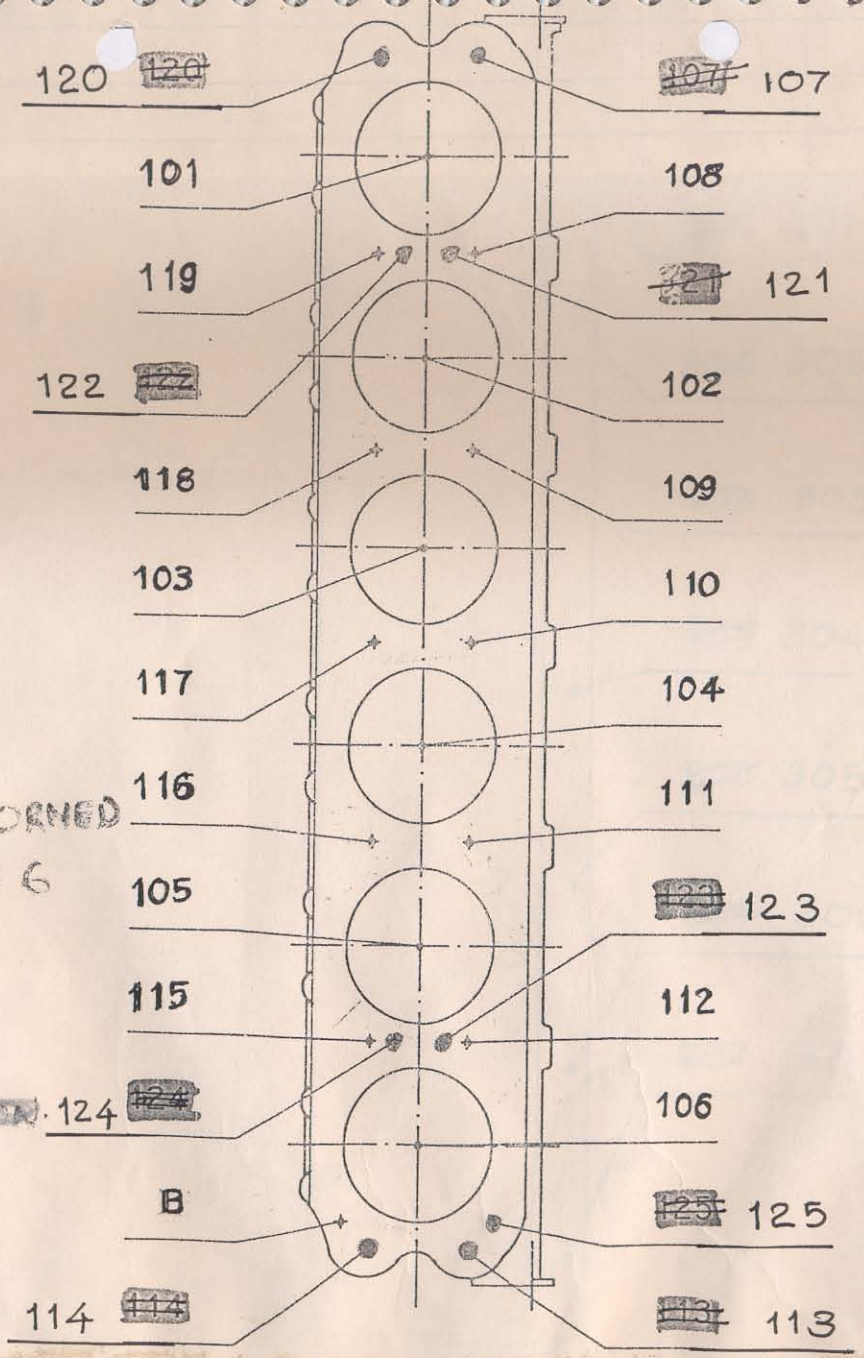
SHT. 5 OF 24





201-205 - HOLES ARE WELDED AND PLUGGED.
NO OPERATION.

