TABLE OF CONTENTS

NOTE:

The empty weight, center of gravity, and equipment list for the airplane as delivered from Mooney Airplane Company, Inc. is contained in this section. The use of this section is valid for use with the airplane identified below when approved by Mooney Airplane Company, Inc..

MOONEY - M20R

AIRCRAFT SERIAL NO._____

AIRCRAFT REGISTRATION NO._____

_____

Mooney Airplane Company, Inc, - Approval Signature & Date

INTRODUCTION

This section describes the procedure for calculating loaded aircraft weight and moment for various flight operations. In addition, procedures are provided for calculating the empty weight and moment of the aircraft when the removal or addition of equipment results in changes to the empty weight and center of gravity. A comprehensive list of all Mooney equipment available for this airplane is included in this section. Only those items checked (X) were installed at Mooney and are included in the empty weight-and-balance data.

The aircraft owner and/or pilot, has the responsibility of properly loading the aircraft for safe flight. Data presented in this section will enable you to carry out this responsibility and insure that your airplane is loaded to operate within the prescribed weight and center- of-gravity limitations.

At the time of delivery, Mooney Aircraft Corporation provides the empty weight and center of gravity data for the computation of individual loadings. (The empty weight and C.G. (gear extended) as delivered from the factory is tabulated on page 6-5 when this manual is supplied with the aircraft from the factory.)

FAA regulations also require that any change in the original equipment affecting the empty weight and center of gravity be recorded in the Aircraft Log Book. A convenient form for maintaining a permanent record of all such changes is provided on page 6-5. This form, if properly maintained, will enable you to determine the current weight- and-balance status of the airplane for load scheduling. The weight-and-balance data entered as your aircraft left the factory, plus the record you maintain on page 6-5, is all of the data needed to compute loading schedules.

The maximum certificated gross weight for the TCM powered M20R is 3368 lbs (1528 Kg) for Takeoff and 3200 pounds (1452 Kgs) for Landing. Maximum useful load is determined by subtracting the corrected aircraft empty weight from its maximum gross weight. The aircraft must be operated strictly within the limits of the Center-of-Gravity Moment Envelope shown on page 6-8.

AIRPLANE WEIGHING PROCEDURE

(A) LEVELING: Place a spirit level on the leveling screws above the tailcone left access door when leveling the aircraft longitudinally. Level the aircraft by increasing or decreasing air pressure in the nose wheel tire.

(B) WEIGHING: To weigh the aircraft, select a level work area and:

1. Check for installation of all equipment as listed in the Weight & Balance Record Equipment List.
2. Top off both wing tanks with full fuel. Subtract usable fuel, 89.0 U.S. gals. (337 liters) @(5.82 lb/gal(100LL)(.69 Kg/l) =518 lbs. (235 Kgs.), from total weight as weighed.

———*———

OPTIONAL METHOD - Ground aircraft and defuel tanks as follows:

a. Disconnect fuel line at fuel system union located forward of the firewall on the lower left hand side.
b. Connect a flexible line to output fitting that will reach fuel receptacle.
c. Turn fuel selector valve to tank to be drained; remove filler cap from fuel filler port.
d. Turn on fuel boost pump until tank is empty.
REPEAT STEPS C. AND D. TO DRAIN OTHER TANK.
e. Replace 3.0 gallons (11.4 liters) fuel into each tank (unusable fuel). (Use 5.82lb/gal.(.69 Kg/liter) for 100LL fuel).
f. Replace filler caps.

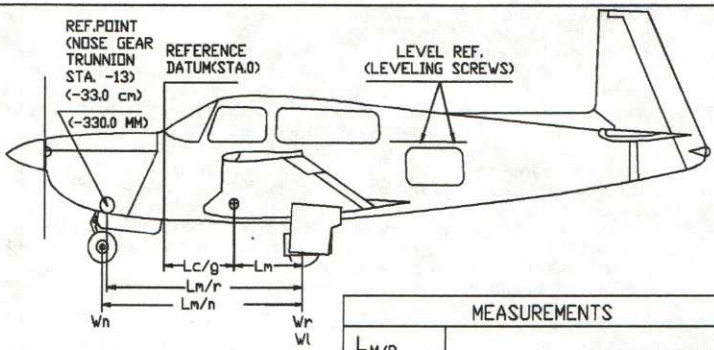
———*———

WEIGHING (con't.) . . . . . .

3. Fill oil tank to capacity (8 qts.).
4. Position front seats in full forward position.
5. Position flaps in full up position.
6. Position a 2000-pound (907.2 Kg.) capacity scale under each of the three wheels.
7. Level aircraft as previously described making certain nose wheel is centered.
8. Weigh the aircraft and deduct any tare from each reading.
9. Find reference point by dropping a plumb bob from center of nose gear trunion (retracting pivot axis) to the floor. Mark the point of intersection.
10. Locate center line of nose wheel axle and main wheel axles in the same manner.
11. Measure the horizontal distance from the reference point to main wheel axle center line. Measure horizontal distance from center line of nose wheel axle to center line of main wheel axles.
12. Record weights and measurements, and compute basic weight and CG as follows on next page:

NOTE:
Wing Jack Points are located at Fus. Sta. 56.658 in. (143.91 cm). Nose Jack Point is located at Fus. Sta. -5.51 in. (- 14.0 cm.). Refer to SECTION VIII, Jacking, for procedures.

M20R - WEIGHT & BALANCE CHART



MEASUREMENTS	
$L_{M/R}$	INCHES/CM/MM
$L_{M/N}$	INCHES/CM/MM

SCALE POSITION AND SYMBOL	SCALE READING	TARE	NET WEIGHT
NOSE WHEEL (W_N)			
RIGHT MAIN WHEEL (W_R)			
LEFT MAIN WHEEL (W_L)			
BASIC EMPTY WEIGHT (W_T)			(If fuel has been drained)
AS WEIGHED (W_T)			(If fuel has not been drained)

a. CG Forward of Main Wheels:

_____Lbs/Kg (Weight of Nose (W_N)) X _____In/cm/mm (Distance Between Main and Nose Wheel Axle Centers ($L_{M/N}$)) ÷ _____Lbs/Kg (Total weight of Aircraft (W_T)) = _____In/cm/mm (CG Forward of Main Wheels (L_M))

b. CG Aft of Datum (Station 0):

_____In/cm/mm (Distance from Center Nose Gear Trunion to Center of Main Wheel Axles (Horizontal) (L_{WR})) — 13 in/33.0 cm/330 mm (Distance from Nose Gear TDrunion to Datum) (CONSTANT) — _____In/cm/mm (Result of Computation Above (L_M)) = _____In/cm/mm (CG (FUS. STA) Distance Aft of DAtum (Empty Weight CG) ($L_{C/G}$))

If fuel has not been drained, the usable fuel must be analytically subtracted to determine the Basic Empty Wt. and CG. Use loading calculation procedure shown on page 6-6.

WEIGHT	LBS. (Kg)	C.G. IN/cm/mm	MOMENT Lb-In(Kg-cm)(Kg-mm)/1000
As Weighed (W_T)			
Usable fuel	—	49.23 in/125 cm/1250 mm	—
Basic Empty Wt.			

OWNERS WEIGHT AND BALANCE RECORD

(ENTER BELOW ALL WEIGHT CHANGE DATA FROM AIRCRAFT LOG BOOK)

AIRPLANE MODEL – M20R | SERIAL NO. 29-0212 | FAA REG. NO. N2210Y

DATE	DESCRIPTION OF MODIFICATION	WEIGHT CHANGE ADDED (+) WT. (LBS) (Kg)	ADDED (+) ARM (INCHES) (cm)/(mm)	REMOVED (-) WT. (LBS) (Kg)	REMOVED (-) ARM (INCHES) (cm)/(mm)	RUNNING EMPTY WEIGHT WT. (LBS) (Kg)	MOMENT /1000	ARM (IN) (cm)/(mm)	USEFUL LOAD
01-18-00	BASIC EMPTY WEIGHT AS DELIVERED (Wt) (Includes full oil – Qts. (liters)	—	—	—	—	2316	104.60	45.2	1052
2-9-00	Oxygen System	44.55	137.0	—	—	2361	110.70	46.9	1007
07-17-01	JPI	3.55	-13.0			2364.55	1668.25	46.9	1003.55

(Mult. inches by 25.4 for mm) (Mult. inches by 2.54 for Cm) (Mult. pounds by .4536 for Kg)

PILOT'S LOADING GUIDE

LOADING CALCULATION PROCEDURE

Proper loading of the aircraft is essential for maximum flight performance and safety. This section will assist you in determining whether the aircraft loading schedule is within the approved weight and center-of-gravity limits.

To figure an actual loading problem for your aircraft, proceed as follows:

Step 1. Refer to the latest entry on page 6-5 for the current empty weight and moment.

| NOTE |

Since the engine oil is normally kept at the full level, the oil weight and moment is included in basic empty weight and is constant in calculating all loading problems.

Step 2: Note the pilot's weight and the position his seat will occupy in flight. Find this weight on the left scale of the Loading Computation Graph (page 6-7) and cross the graph horizontally to the graph for #1 and #2 seats. When this point is located, drop down to the bottom scale to find the value of the moment/1000 due to the pilot's weight and seat position.

Repeat procedure for co-pilot and enter these weights and moment/1000 values in the proper sub-columns in the Problem Form on page 6-7.

Step 3: Proceed as in Step 2 to account for the passengers in seats 3 and 4. Enter the weight and value of moment/1000 in the proper columns.

Step 4: Again proceed as in Step 2 to account for the amount of fuel carried, and enter the weight and moment/1000 values in the proper columns.

Step 5: Once more proceed as in Step 2 to account for the baggage to be carried and enter the figures in the proper columns.

Step 6: Total the weight columns. This total must be 3368 Pounds(1528 Kg) or less. Total the Moment/1000 column.

DO NOT FORGET TO SUBTRACT NEGATIVE NUMBERS.

Step 7: Refer to the Center-of-Gravity Moment Envelope (page 6-8). Locate the loaded weight of your airplane on the left scale of the graph and trace a line horizontally to the right. Locate the total moment/1000 value for your airplane on the bottom scale of the graph and trace a line vertically above this point until the horizontal line for weight is intersected. If the point of intersection is within the shaded area, your aircraft loading is acceptable. If the point of intersection falls outside the shaded area, you must rearrange the load before takeoff.