CYLINDER JACKET RH/LH	SKETCH B		SHT. 6 OF 24



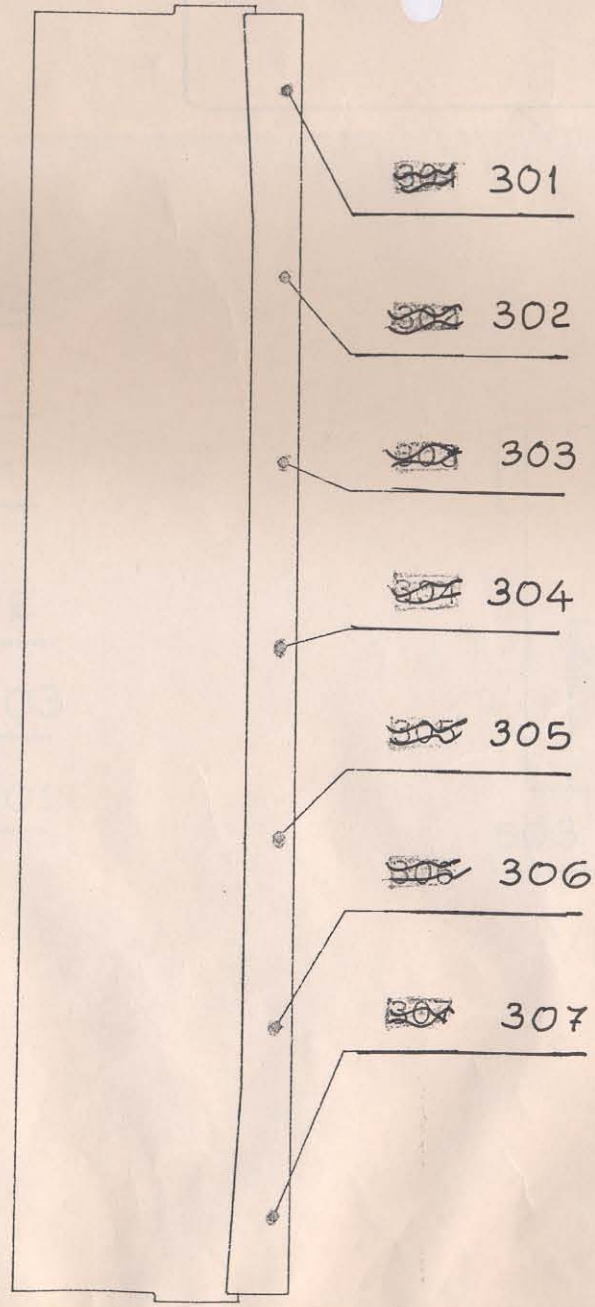
101 - 106 - OPN. PERFORMED FROM 1 TO 6

~~106 - 112~~ ~~HOLES ARE~~ ~~ALL DIA~~.

115 - 119 ~~NO CONFIGURATION~~

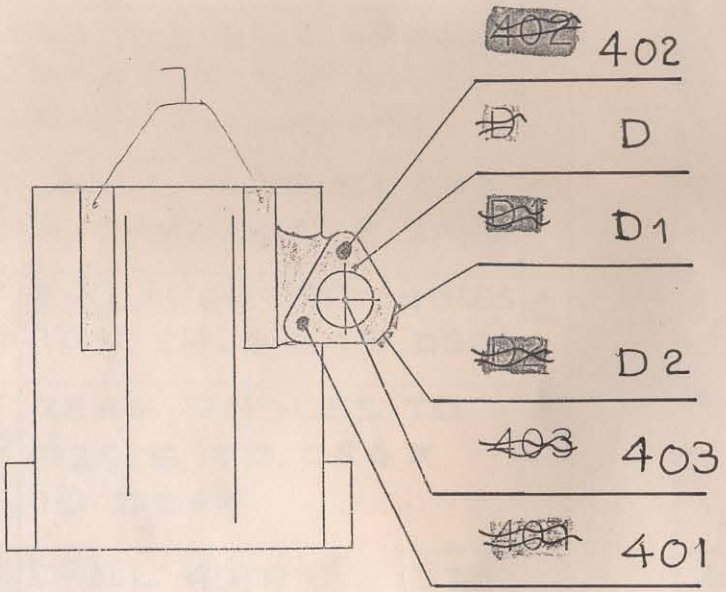
CYLINDER JACKET RH/LH	SKETCH C		SHT. 7 OF 24