Weight / Balance & Equipment List Revision

DLK Aviation, Inc. - DK7R795J

2601 Cessna Lane Kennesaw GA 30144
770-427-4954

WB ID # : 45
A/C Tail # : N2210Y
Register Name : DUNCAN EQUIPMENT LEASING LLC
Address : 889 F BUFORD ROAD
City, State, PC : CUMMING, GA 30041

A/C Make : MOONEY
A/C Model : M20R
A/C Serial # : 29-0212
WO Ref # : 01-396
WB Date : 17-Jul-2001

Previous data taken from document dated 09-Feb-2000 Previous useful load = 1007.00

Model / Part #	Description	Weight	CG/Arm	Moment
	Previous data ->	2361.00	46.90	110703.40
NO ITEMS REMOVED				
*INSTALLED				
EDM700	JPI	3.55	-13.00	-46.15
INSTALLED	1 Items @	3.55	-13.00	-46.15
NEW DATA >>	NEW USEFUL LOAD = 1003.45	2364.55	46.80	110657.25

Daniel L Kendall

Authorized Individual : DK7R795J DANIEL L. KENDALL

MOONEY FACTORY SERVICE CENTER

AIRCRAFT

WEIGHT & BALANCE REVISION
EQUIPMENT LIST REVISION

MODEL: M20R

S/N: 29-0212

REG: N2210Y

Add or Remove	Item	P/N	Weight	Arm	Moment
XXXXXXX	Previous Empty Weight & C.G.	xxxxxxxxxxx	2316	45.2	104600
ADD	OXYGEN SYSTEM	870029	44.55	137.0	6103.35
		Superseded			
		07-17-01			

	Revised Aircraft Empty Weight & C.G.		2360.6	46.9	110703.4

AIRCRAFT EMPTY WEIGHT 2361

AIRCRAFT EMPTY WT C.G. 46.9

AIRCRAFT USEFUL LOAD 1007

AIRCRAFT MOMENT 110.70

EQUIPMENT REMOVED: _____ (Wt.) @ _____ (Arm)

EQUIPMENT INSTALLED: 44.55 (Wt.) @ 137.0 (Arm)

DATE: 02-09-00

M O O N E Y
FACTORY SERVICE CENTER
CRS FH2R820K

PROBLEM FORM

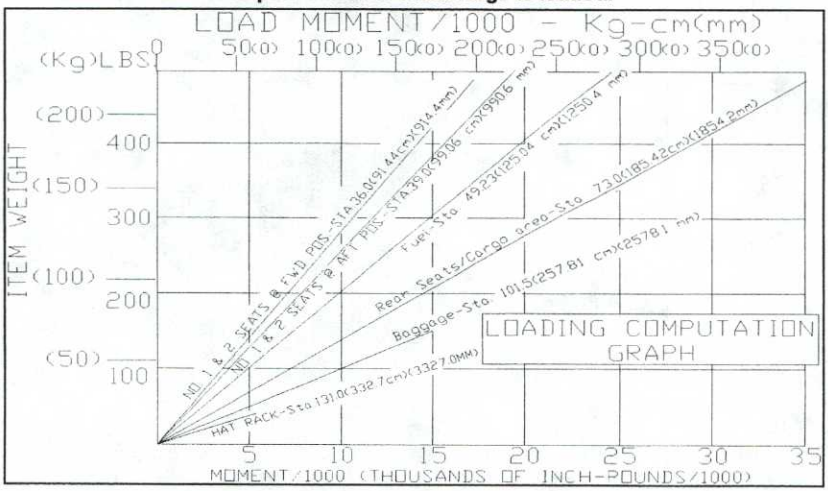
STEP	ITEM	SAMPLE PROBLEM WEIGHT (Kg) / Lbs	SAMPLE PROBLEM MOMENT (Kg-cm /1000) / lb-in /1000	YOUR PROBLEM WEIGHT (Kg) / Lbs	YOUR PROBLEM MOMENT (Kg-cm /1000) / lb-in /1000
1.	A/C Basic Empty Wt.(W)(from page 6-5) (Includes Full Oil) 8 Qts.(7.57 Li) @1.875lbs /Qt.(.80 Kg/Li)(Sta. -20.19)(-51.3 cm) (Oil sump assumed FULL for all flights)	(1009) / 2225	(114.6) / 99.46		
2.	Pilot Seat (#1) *	(77.1) / 170	(7.64) (aft pos) / 6.63		
	Co-Pilot Seat (#2) *	(77.1) / 170	(7.25) (2nd. pos) / 6.29		
3.	Left Rear Seat (#3) or Cargo Area	(77.1) / 170	(14.3) / 12.41		
	Right Rear Seat (#4) or Cargo Area	(77.1) / 170	(14.3) / 12.41		
4	Fuel (Max. Usable - 89.0 Gal/534 Lbs) (337 Li/242Kg) @ Sta 49.23(125 cm)	(164.7) / 363	(20.59) / 17.87		
5.	Baggage (Max. 120 Lbs(54.4 cm)@Sta.101.5 (257.8 cm)	(45.4) / 100	(11.70) / 10.15		
	Hat Rack (Max. 10 Lbs(4.54 Kg)@Sta. 126.0 (320 cm)				
6.	Loaded A/C Weight(Takeoff at Max. Weight) A/C will have to burn off 168 lbs. fuel before normal landing is accomplished.	(1528) / 3368	(190.2) / 165.0		
7.	Required Fuel Burn-Off 28 Gals (105.9 Li) @ 6 Lbs./Gal.	(76.2) / 168	(-9.53) / -8.27		
8.	MAXIMUM LANDING WEIGHT of A/C	(1452) / 3200	(180.6) / 156.7		

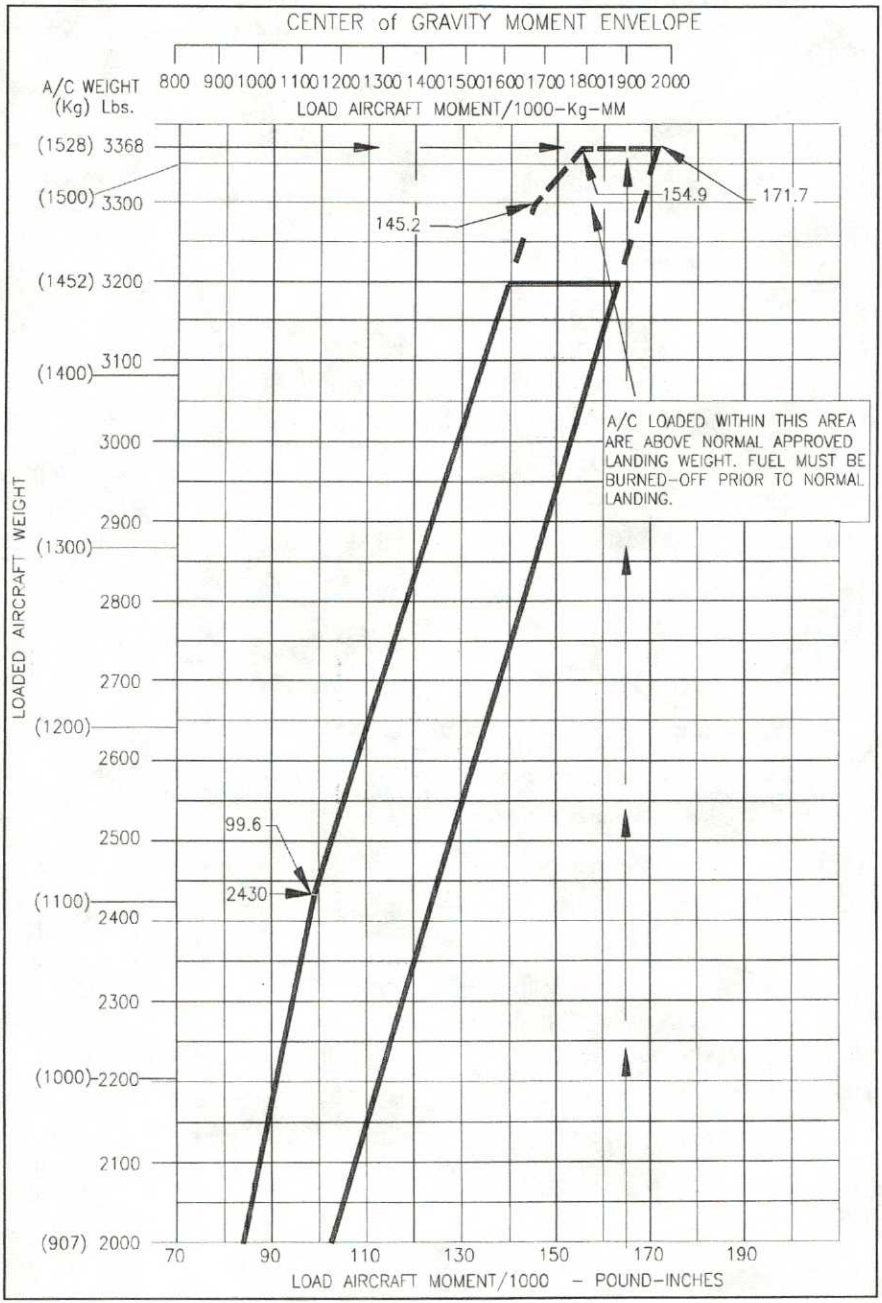
9. Refer to Center of Gravity Moment Envelope, to determine whether your A/C loading is acceptable. CAUTION-DO NOT LAND A/C WHEN OVER 3200 LBS EXCEPT IN AN EMERGENCY SITUATION.

* Obtain the moment/1000 value for each seat position (FWD, MID or AFT) from loading computation graph.

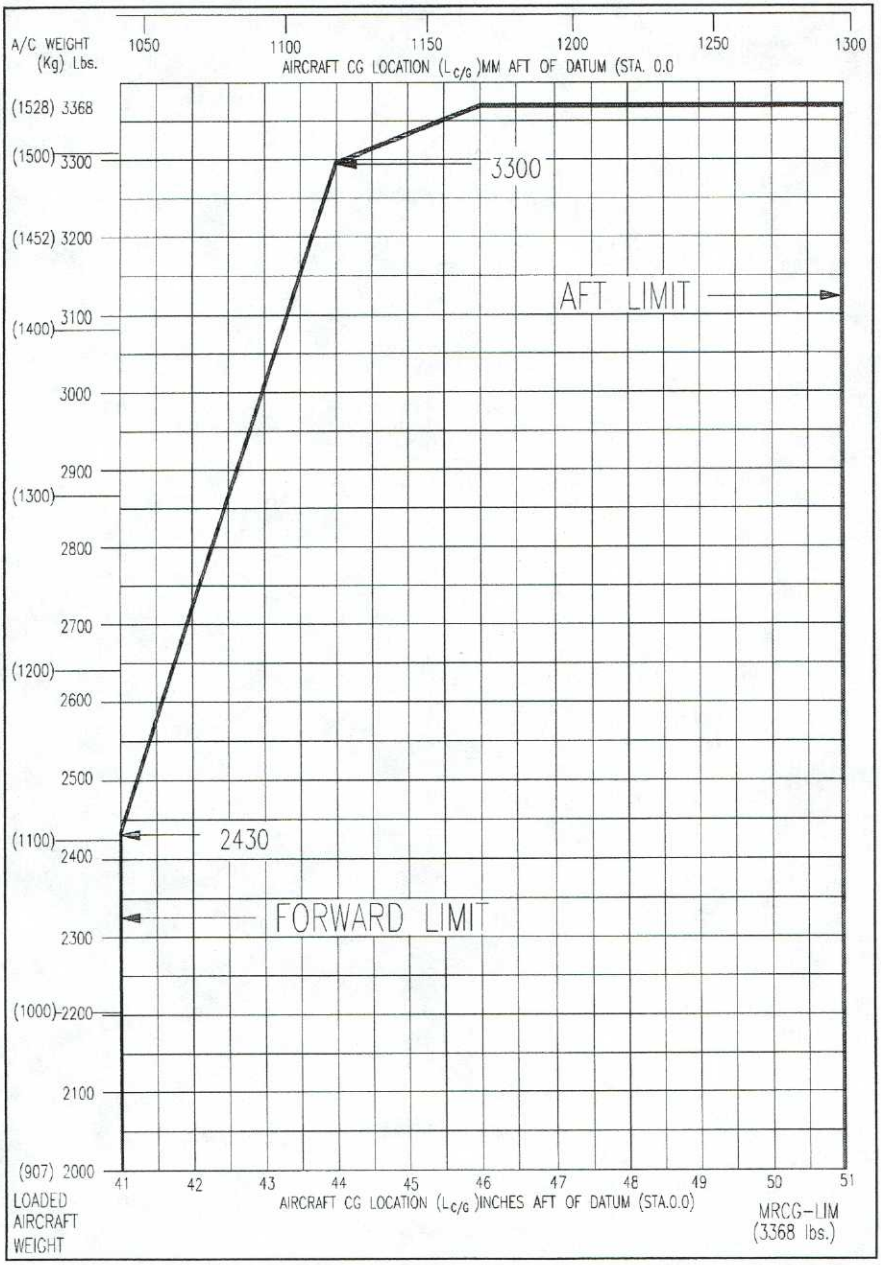
CAUTION

Pilot is responsible for cargo loaded in rear seat area, with seat backs folded down. Cargo Center of Gravity location varies with total weight loaded. Compute CG value when cargo is loaded.




CENTER of GRAVITY MOMENT ENVELOPE
A/C WEIGHT (Kg) Lbs.
800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
LOAD AIRCRAFT MOMENT/1000-Kg-MM
(1528) 3368
(1500) 3300
(1452) 3200
(1400) 3100
3000
2900
(1300)
2800
2700
(1200)
2600
2500
(1100)
2400
2300
(1000) 2200
2100
(907) 2000
LOADED AIRCRAFT WEIGHT
145.2
154.9
171.7
99.6
2430
A/C LOADED WITHIN THIS AREA ARE ABOVE NORMAL APPROVED LANDING WEIGHT. FUEL MUST BE BURNED-OFF PRIOR TO NORMAL LANDING.
70 90 110 130 150 170 190
LOAD AIRCRAFT MOMENT/1000 - POUND-INCHES

M20R - CENTER OF GRAVITY LIMITS ENVELOPE



FIXED BALLAST

The M20R has provisions for a fixed ballast located in the tailcone at Fuselage Station 209.5. Some aircraft with EFIS, TKS & other systems, may require all or a portion of the fixed ballast to be removed in order to stay within the weight and balance center of gravity envelope.

EQUIPMENT LIST

The following equipment list is a listing of items approved at the time of publication of this manual for the Mooney M20R.

Only those items having an X in the "Mark If Installed" column and dated were installed at Mooney Aircraft Corporation at the time of manufacture.

If additional equipment is to be installed it must be done in accordance with the reference drawing or a separate FAA approval.

| NOTE |

Positive arms are distances aft of the airplane datum. Negative arms are distances forward of the airplane datum.

Asterisks (*) after the item weight and arm indicate complete assembly installations. Some major components of the assembly are listed and indented on the lines following. The summation of the major components will not necessarily equal the complete assembly installation.

EQUIPMENT LIST

M-EQ-A

MO.	01	
DAY	18	
YEAR	00	

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg.)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	A. FIXED BALLAST								
1A	WEIGHT (-501 INSTL)	350203	(2.81)	6.2	(532.1)	209.50			
2A	WEIGHT (-503 INSTL)	350203	(6.08)	13.4	(532.1)	209.50			
3A	WEIGHT (-505 INSTL)	350203	(8.94)	19.7	(532.1)	209.50			

EQUIPMENT LIST

R2-EQ-B1

MO.	01
DAY	18
YEAR	00

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT Lbs.	ARM (Cm)	ARM In.	MARK IF INSTLD		
	B. POWERPLANT & ACCESSORIES								
1B	ENGINE-TCM IO-550-G(6) *, INCLUDES: STARTER, ALTERNATOR, EXHAUST, INDUCT. SYST., ALT. AIR, ENG. MT., FULL OIL, PROP. GOV.	600270	(249.3)	549.5	(159.16)	-23.29	X		
2B	PROPELLER * - CONSTANT SPEED McCAULEY - HUB-2A34C241 BLADES (2) 82PGC-6, W/ SPINNER	680030	(29.5)	65.0	(-125.7)	-49.5	X		
3B									
	* Refer to Section I & II for engine/propeller configuration.								

EQUIPMENT LIST

M-EQ-B2

MO.	01		
DAY	18		
YEAR	00		

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg) (POUNDS)	ARM (cm) (INCHES)	MARK IF INSTALLED		
B.	POWERPLANT & ACCESSORIES (con't.)						

EQUIPMENT LIST

MO.	01	
DAY	18	
YEAR	00	

M-EQ-C1

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	C. ELECTRICAL SYSTEM								
1C	BATTERIES 24 VOLTS (2)	800311	(13.4)	29.55	(370.8)	146.0	X		
2C	REGULATOR, VOLTAGE (2)	800311	(.27)	.6 EA	(41.28)	16.25	X		
3C	PITOT, HEATED	820252	(.52)	1.15	(106.3)	41.85	X		
4C	[redacted]								
5C	FUEL PUMP, ELECTRIC	610293	(.86)	1.9	(38.1)	15.0	X		
6C	STALL WARNING INDICATOR	800311	(.45)	1.0	(127.0)	50.0	X		
7C	GEAR WARNING INDICATOR	800311	(.45)	1.0	(49.53)	19.5	X		
8C	WING TIP STROBE LIGHT INSTL.	800311	(2.27)	5.0	(134.62)	53.0	X		
9C	TAIL STROBE LIGHT INSTL.	800311	(.68)	1.5	(578.7)	227.82	X		
10C	LANDING/TAXI LIGHTS (2 SETS)	210417	(2.7)	5.88	(105.6)	41.6	X		
11C	ACTUATOR, FLAPS	750110	(2.3)	5.1	(277.1)	109.1	X		
12C	ACTUATOR, LANDING GEAR	560260	(5.08)	11.2	(99.06)	39.0	X		

EQUIPMENT LIST

M-EQ-C2

MO.	01
DAY	18
YEAR	00

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	C. ELECTRICAL SYSTEM (CON'T)								
13C	E.L.T. (D & M) ELT-8	810152	(1.63)	3.59	(337.8)	133.0			
14C	E.L.T.(Ameri-King AK-450)	810436		3.1		168.9	X		
15C	E.L.T. (ARTEX) ELT110-4	810150	(2.26)	4.98	(436.8)	172.0			
16C	E.L.T. (ARTEX) ELS-10	810150	(2.95)	6.5	(407.7)	160.5			
17C	E.L.T. (AMERI-KING)	810436	(1.41)	3.1	(429.0)	168.9			
18C									
19C									
20C									
21C									

EQUIPMENT LIST

M-EQ-D1

MO.	01	
DAY	18	
YEAR	00	

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	D. WHEELS, TIRES & BRAKES								
1D	MAIN WHEEL & BRAKE ASSYS (2)	520029	(6.22)*	* 13.72	(163.57)	64.4	X		
	WHEEL ASSEMBLY (2)	520029	(4.99)	11.0	(162.51)	63.98	X		
	BRAKE ASSEMBLY (2)	520029	(.816)	1.8	(153.74)	60.53			
2D	TIRES, MAIN (2) (6 PLY RATING) 6.00 X 6 TYPE III W/ TUBES	520029	(7.71)	17.0	(162.51)	63.98	X		
3D	NOSE WHEEL ASSEMBLY (1)	540000	(1.18)	2.6	(-33.8)	-13.3	X		
4D	TIRE, NOSE (1) (6 PLY RATING) 5.00 X 5 TYPE III W/ TUBE	540000	(3.18)	7.0	(-33.8)	-13.3	X		
5D	MASTER CYLINDER, BRAKE (2)	850109	(1.36)	3.0	(21.08)	8.3	X		
6D	VALVE, PARKING BRAKE	850109	(.27)	.6	(-3.68)	-1.45	X		
7D	DUAL PUCK BRAKE ASSEMBLY (2)	520029	(1.35)	2.98	(168.48)	66.53	X		
8D									
9D									

EQUIPMENT LIST

M-EQ-D2

MO.	DAY	YEAR
01	18	00

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg) (POUNDS)	ARM (cm) (INCHES)	MARK IF INSTALLED		
	D. WHEELS, TIRES & BRAKES (con't.)						
[redacted]							

EQUIPMENT LIST

M-EQ-E1

MO.	01		
DAY	18		
YEAR	00		

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	E. INSTRUMENTS								
1E	GYRO HORIZON	820336	(1.33)	2.93	(44.3)	17.46			
2E	DIRECTIONAL GYRO		(1.33)	2.93	(42.7)	16.8			
3E	CLOCK, PANEL MOUNTED		(.11)	.25	(49.78)	19.6	X		
4E	OAT GAUGE		(.25)	.55	(46.99)	18.5	X		
5E	INDICATOR, VERTICAL SPEED		(.23)	.5	(44.9)	17.67	X		
6E	INDICATOR, TURN & SLIP/TURN COORD.		(.83)	1.84	(41.91)	16.5	X		
7E	ALTIMETER		(.49)	1.07	(36.0)	14.17	X		
8E	INDICATOR, AIRSPEED		(.32)	.70	(47.75)	18.8	X		
9E	TACHOMETER		(.36)	.8	(48.13)	18.95	X		
10E	FUEL FLOW		(.63)	1.39	(46.99)	18.48			
11E	TIT GAUGE		(.23)	.5	(44.5)	17.5	X		
12E	ENGINE GAUGES (DUAL CLUSTERS)	820336	(1.6)	3.5	(46.99)	18.5	X		

EQUIPMENT LIST

MO.	01	
DAY	18	
YEAR	00	

M-EQ-E2

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	E. INSTRUMENTS (CON'T)								
13E	ANNUNCIATOR PANEL	820336	(.58)	1.3	(44.45)	17.5	X		
14E	MAGNETIC COMPASS	130323	(.23)	.5	(60.6)	23.87	X		
15E	MANIFOLD PRESSURE	820336	(.45)	1.0	(46.94)	18.48	X		
16E	ALTERNATE STATIC AIR SOURCE	820336	(.14)	.31	(44.69)	18.5	X		
17E									
18E									
19E									
20E									

EQUIPMENT LIST

MR-EQ-F1

MO.	01	02
DAY	18	09
YEAR	00	00

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	F. MISCELLANEOUS SYSTEMS								
1F	VACUUM SYSTEM INSTALLATION	860015	(2.58)	5.68	(-2.54)	-1.0	X		
2F	VACUUM PUMP	860015	(1.54)	3.4	(-7.6)	-3.0	X		
3F	STAND-BY VACUUM PUMP(CLUTCH)	860015	(2.45)	5.41	(-6.4)	-2.5			
4F	STAND-BY VACUUM PUMP(TAILCONE)	860063	(5.44)	12.0	(280.42)	110.4	X		
5F	OXYGEN SYSTEM (115.7 cu. ft.)	870029	(20.2)	44.55	(347.9)	137.0		X	
6F	DESCENT RATE CONTROL (VACUUM)	950155	(5.59)	12.32	(177.8)	70.0			
7F	DESCENT RATE CONTROL (ELECTRIC)	950271	(5.8)	12.8	(177.8)	70.0	X		
8F	PROPELLER DE-ICE (ELECTRIC)	690003	(2.69)	5.93	(-115.6)	-45.5			
9F									
10F									
11F									

EQUIPMENT LIST

M-EQ-G1

MO.	01
DAY	18
YEAR	00

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg) (POUNDS)	ARM (cm) (INCHES)	MARK IF INSTALLED		
	G. CABIN ACCOMODATIONS						
1G	SUN VISORS (2)	130303	(.32) 1.0	(83.8) 33.0	X		
2G	RESTRAINT ASSY, REAR (2)	140318	(2.27) 5.0	(194.3) 76.48	X		
3G	RESTRAINT ASSY, FWD (2)	140318	(2.27) 5.0	(106.7) 42.0	X		
4G	SEAT BELT ASSY - REAR (2)	140262	(1.36) 3.0	(180.3) 71.0	X		
5G							
6G							
7G							
8G							
9G							
10G							
11G							