FORM No: EFA/P-039

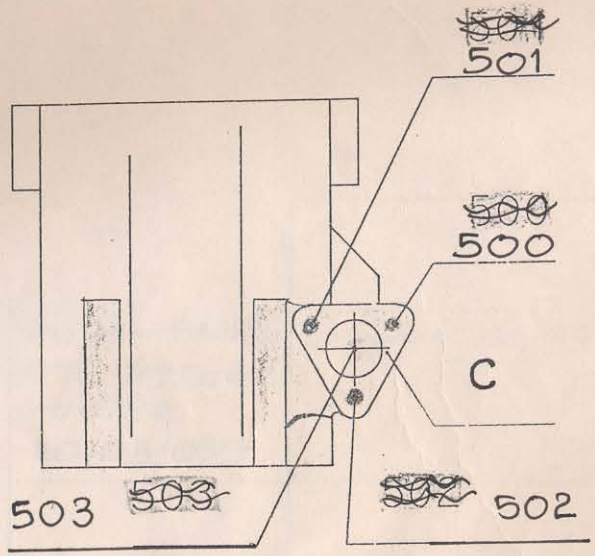


CYLINDER JACKET RH/LH	SKETCH D		SHT. 8 OF 24

FORM No: EF A/P-039



VIEW Y



VIEW X

403- HOLE AS CAST.
NO OPERATION

CYLINDER JACKET RH/LH	SKETCH E		SHT. 9 OF 24

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : Y-46-6 CYLINDER JACKET RH/LH & ASSY PROGRAM NO : POSITION : 1

DRAWING Nº : SB 303-06-18 (RH) / SB 303-05-6 (LH) ASSYS SB 303-03-11 1011 PALLET : 11

SB 303-02-16 FMS M/C Nº : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
030/1	B	–	ROUGH MILL SURFACE KEEPING 0.5 MACHINING ALLOWANCE.	C		019	FACE MILL ϕ250	–	
030/2	–	107 113	DRILL 2 HOLES ϕ25 & CHAMFER 0.5×45°	C		025	END MILL ϕ25/ ϕ28×90°	–	
030/3	–	107 113	ENLARGE THE HOLES TO ϕ25.4 × 15 DEEP	C		101	BORING BAR ϕ25.4	–	
030/4	–	107 113	REAM 2 HOLES TO ϕ25.6 +0.084 × 15 DEEP	C		502	REAMER ϕ25.6 +0.084	~~PLUG GAUGE FOR ϕ25.6 +0.084 20/08/055~~ ①	3 PIN MIC. 25-30
030/5	–	121 TO 124	DRILL 4 HOLES ϕ7.5 × 14.0 ±0.55 DEEP & CHAMFER 0.5×45°	C		201	TWIST DRILL ϕ7.5/ϕ9.5	–	
030/6	–	121	REAM 4 HOLES ϕ8.0 +0.076/+0.04 × 14.0 ±0.055 DEEP. Ra2.5	C		503	REAMER ϕ8.0 +0.076/+0.040	~~PLUG GAUGE~~ FOR ϕ8.0 +0.076/+0.040 ~~020/03/39~~ ①	3 PIN MIC. 6-8.
030/7	–	125	DRILL ONE HOLE ϕ16 × 16 DEEP & CHAMFER 0.5×45°	C		211	TWIST DRILL ϕ16/ϕ17.	–	

PREPARED	CHECKED	APPROVED		P&TC REF	ISSUE	DATE
				160	1	16.11.02

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FORM No: EFA/P-039

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : V-46-6 CYLINDER JACKET RH/LH & ASST