EQUIPMENT LIST

MR-EQ-H1

MO.	01		
DAY	18		
YEAR	00		

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	H. AVIONICS & AUTOPILOTS								
1H	NAT AA80 INTERVOX	810150	(.32)	.7	(43.2)	17.0			
2H	KING KLN90A GPS	810427	(3.13)	6.9	(59.44)	23.4			
3H	KING KCS-55A	810150	(5.14)	11.34	(168.81)	66.46	X		
4H	KING KMA-24	810150	(.77)	1.7	(48.26)	19.0			
5H	TERRA ENCODER	810150	(.23)	.50	(30.48)	12.0			
6H	KING KLN-90B GPS	810434	(3.13)	6.9	(59.44)	23.4			
7H	DAVID CLARK ISOCOM	810150	(.32)	.70	(43.18)	17.0			
8H	KING KX 155	810150	(2.3)	5.1	(36.65)	14.43			
9H	KING KX 165	810150	(2.6)	5.7	(36.53)	14.38			
10H	KING KI 203	810150	(.73)	1.6	(38.1)	15.0			
11H	KING KR 87 w/KI 229	810150	(3.61)	8.0	(112.4)	44.25			
12H	KING KR 87	810150	(2.41)	5.2	(148.3)	58.4			

EQUIPMENT LIST

MR-EQ-H2

MO.	01
DAY	18
YEAR	00

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	H. AVIONICS & AUTOPILOTS								
13H	KING KN 62A	810150	(1.20)	2.6	(38.1)	15.0			
14H	KING KT 76A	810150	(1.4)	3.1	(37.1)	14.6			
15H	KING KFC 150	830081	(13.4)	29.5	(204.0)	80.3			
16H	KING KR87 w/KI227	810150	(2.67)	5.9	(136.1)	53.6			
17H	KING KLN89B	810434	(1.43)	3.15	(86.7)	34.13			
18H	INSIGHT STRIKEFINDER	810430	(2.0)	4.35	(220.0)	86.6			
19H	INSIGHT GEM MODEL 602	950248	(1.20)	2.6	(-7.6)	-3.0			
20H	GARMIN 155 GPS	810433	(1.0)	2.2	(36.5)	14.38			
21H	DRE SYMPHONY INTERCOM	810202	(.55)	1.22	(81.28)	32.0			
22H	INTERCOM (QUITE FLITE)	810150	(.23)	.5	(48.3)	19.0			
23H	NAT INTERCOM	810150	(.32)	.7	(43.2)	17.0			
24H	KAP 100 PA	830081	(10.3)	22.8	(209.83)	82.6			

EQUIPMENT LIST

M-EQ-H3

MO.	01		
DAY	18		
YEAR	00		

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	H. AVIONICS & AUTOPILOTS (CON'T)								
25H	KT71-00 TRANSPONDER	810150	(1.8)	3.9	(39.6)	15.6			
26H	KI229 RMI	810150	(1.3)	2.8	(45.7)	18.0			
27H	AA80 INTER-VOX	810202	(.32)	.7	(43.2)	17.0			
28H	AA83 INTER-VOX (MUSIC)	810202	(.32)	.7	(43.2)	17.0			
29H	WX10/10A	810413	(5.6)	12.3	(245.1)	96.5			
30H	WX1000/1000+ SERIES III	810197	(5.0)	10.9	(283.3)	111.5			
31H	KAP 150 PA (KFC-150)	830081	(13.2)	29.1	(206.5)	82.6			
32H	KAS297B ALT. PRESELECT	830081	(1.4)	3.1	(29.7)	11.7			
33H	EHIS 40	810247	(15.8)	34.9	(226.1)	81.3			
34H	KRA 10 RADAR ALT.	810150	(1.7)	3.8	(149.4)	58.8			
35H	FUEL FLOW (SHADIN)	820336	(.63)	1.4	(46.9)	18.5	X		
36H	GPS 155 (GARMIN)	810433	(1.5)	3.3	(58.4)	23.0			

EQUIPMENT LIST

MR-EQ-H4

MO.	01
DAY	18
YEAR	00

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	H. AVIONICS & AUTOPILOT'S (CON'T)								
37H	KING KX155A-w/GLIDE SLOPE	810150	(1.81)	4.0	(36.9)	14.54			
38H	KING KX155A-	810150	(1.59)	3.5	(36.9)	14.54			
39H	KING KI 204	810150	(.77)	1.7	(38.1)	15.0			
40H	KING KT 76C	810150	(1.09)	2.4	(38.1)	15.0	X		
41H	BOSE HEADSET (w/INTERFACE)	810150			*	*	X		
42H	PMA 7000MS	810150	(1.0)	2.2	(73.7)	29.0	X		
43H									
44H									
45H									
46H									
47H									
	* LOCATION WILL VARY								

EQUIPMENT LIST

M-EQ-I1

MO.	01	
DAY	18	
YEAR	00	

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	I. AUXILIARY EQUIPMENT (FLY AWAY)								
1I	TOW BAR, FOLDING (STOWED)	010036	(1.03)	2.6	(273.1)	107.5	X		
2I	JACK POINTS (2) (STOWED)		(.07)	.1	(332.7)	131.0	X		
3I	EYE BOLT, WING TIE DOWN (2) (STOWED)		(.09)	.1	(332.7)	131.0	X		
4I	FUEL SAMPLER CUP (STOWED)		(.04)	.05	(332.7)	131.0	X		
5I	BAGGAGE TIE DOWNS (2) (STOWED)		(.04)	.16	(332.7)	131.0	X		
6I	CARGO RESTRAINT BELTS (2) (STOWED)		(.27)	1.0	(332.7)	131.0	X		
7I	PITOT COVER (STOWED)		(.03)	.3	(332.7)	131.0	X		
8I	POH/AFM No. - MOONEY		(.84)	1.5	(332.7)	131.0	X		
9I	ENGINE OPERATOR'S MANUAL-LYCOMING		(.35)	.5	(332.7)	131.0	X		
10I	ENGINE LOG BOOK		(.07)	.2	(332.7)	131.0	X		
11I	AIRFRAME LOG BOOK	010036	(.063)	.2	(332.7)	131.0	X		
12I									

EQUIPMENT LIST

MO.	01		
DAY	18		
YEAR	00		

M-EQ-J1

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	J. OPTIONAL EQUIPMENT								
1J	ARM REST INSTL. PILOT'S SEAT	140295	(.95)	2.1	(87.6)	34.5	X		
2J	LUMBAR SUPPORT INSTL. (2)	140300	(.99)	2.18	(88.9)	35.0			
3J	ACCESS PANEL. FUEL GAUGE (2)	210099	NEGLIGIBLE DIFFERENCE				X		
4J	RECOGNITION LIGHT INSTL (2)	210413	(.60)	1.32	(134.6)	53.0	X		
5J	RUDDER PEDAL EXTENSION INSTL (2)	720115	(.059)	.13	(38.1)	15.0	X		
6J	AUX. POWER RECPT. INSTL.	800166	(1.48)	3.27	(332.7)	131.0	X		
7J	AUX. POWER CABLE ADAPTER	880042	(3.43)	7.57	***				
8J	DUAL BRAKE INSTL	950112	(1.38)	3.05	(38.1)	15.0	X		
9J	STATIC DISCHARGE INSTL	950253	NEGLIGIBLE DIFFERENCE				X		
10J	STEP ASSY & INSTL	950256	(1.25)	2.75	(274.3)	108.0	X		
11J	FIRE EXTINGUISHER INSTL	130328	(1.20)	2.65	(153.7)	60.5	X		
12J									

*** NORMALLY STOWED IN BAGGAGE COMPARTMENT BETWEEN STA. 110 & 130.

EQUIPMENT LIST

M-EQ-J2

MO.	01		
DAY	18		
YEAR	00		

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	J. OPTIONAL EQUIPMENT (CON'T)								
13J	ANTI-COLLISION BEACON,FLASHING (RED)	950272	(.48)	1.06	(457.2)	180.0	X		
14J	ANTI-COLLISION BEACON,ROTATING (RED)	950252	(.68)	1.5	(457.2)	180.0			
15J	TANIS HEATER	950209	(.78)	1.71	(-62.87)	-24.75			
16J	HEADREST INSTL., REAR	140313/140323	(1.57)	3.47	(203.20)	80.0	X		
17J	HEADREST INSTL., FRONT	140313/140323	(1.57)	3.47	(114.3)	45.0	X		
18J	SKYMAP	810218	(8.71)	19.2	(159.25)	62.7			
19J	DEFROSTER BLOWER	640314	(.39)	.87	(24.1)	9.5	X		
20J	3 PASSENGER, REAR, BENCH SEAT	140305	NO CHANGE		NO CHANGE				
21J	TKS AIRFRAME/WINGS	690007	(16.8)	36.5	(202.3)	79.6	(NO FLUID)		
22J	TKS PROPELLER (KNOWN ICING)	690007	(18.1)	39.8	(203.5)	80.1	(NO FLUID)		
23J	TKS - FLUID (6 GAL.)	690007	(25.0)	55.2	(179.6)	70.7			
24J	WX-950 STORMSCOPE	810437	(2.7)	5.9	(175.4)	69.1			

EQUIPMENT LIST

MR-EQ-J3

MO.	01
DAY	18
YEAR	00

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg) (POUNDS)	ARM (cm) (INCHES)	MARK IF INSTALLED		
	J. OPTIONAL EQUIPMENT (CON'T)						
25J	King KFC225 A/P w/KEA130A	830139	33.1	81.64	X		
26J	WX-500 Processor	810447	3.34	147.42	X		
27J	Garmin GNS 430	810445	6.50	15.05	X		
28J	Garmin GNS 430	810445	6.50	15.05	X		
29J	GI 106A w/Glideslope	810445	1.4	15.00	X		
30J							
31J							
32J							
33J							
34J							

EQUIPMENT LIST

MO.	01
DAY	18
YEAR	00

MR-EQ-J4

ITEM NO.	ITEM DESCRIPTION	REF. DRAWING	WEIGHT (Kg)	WEIGHT (POUNDS)	ARM (cm)	ARM (INCHES)	MARK IF INSTALLED		
	J. OPTIONAL EQUIPMENT (CON'T)								

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TABLE OF CONTENTS (con't)

INTRODUCTION

Acquiring a working knowledge of the aircraft's controls and equipment is one of your important first steps in developing a fully efficient operating technique. This Airplane and Systems Section describes location, function, and operation of systems' controls and equipment. It is recommended that you, the pilot, familiarize yourself with all controls and systems while sitting in the pilot's seat and rehearsing the systems operations and flight procedures portions of this manual.

AIRFRAME

The M20R is an all metal, low wing, high performance airplane. The fuselage has a welded, tubular-steel cabin frame covered with non-structural aluminum skins. Access to the cabin is provided by a door located on the right side of the fuselage. A door is provided aft of the rear seat for access to the baggage compartment. The aft fuselage, tailcone, is of semi-monocoque construction.

Seating in the cabin is provided for the pilot and three passengers.

The M20R has a tapered, full-cantilever, laminar-flow type wing. The airfoil varies from a NACA 63_2-215 at the wing root to a NACA 64_1-412 at the wing tip, modified by an inboard leading edge cuff.

An aerodynamically designed cover is attached to the wing tip and contains the wing navigation, anti-collision and optional recognition lights. Wrap-around stretched formed skins cover the wing; flush riveting is used on the forward, top and bottom two thirds of the wing chord to provide benefit of laminar flow aerodynamics.

The empennage consists of the vertical and horizontal stabilizer assembly and the rudder and elevator surfaces. The entire empennage pivots around attaching points on the aft fuselage to provide pitch attitude trim.

The tricycle landing gear allows maximum vision and ground maneuvering. Hydraulic disc brakes and a steerable nose wheel aid in directional control during taxiing and ground operations. The landing gear is electrically retracted and extended. A warning horn, a gear position indicator on the floorboard and a green "GEAR DOWN" light help prevent inadvertent gear-up landings. A manual emergency gear extension system is provided in the event of electrical failure.