DRAWING Nº : SB303-06-18 & SB303-05-6 & ASST SB303-03-11 SB303-02-16

PROGRAM NO : 1011

POSITION : 1

PALLET : 11

FMS M/C Nº : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
030/8	– 115 TO 119	108 TO 112	DRILL THRU 10 HOLES ϕ26.			017	END MILL ϕ26	–	
030/9	–	301 TO 307	MAKE CENTRE TO ϕ6×90° FOR 7 HOLES	D		212	TWIST DRILL ϕ16×90°	–	
030/10	–	301 TO 307	DRILL THRU' 7 HOLES ϕ4	D		213	TWIST DRILL ϕ4	–	
030/11	–	601	MAKE ONE HOLE ϕ24 AT 60°	B		026	END MILL ϕ24	–	
030/12	–	602	MAKE ONE HOLE ϕ21 AT 60°	B		027	END MILL ϕ21	–	
030/13	–	603	MAKE ONE HOLE ϕ18 AT 60°	B		028	END MILL ϕ18	–	
030/14	–	604	MAKE ONE HOLE ϕ17 AT 60°	B		029	END MILL ϕ17	–	
030/15	–	605	MAKE ONE HOLE ϕ20 AT 60°	B		030	END MILL ϕ20	–	
030/16	–	606	MAKE ONE HOLE ϕ12 AT 60°	B		031	END MILL ϕ12	–	

PREPARED	CHECKED	APPROVED		P&TC REF	ISSUE	DATE

SHT. 11 OF 24

FORM No: EF/PP/029

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : V-46-6 CYLINDER JACKET RH/LH & ASSYS.
DRAWING Nº : SB303-06-18-RH & SB. 303-03-11
SB303-05-6-LH & SB 303-02-16
PROGRAM NO : 1011

POSITION : 1
PALLET : 11
FMS M/C Nº. : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
030/17	B	–	FINISH MILL BLOCK JOINING FACE (B) Ra 1.25. TECH. REQT : FLATNESS OF THE SURFACE IS TO BE WITHIN 0.05 mm ALONG LENGTH & 0.02 mm ALONG WIDTH.	C		018	FACE MILL ϕ250	–	

PREPARED	CHECKED	APPROVED		PATE REF	ISSUE	DATE

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FORM No: EFA/P-039

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : V-46-6 CYLINDER JACKET RH/LH & ASSY.

DRAWING Nº : SB 303-06-18-RH, SB 303-05-6-LH & ASSY SB 303-03-11, SB 303-02-16

PROGRAM NO : 1011

POSITION : 2

PALLET : 11

FMS M/C Nº : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
080/1	A	–	ROUGH MILL THE SURFACE 'A' KEEPING 0.5 MACHINING ALLOWANCE	A	–	019	FACE MILL ϕ250	–	
080/2	A	–	MILL 5 SLOTS TO 75±1.2 X 70±1.2 WIDTHS X 4 ±1.2 DEER. R2 20	A	–	015	SHELL END MILL ϕ50X60°	–	
080/3	–	25 TO 36 51 TO 62	MILL BACK FACE TO ϕ90 MAINTAINING DIMN. 48.0 -1.0	A	–	016	DISC MILL ϕ90X20	–	
080/4	–	25 TO 36 51 TO 62	DRILL THRU' 24 HOLES ϕ11 & CHAMFER 0.5X45°	A	–	209	TWIST DRILL ϕ11/ϕ13	–	
080/5	–	37 TO 50 63 TO 72	DRILL THRU' 24 HOLES ϕ11	A		209	TWIST DRILL ϕ11/ϕ13	–	