FLIGHT CONTROLS DESCRIPTION

The aircraft has dual flight controls and can be flown from either the pilot or co-pilot seat. Dual pairs of foot pedals control rudder and nose wheel steering mechanisms. Push-pull tubes, rather than conventional cable/pulley systems, actuate all-metal flight control surfaces. Rod-end bearings are used throughout the flight control systems. These bearings are simple and require little maintenance other than occasional lubrication. Specially designed aluminum-alloy extrusions, that permit flush skin attachment, form the leading edges of the rudder and elevators. A spring-loaded interconnect device indirectly joins aileron and rudder control systems to assist in lateral stability during flight maneuvers. Longitudinal pitch trim is achieved through a trim control system that pivots the entire empennage around tailcone attachment points. A variable down-spring located in the tailcone and a bobweight located forward of the control column help create desirable stability characteristics.

Aileron System

The ailerons are of all-metal construction with beveled trailing edges. Three hinges of machined, extruded aluminum attach each aileron to aft wing spar outboard of wing flaps. The ailerons link to the control wheel through push-pull tubes and bellcranks. Counterweights balance the system.

Elevator System

Elevator construction is essentially the same as that of the ailerons. Both elevators attach to the horizontal stabilizer at four hinge points. Push-pull tubes and bellcranks link the elevators to the control wheel. Counterweights balance the elevators.

Rudder System

The rudder attaches to the aft, vertical fin spar at four hinge points. Push-pull tubes and bell-cranks link rudder to the rudder pedals.

Stabilizer Trim System

To provide pitch trim control, the entire empennage pivots around its main hinge points. The system consists of a manually operated (electrical operation optional) actuator that operates a series of torque tubes and universal joints connected to a jack screw on the aft tailcone bulkhead. A trim control wheel, located between pilot and co-pilot seats, allows pilot to set stabilizer trim angle. Trim position is indicated by an electrical gauge (LED) located in the lower, center instrument panel. The indicator is controlled by a potentiometer. This indicates stabilizer position relative to the aircraft thrust line.

Rudder Trim System

The M20R is equipped with an electric rudder trim system which allows the pilot to trim out much of the rudder force required for takeoff, climb, cruise and descent. The system is a "bungee" type spring assembly, attached to the rudder control system and driven by an electric motor. The trim system is operated by a split, toggle switch located above the throttle on the pilot's panel. The split switch is a safety measure that greatly reduces the possibility of a runaway trim situation. The electric trim indicator (LED) is located adjacent to the toggle switch. A potentiometer controls the rudder trim position indicator. Takeoff position is within the last 3 lighted segments on the right end of the indicator. Rudder force varies from negligible (with trim to the far right) to mild (with trim set to the third segment from the right). Cruise setting will result in the trim indicator being slightly left of neutral. A high speed descent will result in an even more left of neutral position.

Wing Flaps

The wing flaps are electrically operated and interconnected through a torque tube and bell-cranks. Total flap area is 17.98 square feet.
Nominal travel is 0 to 33°. Limit switches prevent travel beyond these limits. Wing flap position is controlled by a pre-select switch located on the lower center console. Also located on the center console is a flap position indicator showing which pre-select position has been selected: full up, takeoff (10°) or full down positions. A potentiometer controls the flap position indicator (LED). Generally, aircraft trim requirements will change with use of the flaps. Lowering of the flaps will cause a nose down pitching condition which can be easily corrected by application of nose up trim. Conversely, retraction of the flaps, from a trimmed flight condition, will cause a nose up pitching condition. Use of flaps should always be within the operational limits established in SECTION II. The flaps are very effective in lowering landing speed and can be used to slow the aircraft to approach speeds.

INSTRUMENT PANEL

The instrument panel is designed to provide functional grouping of all flight, radio, engine instruments, switches and controls required to operate various systems. All flight instruments are grouped on the shock-mounted panel directly in front of the pilot. Power plant instruments are grouped in clusters and located above the flight instruments. The radio panel is in two sections, slightly left and forward of co-pilot's seat. The annunciator panel and optional radio console are on the left section of the radio panels. The circuit breaker panel is located on the far right, in front of the co-pilot's seat.

NOTE: The illustrations depict a standard panel configuration. The location of instruments, switches, and avionics may be relocated in each aircraft, dependant upon the optional equipment selected by the customer and available panel space.

FLIGHT PANEL & INSTRUMENTS

Flight instruments operate: (1) by barometric pressure or barometric-impact air pressure differences, (2) by variations in electric current due to mechanically varied resistance, (3) by a drawn into an evacuated case or (4) by reference to the earth's magnetic field.

1. CLOCK)
The electric, digital, panel mounted DAVTRON Model 800 clock, may be used and set by the following procedures:

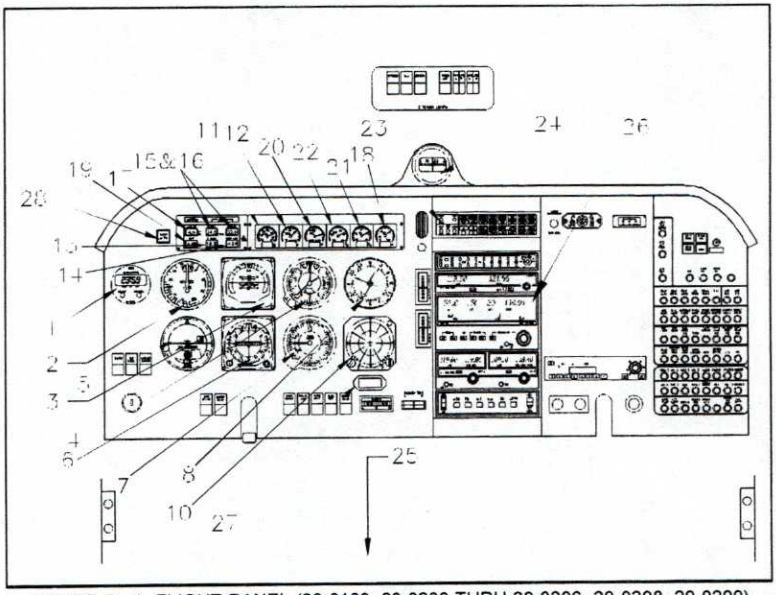

FIGURE 7 - 1 FLIGHT PANEL (29-0183, 29-0200 THRU 29-0296, 29-0298, 29-0299)

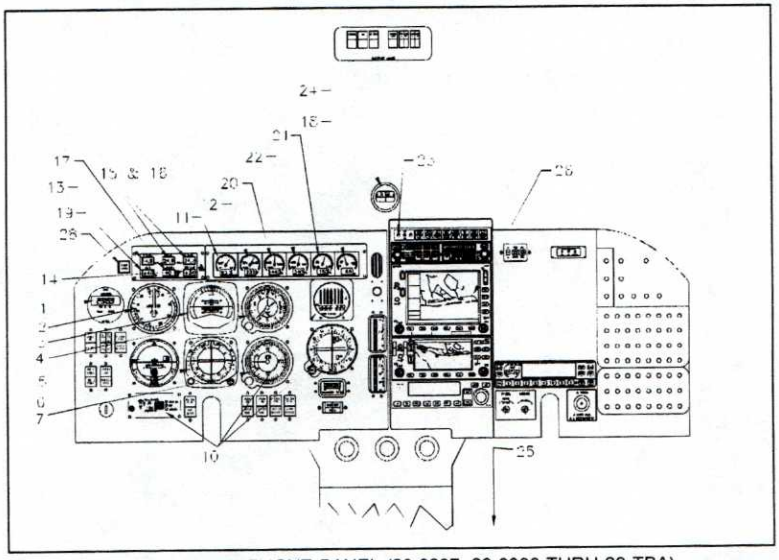

FIGURE 7 - 1A FLIGHT PANEL (29-0297, 29-0300 THRU 29-TBA)

The SEL button selects what is to be displayed on the four digit window and the CTL button controls what is being displayed. Pressing select sequentially selects GMT, Local Time , Elapsed Time and back to GMT. The control button starts and resets Elapsed Time when momentarily pushed . Normal operation of the M800 cannot accidentally reset time.

-SETTING GMT
Select GMT for display in the four digit window with the SEL button. Simultaneously press both the select and control buttons to enter the set mode. The tens of hours digit will start flashing. The control button has full control of the flashing digit and each button push increments the digit. Once the tens of hours is set, the select button selects the next digit to be set. After the last digit has been selected and set with the control button, a final push of the select button exits the mode. The lighted annunciator will resume its normal flashing, indicating the GMT clock is running.

-SETTING LOCAL TIME
Select Local Time, (LT) using the SEL button. Simultaneously push the SEL and CTL buttons to enter set mode. The tens of hours digit will start flashing. The set operation is the same as GMT, except that minutes are already synchronized with the GMT clock and cannot be set in Local Time.

-TEST MODE
Hold SEL button down for three seconds and the display will indicate 88:88 and activate all four annunciators.

-ELAPSED TIME COUNT "UP"
Select ET for display. Press CTL button, ET count will start. Elapsed Time counts up to 59 minute, 59 seconds, and then switches to hours and minutes. It continues counting up to 99 hours and 59 minutes. Press CTL button again to reset to zero.

-ELAPSED TIME COUNT "DOWN"
Select ET display and enter set mode by pressing both buttons. The countdown time can now be set. Entering the time is identical to GMT time setting. When the time is entered and the last digit is no lights flashing, the clock is ready to start the countdown. Momentarily pressing the button starts the countdown. When the count reaches zero, the displays flash and the external alarm is activated. Pressing either SEL or CTL will deactivate the alarm. ET continues counting UP.

2. AIRSPEED INDICATOR
The airspeed indicator registers airspeed in knots. The air pressure difference between the pitot tube and static ports on each side of the tailcone operates the airspeed indicator.

3. ARTIFICIAL HORIZON
Varies with installed equipment.

4. ALTIMETER
The altimeter operates by absolute pressure and converts barometric pressure to altitude reading in feet above mean sea level. The altimeter has a fixed dial with three pointers to indicate hundreds, thousands and tens-of-thousands of feet. Barometric pressure is sensed through the static ports. A knob adjusts a movable dial, a small window on the face of the main dial, to indicate local barometric pressure and to correct the altimeter reading for prevailing conditions.

5. TURN COORDINATOR
The turn coordinator operates from an electric power source. The turn coordinator is independent of the flight reference gyros. The turn coordinator displays variation in roll and yaw to the pilot by means of a damped miniature aircraft silhouette display - this provides the pilot with essential information to execute a "proper turn".

6. GYROSCOPIC HEADING INDICATOR (DG)
The vacuum operated directional gyro displays airplane heading on a compass card in relation to a fixed simulated airplane image and index. The directional indicator may precess slightly over a period of time. Therefore, the compass card should be set in accordance with the magnetic compass just prior to takeoff and occasionally checked and readjusted on extended flights. A knob on the lower left edge of the instrument is used to adjust the compass card to correct for any precession. A slaved flux gate compass is optional; if installed and ON will keep the DG corrected during the flight.
Optional equipment may be installed as desired.

7. VERTICAL SPEED INDICATOR
The vertical speed indicator converts barometric pressure changes in the static lines to aircraft ascent or descent rate readings in feet per minute. This indicator has a single needle and two adjoining scales that read from 0 to 2000 feet per minute.

8. AUTOMATIC DIRECTION FINDER (INDICATOR) (ADF)

9. NAVIGATION INSTRUMENT NO. 2.

10. (OPTIONAL) Stormscope, Second Altimeter, etc.

11. MANIFOLD PRESSURE
The manifold pressure gauge is of the direct reading type. The gauge is calibrated in inches of mercury (Hg) and indicates the pressure in the induction air manifold.

12. TACHOMETER
The tachometer is an electronic meter which counts ignition pulses. The instrument is calibrated in engine revolutions per minute (RPM).

13. FUEL FLOW
Fuel flow gauge - an electric instrument operating from information provided by a fuel flow transducer. The gauge indicates fuel flow being used by the engine. The FT-101A system will depict the quantity of fuel used when the "USED" button is pushed.

14. AMMETER
Ammeter indicates battery charge or discharge. A PUSH for VOLTS button is available to show buss voltage if desired. Voltage is read on a separate scale using the same needle.

15 & 16. FUEL QUANTITY INDICATORS
Fuel quantity indicators are used in conjunction with float-operated variable-resistance transmitters in each fuel tank. Tank-full position of transmitter floats produces maximum resistance through the transmitters, permitting minimum current flow through fuel quantity indicator and maximum pointer deflection. Instruments are calibrated in portions of tank volume.

17. VACUUM INDICATOR Indicates operating vacuum pump pressure.

18. OIL PRESSURE
Electrical instrument - uses a transducer as a reference. Calibrated in pounds per square inch (PSI).

19. OAT (Outside Air Temperature)
Outside air temperature gauge provides pilot with free stream outside air temperature in ^{o} C. Location may vary on panel.

20. EXHAUST GAS TEMPERATURE (EGT)
A thermocouple probe, located at junction of #1, 3 & 5 exhaust pipes, transmits temperature variations to the indicator which serves as a visual aid during leaning. EGT varies with fuel-air ratio, power and RPM. Engine operation within BLUE ARC, during climbs, provides sufficient fuel to keep engine power within proper temperature range. Location varies on panel.

21. OIL TEMPERATURE
Oil temperature gauge - an electric instrument connected to an electrical resistance bulb on engine. Temperature changes of engine oil changes electrical resistance, thereby allowing more or less current to flow through indicating gauge. Instrument is calibrated in ^{o} F.

22. CYLINDER HEAD TEMPERATURE
Cylinder head temperature indication is controlled by an electrical resistance type temperature probe installed in cylinder number 2. The indicator receives power from aircraft electrical system. Instrument is calibrated in ^{o} F.
A 6 position switch, with probes installed in all cylinders, is optional.

23. ANNUNCIATOR PANEL
See description elsewhere in this SECTION.

24. MAGNETIC COMPASS
Magnetic compass dial is graduated in five-degree increments and is encased in liquid-filled glass and metal case. It is equipped with compensating magnets, adjustable from front of case. Access to compass light and compensating magnets is provided by pivoted covers. No maintenance is required on magnetic compass except an occasional check on a compass rose, adjustment of the compensation screws (if necessary) and replacement of the lamp.

25. HOUR METER
Hour meter - located on baggage compartment bulkhead and indicates elapsed time while engine is running. Location may vary depending on installed systems.

26. RADIO INSTRUMENTS
Refer to SECTION IX for the description of the radio/navigation configuration installed in this aircraft.

27. ALTITUDE PRE-SELECT - OPTIONAL

28. MASTER WARNING LIGHT - When any RED warning light on the panel shows that a system or component is malfunctioning, this MASTER WARN light illuminates in approximately 15-20 seconds after any annunciator light begins to show a malfunction. Pilot should identify the source system warning light on the annunciator, then PUSH the MASTER WARN light (it contains a PUSH switch under the light). MASTER WARN light will extinguish for approximately 2 minutes or until the next system malfunction warning light on the annunciator illuminates. Repair inoperable system prior to next flight.

SWITCHES & CONTROLS

NOTE: The illustrations depict a standard panel configuration. The location of instruments, switches, and avionics may be relocated in each aircraft, dependant upon the optional equipment selected by the customer and available panel space.

1. MAGNETO/STARTER SWITCH
Magneto/Starter switch combines both ignition and starting functions. Turning ignition key clockwise through R, L, and BOTH to START position and then pushing forward on key and receptacle, engages starter. Releasing key when engine starts allows switch to return, by spring action, to BOTH position.

2. RADIO MASTER SWITCH
Switch operates a relay supplying power to the avionics buss. Since relay is energized to turn avionics buss OFF, failure of relay coil will still allow electrical power to avionics buss. Energizing starter automatically energizes relay and disconnects all avionics from buss. Electric trim switch, on control wheel, is tied to avionics buss and will not operate unless RADIO MASTER and TRIM switch on pilot's panel are - ON.

3. ALTERNATOR FIELD SWITCH
This switch cuts alternator field power from main buss to alternator.

4. MASTER SWITCH
Master switch operates battery relay which controls battery power (selected battery) to main buss. This switch cuts ALL ship power OFF, except cabin overhead lights, baggage compartment light and electric clock.

5. OPTIONAL - Rotating/Flashing Beacon, etc.

6. STROBE LIGHT (STROBE LITE) SWITCH/CIRCUIT BREAKER
Strobe light combination switch/circuit breaker turns wing tip and tail strobe lights ON. Should a short occur, the combination switch/circuit breaker will automatically trip to the OFF position.

7. NAVIGATION LIGHT (NAV LITE) SWITCH/CIRCUIT BREAKER
Navigation light combination switch/circuit breaker turns wing tip and tail navigation lights ON. Should a short occur, the combination switch/circuit breaker will automatically trip to the OFF position. The glareshield and panel lights are also turned on when this switch is ON. Control dimming of either glareshield or panel lights with rotating switches on lower console.

8. RECOGNITION LIGHT (LITE) (If installed)
Recognition light combination switch/circuit breaker turns recognition light ON. Should a short occur, combination switch/circuit breaker will automatically trip to OFF position.

9. TAXI LIGHT (TAXI LITE) SWITCHES (L & R)
10. LANDING LIGHT (LDG LITE) SWITCHES (L & R)
Select and push split switches to turn desired set of lights ON. Push switches OFF to turn desired set of lights off. Lights should be operated only for short time periods while not in flight to preclude overheating of lamps. Over load protection is achieved by circuit breakers in panel.

11. GEAR SAFETY BY PASS SWITCH (Gear Retraction Override)
Gear safety over ride switch is a manual means of electrically by-passing the Air speed Safety Switch. In the event the landing gear switch is placed in gear-up position, a properly operating Airspeed Safety Switch prevents gear from being retracted before takeoff speed of approximately 60 +/-5 KTS is reached. To retract landing gear at a lower air speed, the GR SAFETY BY PASS switch may be held de-pressed until landing gear is completely retracted.

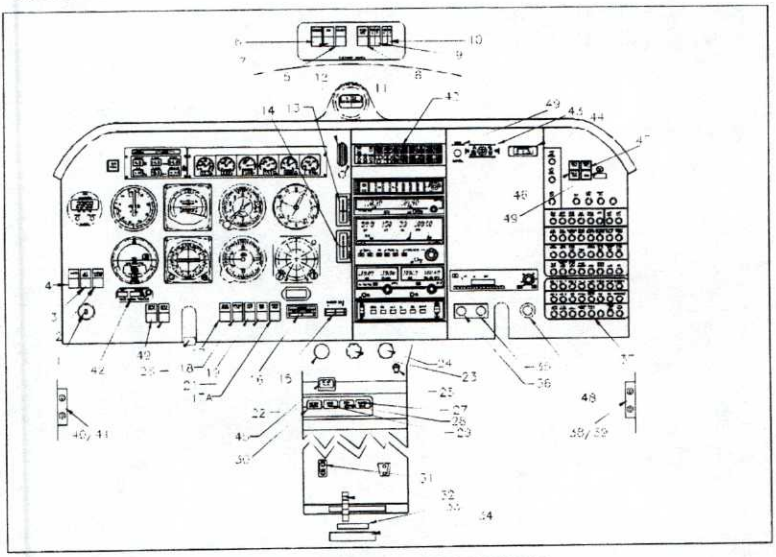

FIGURE 7 - 2 SWITCHES/CONTROLS
(29-0183, 29-0200 THRU 29-0296, 29-0298, 29-0299)

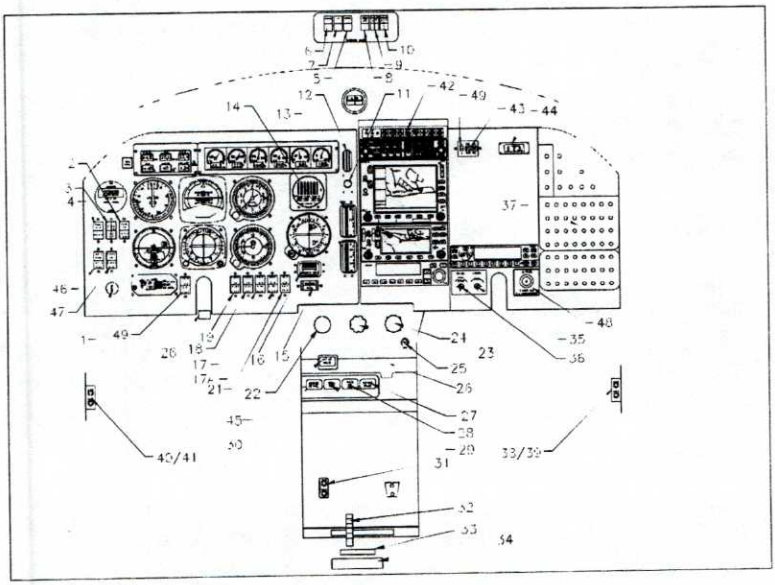

FIGURE 7 - 2A SWITCHES/CONTROLS (29-0297, 29-0300THRU 29-TBA)

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~ CAUTION ~

Activation of landing gear safety override switch overrides the safety features of airspeed safety switch and CAN cause landing gear to start retracting while aircraft is on ground.

12. LANDING GEAR SWITCH
Electric gear switch, identified by its wheel shaped knob, is a two-position switch. Pulling aft and lowering knob lowers landing gear while pulling aft and raising knob raises landing gear.

| NOTE|

Failure to "Pull" knob out prior to movement may result in a broken switch.

13. STABILIZER TRIM POSITIONINDICATOR
Stabilizer trim position indicator (LED) is electrically activatedby a potentiometer attached to trim wheel mechanism. The position signal is transmitted to indicator by resistance readings.

14. FLAP POSITIONINDICATOR
Wing flap position is electrically indicated by the (LED) flap indicator, located on flight panel. The intermediate mark on lens is the flap TAKEOFF setting. Signal is transmitted to indicator thru a potentiometer attached to flap mechanism. Position signal is transmitted to indicator by resistance readings.

15. RUDDER TRIM SWITCH
Push split toggle switch to position rudder into trimmed condition to reduce rudder pedal forces during takeoff, climbs or descents. Right - take off and climbs; Left - descents. Pushing left side of spring loaded switch trims rudder left, pushing right side of switch trims rudder right.

16. RUDDER TRIM POSITION INDICATOR
Rudder trim positionis electricallyindicated on an (LED) indicator located adjacent to switch. Signal is transmitted to indicator thru a potentiometer attached to trim mechanism. Position signal is transmitted to indicator by resistance readings.

17. " HIGH BOOST " FUEL BOOST PUMP SWITCH
An electric fuel boost pump, capable of operating engine at reduced power in case of engine driven fuel pump failure, is provided. The guarded switch (lift guard) can be pushed ON to operate engine (at reduced power) if required.

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~ CAUTION ~

Pushing HIGH BOOST pump switch ON when engine driven pump is operating properly will cause engine to quit due to excessive rich fuel mixture.

17A. BOOST PUMP SWITCH (LOW BOOST)
The Low Fuel boost pump switch connects the fuel boost pump through a voltage regulator to provide engine priming capability prior to engine start and to provide a means of purging fuel vapor from fuel system during extreme temperature situations, either environmental sources or from engine heat soak situations.