PREPARED	CHECKED	APPROVED		P&TC REF	ISSUE	DATE

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : V-46-6 CYLINDER JACKET RH/LH & ASSY
DRAWING Nº : SB 303-06-18 RH & SB 303-05-6 LH & ASST SB 303-03-11 SB 303-02-16
PROGRAM NO : 1011
POSITION : 2
PALLET : 11
FMS M/C Nº. : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
080/6	–	37 TO 50 63 TO 72	C/BORE φ12.5 +0.27 X 7 +1.5 DEEP ON 24 HOLES & CSK TO φ14 × 45°.	A		401	C/BORING TOOL φ12.5/φ15	–	
080/7	–	8 TO 12 15 TO 19	DRILL THRU' 10 HOLES φ25.0 +0.84 & CHAMFER 0.5 × 45°	A		025	TWIST DRILL φ25/φ26 × 90°	–	
080/8	–	14	DRILL THRU" ONE HOLE φ28 × 8 +1.5 DEEP.	B		403	C/BORING TOOL φ28	–	
080/9	–	21 TO	DRILL 4 HOLES φ7.5 × 15 ±0.55 DEEP	A		201	TWIST DRILL φ7.5/φ11	–	
080/10	–	21 TO 24	REAM 4 HOLES φ8.0 -0.028/-0.064 × 15 ±0.55 DEEP	A		504	REAMER φ8.0 -0.028/-0.064	~~PLUG GAUGE~~ φ8.0 -0.028 -0.064 ~~020/03/040~~	3 PIN MIC. 6-8 ①
080/11	–	206 TO 211	MAKE CENTRE TO φ6 × 90° FOR 6 HOLES	B		212	TWIST DRILL φ16 × 90°		

PREPARED	CHECKED	APPROVED		P&TC REF	ISSUE	DATE
				160	1	16.11.02

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PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : V46-6 CYLINDER JACKET RH/LH & ASSYS.
DRAWING Nº : SB 303-06-18 - RH & SB 303-03-11
SB 303-02-16 - LH & SB-303-02-16
PROGRAM NO ÷ 1011
POSITION : 2
PALLET : 11
FMS M/C Nº : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
080/12	–	206 TO 211	DRILL THRU' 6 HOLES Ø4	B		213	TWIST DRILL Ø4	–	
080/13	–	607	MAKE ONE HOLE Ø4 AT 55°+5° IN 3rd OR 4th CYLINDER BORE	*		032	END MILL Ø4	–	
080/14	A	–	FINISH MILL HEAD SEATING FACE TO DIMN. 217.6 ±0.08. Ra 1.25. TECH. REQTS: 1) FLATNESS OF SURFACE IS TO BE WITHIN 0.05 ALONG LENGTH & 0.02 ALONG WIDTH. 2) PARALLELISM OF SURFACE 'A' & 'B' IS TO BE WITHIN 0.05	A		018	FACE MILL Ø 250		

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SHT. 15 OF 24

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : V46-6 CYLINDER JACKET RH/LH & ASSY PROGRAM NO : 1011 POSITION : 3

DRAWING Nº : SB 303-06-18-RH & SB 303-05-6-LH & ASSY SB 303-03-11 SB 303-02-16 PALLET : 11

FMS M/C Nº : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
130/1	C	–	FINISH MILL TRIANGULAR FLANGE FACE TO DIMN 551 FROM HOLE AXIS Nº. 10.	E		019	FACE MILL Ø250	–	
130/2	D	–	FINISH MILL TRIANGULAR FLANGE FACE TO DIMN. 551 FROM HOLE AXIS Nº. 1	E		019	FACE MILL Ø250	–	
130/3	D_1 D_2	– –	MILL TRIANANGULAR FLANGE ENDS TO 45°	E		014	END MILL Ø40	–	
130/4	~~–~~ ~~402~~	401 402	DRILL THRU 2 HOLES Ø6.63 AND CHAMFER	E		220	TWIST DRILL Ø6.63/Ø10	–	
130/5	–	500 TO 502	DRILL THRU 3 HOLES Ø6.63 AND CHAMFER	E		220	—DO—	–	
130/6	–	500 TO 502	TAP THRU 3 HOLES M8X1.25TO	E		603	TAP M8X1.25TO	SCREW PLUG GAUGE M8X1.25TO 403332	
130/7	–	402	TAP THRU ONE HOLE M8X1.25TO	E		603	TAP M8X1.25TO	—DO—	