18. STAND-BY VACUUM (STBY VAC) SWITCH.
When HI/LO VAC annunciator light illuminates (steady or flashing), the vacuum operated gyro instruments are considered to be unreliable. STBY VAC switch should be turned ON. Refer to Airborne Service Letter, No. 31, located in SECTION X.

19. PITOT HEAT SWITCH/CIRCUIT BREAKER
Pitot heat combination switch/circuit breaker turns heating elements within pitot tube on. Should a short occur, the combination switch/circuit breaker will automatically trip to OFF position. "PITOT HEAT" annunciator light will illuminate "BLUE"when switch is ON and current is flowing through pitot heater. On some export aircraft, annunciator will illuminate "AMBER" when switch is OFF and will not be illuminated when ON and drawing current.

20. PROPELLER DE-ICE (PROP DE-ICE) SWITCH (If installed).
See SECTION IX for operating procedures. (29-0001 thru 29-0169)
NOT USED ON FIGURE 2A.

21. ELEVATOR TRIM (ELEC TRIM)SWITCH
Switch is normally left in ON position and serves as both a circuit protectorand a masterdisconnect for the electric trim system in the event of a malfunction. The Radio Master Switch must be ON before power is available to elevator trim system.

22. THROTTLE CONTROL
Push throttle control forward to increase engine power. Pull throttle aft to decrease engine power. Vernier control is optional.

23. PROPELLER CONTROL
Push propeller control forward to increase engine RPM; pull control aft to decrease engine RPM. Control is a vernier type and fine adjustments of RPM can be obtained by turning knob clockwise to increase RPM and counter clockwise to decrease RPM. Knob should not be turned IN any closer than .030" to .060" to panel nut face.

24. MIXTURE CONTROL
Mixture control allows pilot to adjust the fuel-air ratio (mixture) of the engine. Push control forward to enrichen mixture. Pull control full aft to close idle cutoff, shutting down engine. Control is a vernier type and fine adjustments of mixture can be obtained by turning knob clockwise to enrichen mixture and counterclockwise to lean. Knob should not be turned IN any closer than .030" to .060" to panel nut face.

25. WING FLAP SWITCH
Flap switch, on console, operates the electrically-actuated wide span wing flaps. The flap switch incorporates a pre-select feature for TAKEOFF and FULL DOWN positions. Move switch down to first detent position to obtain TAKE OFF flaps (10°). Move switch to full down position to select FULL DOWN flaps (33°). When flap switch is moved UP to either TAKE OFF position or FULL UP position the flaps will retract to the selected position.

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~CAUTION~
Positioning Flap Switch to the UP position retracts the flaps completely.

26. ALTERNATE STATIC SOURCE VALVE
Pull alternate static source valve full aft to change source of static air for the altimeter, airspeed and vertical speed indicator from outside of aircraft to cabin interior. Airspeed and altimeter readings are affected slightly when alternate static source is used (See Charts in SECTION V).

27. PARKING BRAKE CONTROL
Depress brake pedals and pull parking brake control to set parking brake. Push parking brake control in to release parking brake.

28. CABIN VENT CONTROL (Fresh Air)
Pull cabin vent control aft to open valve in mixing box connected to cabin air inlet NACA vent located on the right side of the airplane. Optimum use of cabin vent control is described in the Cabin Environment Section.

29. CABIN HEAT CONTROL
Pull cabin heat control to turn cabin heat on. To lower cabin temperature, cabin heat control is pushed forward to ward the OFF position. Optimum use of cabin heat control is described in the Cabin Environment Section.

30. DEFROST CONTROL
Pull defrost control to decrease air flow to lower cabin area and increase air flow to windshield ducts in the front of glareshield area. Optimum use of the defrost control is described in the Cabin Environment Section.

31. MIC. JACK (Hand Held Microphone) [If installed]
Plug hand held microphone jack into this plug and place microphone in holder located on front of lower console.

32. TRIM CONTROL WHEEL
Rotating trim control wheel forward lowers nose during flight; rearward rotation raises nose of aircraft during flight. If optional electric trim system is installed, pushing both sides of split trim switch, located on left hand portion of pilots control wheel, will electrically trim aircraft.

33. FUEL SELECTOR VALVE
Fuel selector valve, located on floorboard, is a three position valve which allows pilot to select either left or right fuel tank. Turning valve OFF, shuts off ALL fuel to engine. At full throttle engine will stop from fuel starvation in 2 to 3 seconds.

34. GEAR DOWN POSITION INDICATOR (Floorboard)
The gear-down position indicator, near back of fuel selector valve pan, aft of center console, has two marks that align when landing gear is down and illuminates when GREEN GEAR DOWN light is ON. A red- white striped decal shows when landing gear is NOT in the down position.
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35. RADIO LIGHT SWITCH AND DIMMER
Turning radio light switch knob clockwise turns radio and indicator lights ON. Continued turning clockwise increases light intensity. This control also operates internal instrument lights.

36. PANEL LIGHT SWITCH AND DIMMER
Turning panel light switch knob clockwise turns instrument lights located in glareshield ON. Continued turning clockwise increases light intensity.

37. CIRCUIT BREAKER PANEL
See details elsewhere in this Section.

38 & 39. CO-PILOT'S HEADSET JACKS.
40 & 41. PILOT'S HEADSET JACKS.

42. ANNUNCIATOR PANEL
See description elsewhere in this section.

43. OPTIONAL DIRECTIONAL GYROSCOPIC INDICATOR REMOTE SLAVE and/or COMPENSATION SWITCH.

44. EMERGENCY LOCATOR TRANSMITTER (ELT) SWITCH (ARM/ON)
Place in ARM position for routine operation. Refer to ELT description elsewhere in this section on proper and lawful usage.

45. ALTERNATE AIR (ALT AIR)
Automatically opens when Induction air system becomes blocked for any reason. May be opened manually by pulling knob aft. AMBER annunciator light will illuminate when alternate air door is open.

46. BATTERY SELECT SWITCH - BAT 1/BAT 2
This switch allows pilot to select either battery as primary for any flight. Battery #1 is normally used for operations. The battery not being used is recharged through a trickle charge system. It is recommended to switch batteries occasionally.

47. EMERGENCY BUSS SWITCH
(Optional when Stand-by Alternator is installed)
When Low Voltage annunciator light illuminates, steady or flashing, pull 70A BAT circuit breaker and PUSH EMERG BUS switch ON to bring Stand-by Alternator on line.

48. ACCESSORY SOCKET (14 volts)
Used for accessories that require 14 volts to operate. Maximum of 3 AMPS continuous, 5 AMPS intermittent requirements.

49. OPTIONAL EQUIPMENT SWITCHES

MAP LIGHT SWITCH/RHEOSTAT, MIKE SWITCH, ELECTRIC TRIM SWITCH (if installed) & OPTIONAL AUTO-PILOT SWITCHES are located in the pilot's control wheel.

ANNUNCIATOR & SWITCH PANEL

ANNUNCIATOR

A. PRESS-TO-TEST SWITCH
Press RED press-to-test switch (3-5 sec.) with Master Switch ON to illuminate light bulbs (some annunciator legends may not be active, see descriptions below). Defective bulbs must be replaced prior to flight. Includes MASTER WARN light on S/N 29-0170 thru 29-TBA.

B. DIM SWITCH
The DIM switch may be activated after the low fuel lights come on bright. The switch will dim both low fuel lights but will not turn them off. To restore display to bright, press TEST switch.

1. GEAR SAFETY INDICATOR (GEAR DOWN)
2. GEAR SAFETY INDICATOR (GEAR UNSAFE)
A GEAR DOWN light (GREEN), a GEAR UNSAFE light (RED), and a warning horn provide visual and audible gear position signals. The green (GEAR DOWN) light shows continuously when gear is fully extended. With navigation lights ON, the GEAR DOWN light is dimmed for night operation. All gear lights are OUT when landing gear is fully retracted. Additional verification is accomplished by checking floorboard indicator window.

3. LEFT FUEL
4. RIGHT FUEL
Left and/or right, fuel annunciator light (RED) comes on when there is 6 to 8 gallons (23 to 30.3 liters) of usable fuel remaining in the respective tank.

5. SPEED BRAKE
Illuminates AMBER when speed brakes are extended.

6. ALT AIR
Illuminates AMBER when the alternate air door is opened, either manually or automatically. In this situation, induction air for the engine is drawn from inside cowling rather than through the NACA induction air intake. The normal induction air system MUST be checked, for proper operation, prior to next flight.

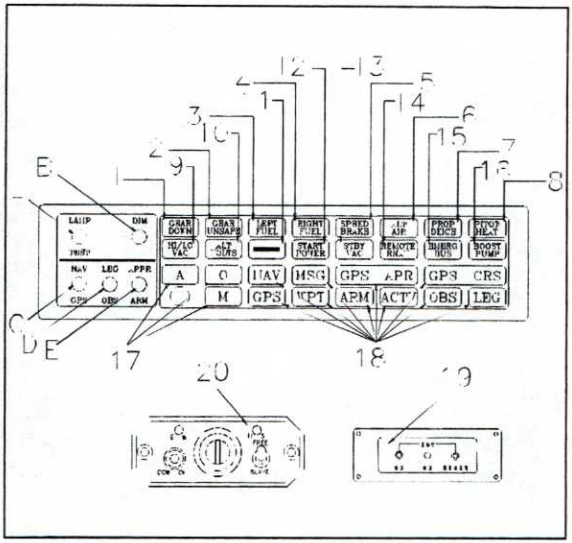

FIGURE 7 - 3 ANNUNCIATOR & SWITCH PANEL
S/N 29-0183, 29-0200 THRU 29-TBA
[CONFIG. VARIES WITH OPTIONAL EQUIP]

| NOTE |

Induction of alternate air (warm air) will result in loss of power.

7. PROP DE-ICE
Illuminates BLUE when Propeller De-Ice has been selected ON.

8. PITOT HEAT
Illuminates BLUE when pilot has selected PITOT HEAT rocker switch ON.
Some exported aircraft will Illuminate AMBER when switch is OFF or when there is any type of electrical failure in pitot heat system and WILL NOT BE illuminated when the switch is ON.

9. HI/LO VAC
A RED light indicates a malfunction or improper adjustment of vacuum system. Vacuum is available for operation of attitude gyro and directional gyro. Designated vacuum range is 4.25 +/- .25 to 5.5 +.2/-0.0 inches of mercury (Hg). The HI/LO VAC light will BLINK WHEN VACUUM IS BELOW 4.25 in. Hg. and illuminate STEADY WHEN VACUUM IS ABOVE 5.5 in. Hg. In either case, gyros should not be considered reliable during this warning time. Refer to Airborne Service Letter No. 31, located in SECTION X.

10. ALT VOLTS
A RED light indicates improper voltage supply. A FLASHING RED light indicates alternator voltage output is below load requirements or no voltage from alternator; a STEADY RED light indicates over voltage or tripped voltage relay.

11. SPARE

12. START POWER
Illuminates RED when the starter switch or relay has malfunctioned and the starter is engaged while the engine is running. Shut the engine off as soon as practicable.

13. STBY VAC
Illuminates AMBER when Stand by Vacuum Switch has been selected to ON.

14. REMOTE RNAV (Optional)
TRIM FAIL Legend is installed for KFC-225 system. Legend may be blank for other systems.

15. EMERGENCY BUS
A steady EMERG BUS light will illuminate AMBER when EMERG BUS is selected ON.

16. BOOST PUMP
Illuminates BLUE when the Electric Fuel Boost Pump is selected ON. Light comes on high; intensity when HI BOOST switch is ON and low intensity when LOW BOOST switch is ON.