PREPARED	CHECKED	APPROVED		PRTC REF	ISSUE	DATE	
							SHT. 16 OF 24

FORM No: EFA/P-039

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : V-46-6 CYLINDER JACKET RH/LH & ASSY PROGRAM NO: 1011 POSITION : 3
DRAWING Nº : SB 303-06-18 RH & ASSY SB 303-03-11 PALLET : 11
SB-303-05-6 LH SB 303-02-16 FMS M/C Nº. : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
130/8	–	403	DRILL ONE HOLE ϕ37.44 X 24 MAX. DEEP & C/BORE ϕ45.5 X 5.5 ±0.6 DEEP.	E		104	BORING BAR ϕ37.44/ϕ45.5	—	
130/9	–	403	TAP ONE HOLE M39X1.5-5H6H X 17 MIN. DEEP	E		604	TAP M39X1.5-5H6H	SCREW PLUG GAUGE FOR M39X1.5-5H6H	
130/10	–		PROBE THE BORE	A		001	RENISHAW PROBE		
130/11	–	1 TO 6	ROUGH BORE CYL. LINER BORES TO ϕ163.5/ϕ164.5 & ϕ165.5			105	BORING BAR ϕ163.5/ϕ164.5/ ϕ165.5	—	
130/12	–	1 TO 6	FINISH BORE TO ϕ164 H7 (+0.04) Ra2.5 ϕ165 H7 (+0.04) Ra2.5 ϕ177 H12 (+0.4) Rz10 X 5.4 +0.05 DEEP. Ra2 REFER NEXT SHT. FOR TECH. REQTS.					SETTING RING ϕ164.0 +0.04 – 094/00/048 ϕ165.0 +0.04 – 094/00/049	

PREPARED	CHECKED	APPROVED	A[illegible]	P&TC REF	ISSUE	DATE

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FORM No: EFA/P-039

PLANNING SHEET FOR FMS COMPONENTS

COMPONENT : V-46-6 CYLINDER JACKET RH/LH & ASST. PROGRAM NO : 1011
DRAWING Nº : SB 303-06-18 RH / SB 303-05-6 LH & ASST SB 303-03-11 / SB 303-02-16

POSITION : 3
PALLET : 11
FMS M/C Nº. : 4

OPN Nº	DESIGNATION FACE	DESIGNATION HOLE	DESCRIPTION OF OPN.	SKETCH	CYCLE TIME MTS	TOOL Nº	DESCRIPTION OF TOOL	GAUGES	REMARKS
130/12 (CONTD.)	—	1 TO 6	TECH. REQTS: 1) PERPEDICULARITY OF THE COMMON AXIS OF BORES ϕ164 & ϕ165 IS TO BE WITHIN 0.03 OVER 190 HEIGHT RELATIVE BOTTOM SURFACE 'B' 2) C/BORE FACE IS TO BE PARALLEL W.R.T BOTTOM SURFACE 'B' WITH IN 0.02 UPTO ϕ170. 3) NON-FLATNESS OF C/BORE FACE IS TO BE CHECKED BY BLUEING USING SPL. GAUGE. THE IMPRINT SHOULD BE UNIFORM ALONG CIRCUMFERENCE AND WIDTH 2 mm. NOTE: PARALLELISM BETWEEN SURFACES 'A' & 'B' AND C/BORE FACE TO BOTTOMFACE 'B' MAY CHECKED IN COMPT. CLAMPED CONDITION.					BLUE BRG. CHECK GAUGE 403388 403297 INSPECTION FIXTURE 401451 401452 401453 401467 401462 (FOR CMM)	4) TOP SURFACE 'A' IS TO BE PARALLEL TO BOTTOM SURFACE 'B' ALONG C/BORE ϕ177 WITHIN 0.02 UPTO ϕ185. 5) VARIATION IN DIMN 5.4 +0.050 (C/BORE DEPTH OF CYL. LINER SEATING FACE) BETWEEN BORE TO BORE SHOULD NOT EXCEED 0.010

PREPARED	CHECKED	APPROVED	AUTH'D	PATE REF	ISSUE	DATE

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