SWITCH PANELS & ANNUNCIATOR PANELS MAY VARY WITH AIRCRAFT

C., D., E.. NAVIGATION MODE SELECTION SWITCHES

17. MARKER BEACONS
Illuminates applicable colors as aircraft passes over marker beacons on approach.

18. NAVIGATION SELECTION LIGHTS (VARIES WITH INSTALLED EQUIPMENT)
Illuminates as the pilot selects the navigation system desired. Varies with installed equipment.

19. ELT SWITCH

20. OPTIONAL SWITCHES

GROUND CONTROL

NOSE GEAR STEERING

Nose gear steering system consists of a steering horn on nose gear leg linked to the rudder pedals by push-pull tubes and . Gear retraction automatically disengages steering mechanism from nose wheel and centers nose wheel for entry into wheel well.

TAXIING AND GROUND HANDLING

The aircraft can be easily taxied with minimum use of brakes. Minimum turning radius is 40 ft. (12.0 m) right & 48 ft. (14.4 m) left, without use of brakes. A MANUAL tow bar is provided to ground handle aircraft. Care must be used to not swivel nose wheel beyond 13° right or 11° left from center. Adjustable steering stops are incorporated on nose gear leg assembly.

~~~~~~
~ CAUTION ~
Exceeding steering swivel angle limits may cause structural damage.

LANDING GEAR

CONSTRUCTION

Landing gear legs are constructed of chrome-molybdenum tubular steel, heat-treated for greater strength and wear resistance. Main gear leg attaching points pivot in bearing surfaces on forward and stub spars. The nose gear mounts on cabin tubular steel frame and engine mount. Rubber discs in all gear leg assemblies absorb shock of taxiing and landing.

RETRACTION SYSTEM

Landing gear is electrically retracted and extended. The landing gear switch operates a landing gear actuator relay. Pull wheel-shaped knob out and move it to upper detent to raise landing gear. However, an Airspeed Safety Switch, located on left fuselage side adjacent to the pilot's left knee and connected to the airspeed indicator, is incorporated into the electrical system to prevent landing gear retraction while on the ground and until a safe takeoff speed (approximately 60 +/-5 KTS) is reached. A properly rigged up-limit switch will stop landing gear in its retracted position. Move control knob to its lower detent to lower landing gear. A properly rigged
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down-limit switch will stop landing gear actuating motor when proper force has been exerted to hold landing gear in the down-and-locked position. Bungee springs pre-load retraction mechanism in an over center position to assist in holding landing gear down. A landing gear safety by-pass switch override is provided, next to the gear switch, should landing gear fail to retract. Depress and hold this switch to manually by pass airspeed safety switch and allow landing gear to retract.

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~ CAUTION ~

Never rely on airspeed safety switch to keep landing gear down during taxi, takeoff or landing. Always make certain that landing gear switch is in down position during these operations.

WHEEL BRAKES

Main gear wheels incorporate self-adjusting, disc-type, dual puck, hydraulic brakes. The pilot's rudder pedals have individual toe-actuated brake cylinders linked to the rudder pedals. Depressing both toe pedals and pulling parking brake control, on console, sets the brakes. Push parking brake control forward to release brakes.
It is not advisable to set parking brake when brakes are overheated, after heavy braking or when outside temperatures are unusually high. Trapped hydraulic fluid may expand with heat and damage the system. Wheel chocks and tie downs should be used for long-term parking.

EMERGENCY EXTENSION SYSTEM

A manual, emergency gear extension mechanism is provided to allow emergency lowering of landing gear. The control mechanism is located between and aft of pilot and co-pilot seats. The RED lever must be released and pulled up (rotated aft) to engage the manual emergency extension mechanism. The mechanism has a spring retracted pull cable which manually drives the gear actuator to extend landing gear. 12-20 pulls are required to fully extend and lock landing gear down. The electrical extension or retraction system will not operate if the manual extension lever is not properly positioned down.

WARNING SYSTEM

The landing gear warning system consists of: 1) landing gear condition lights, GREEN for "GEAR DOWN" and RED for "GEAR UNSAFE", and 2) a warning horn, activated when landing gear is not down-and-locked and throttle is approximately 1/4 inch from idle position. The green light shows continuously when landing gear is fully extended. The red light shows whenever landing gear is in transit or not locked down but is OFF when landing gear is fully retracted. A visual gear-position indicator, located on floorboard, aft of the fuel selector, shows that landing gear is down when indicator marks align. The gear down light is dimmed when navigation lights are turned on.

STEERING

Rudder pedal action steers the nose wheel. Gear retraction relieves the rudder control system of its nose wheel steering and centers wheel to permit retraction into the nose wheel well. Minimum turning radius on the ground is 40 feet (12.0 m) to the right and 48 feet (14.4 m) to the left. Adjustable steering stops have been incorporated on nose gear leg assembly.

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~ CAUTION ~

The nose wheel must not be swivelled beyond 11° left or 13° right of center. To exceed these limits may cause structural damage.

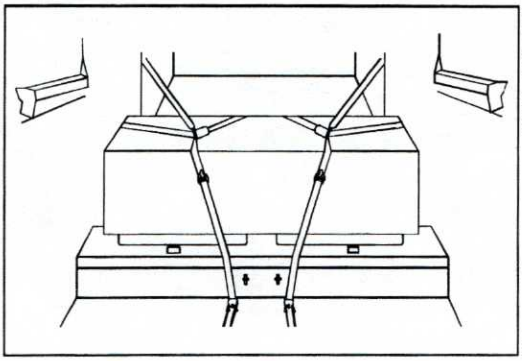
CABIN

BAGGAGE COMPARTMENT

The baggage compartment is located aft of rear passenger seats. The standard compartment has 20.9 cubic feet (.59 cu.m.) of baggage or cargo space. A maximum of 120 pounds (54 Kg) may be loaded in this area. There are floor tiedown straps provided. Passengers should not be allowed to occupy this space.
Additional cargo space is available by removing rear seat, bottom cushion and seat back cushion/cover (fold seat back forward and slide seat cover UP and OFF frame. Store cushions as desired).
To fold rear seat back down, pull lock pin (left side frame). Pull seat frame from pivot rods. Place pivot rods into portion of seat frame that carpet is attached to. Slide frame down until approxi-

mately bottomed out. Pull seat back release handle UP to move catch down. Pivot seat back forward & down into seat cushion cavity.
Both rear seats can be folded down together or independent of each other.
The storage area located aft of the top of the aft baggage compartment bulkhead (hat rack) is restricted to 10 pounds (4.5 Kg).

CARGO RESTRAINT



Cargo tie down rings/clevis pins are to be inserted into holes pro vided in web of front seat rails. The cargo belts attach to these rings and to stan dard seat belt har ness to retain cargo. Refer to Figure 7-4 for typical restraint.

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~ CAUTION ~
Proper loading and retention of cargo is mandatory. See Loading Computation Graph, SECTION VI.

FIGURE 7 - 4 CARGO RETENTION (TYPICAL)

SEATS

The front seats are individually mounted and may be adjusted fore and aft to fit individual comfort preferences. The front seat back may be adjusted by turning left side hand crank (knob) until seat back is in desired position.

Both optional front seat configurations allow vertical seat height adjustment by turning right side hand crank to raise or lower the entire seat assembly.
The rear seat backs have four (4) adjustment positions. Each seat can be adjusted independent of the other by pull ing up on re spec tive re lease han dle lo cated on left or right of air craft center line on for ward spar. This al lows ad just ments from ap proxi mately 10° to 40° re cline po si tion.

SEAT BELTS/SAFETY HARNESS

Safety restraints, if worn properly, (1 occupant per restraint) keep occupants firmly in their seats during T/O, landing, turbulent air and during maneuvers. The belts/harnesses are mechanically simple and comfortable to wear. The front seat inertia belts/harnesses are attached to hard points on side structure and seats. The rear seat belts are attached to brackets firmly mounted to structural hard points. Shoulder harnesses are provided for rear seat occupants. Safety belts/harnesses MUST be fastened for take-off and landing operations. It is recommended that all in fants and small chil dren be low 40 lbs. weight and/or un der 40 in. height be restrained in an approved child restraint system appropriate to their height and weight.

The sin gle di ago nal type safety har ness is de signed so the chest strap crosses di ago nally from the outboard shoulder to an attachment point as low on the in board hip as possible.
Rear seat occupants should take care to conform with this procedure in adjusting chest strap and inboard belt length. This diagonal configuration places body center-of-gravity inside the triangle formed by chest strap and lap belt. The lap belt should be adjusted comfortably tight. As a result, the body is re stricted from roll ing out to ward the un re stricted shoul der or "open" side of the harness, upon forward im pact. Re fer to Figure 7-5 for proper seat belt/harness adjustment.

DOORS, WINDOWS & EXITS

CABIN DOOR

Access into cabin is provided by a door located on right side of fuselage. This door has inside and outside operating handles. Outside door handle can be locked with a key specifically provided for it. The door has two latching mechanisms, one located at the top of door and one at the aft, center of door.
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Should the door come open in flight, flying qualities of the aircraft will not be affected. Procedures for closing door in flight are contained in SECTION III.

PILOT'S WINDOW

A pilot's storm window is located in the left main cabin window. This window is generally used for fresh air for prolonged ground operations or as required during adverse weather conditions. The window should not be opened in flight above 132 KIAS.

EMERGENCY EXITS

The CABIN DOOR is the primary emergency exit from the cabin. If a situation exists where a probable off airport landing will occur, the door should be unlatched to prevent jamming during landing.

The BAGGAGE compartment access DOOR can be used as an auxiliary exit. The door can be opened from the inside even though locked. To open, pull off small ABS cover, pull out latch pin and pull Red Handle.
To verify re-engagement of latching mechanism; open outside handle fully, close inside handle to engage pin into cam slide of latch mechanism; insert latch pin into shaft hole to hold Red Handle down. Replace ABS cover. Operate outside handle in normal method.

ENGINE

GENERAL

The engine installed is a Teledyne Continental Motors IO 550-G(*), normally aspirated fuel injected engine. The following designation describes engine :

I	Denotes "FUEL INJECTED"
O	Denotes "OPPOSED" (refers to the horizontally opposed cylinders)
550	Denotes piston displacement in "CUBIC INCHES"
G(*)	Denotes a specific equipment configuration

* Refer to TCDS for engine configuration required.

The engine operates with three, standard engine controls. The propeller turns clockwise as viewed from the cockpit.

ENGINE CONTROLS

The engine controls are centrally located between the pilot and co-pilot on the engine control console. The BLACK throttle knob regulates manifold pressure; push the knob forward to increase the setting; pull the knob aft to decrease the setting. A vernier throttle control is optional.

The propeller control, with its crowned BLUE knob, controls engine RPM through the propeller governor. Push the knob forward to increase engine RPM; pull the knob aft to decrease RPM.

The mixture control, with its RED fluted knob, establishes the fuel-air ratio (mixture). Push the knob full forward to set the mixture to full-rich, pull the knob gradually aft to lean the mixture. Pull the knob to its maximum aft travel position to close the idle cut-off valve to completely shut down the engine. Precise mixture settings can be established by observing the EGT gauge on the pilot's instrument panel while adjusting the mixture control.

The optional throttle, propeller and mixture controls are vernier type and fine adjustment can be made by turning knobs clockwise or counter-clockwise. The vernier controls should be rigged within .030 to .060 in. from panel nut face. Rapid movement or large adjustments can be made by pushing button on end of control and positioning control where desired. The non-vernier throttle has an integral friction device.

ENGINE INSTRUMENTS

Engine instruments operate electrically, except manifold pressure, through variations in resistance caused by pressure or temperature changes or by variations in current output caused by varying engine RPM or alternator output. The tachometer receives its signal from the Hall effect sensor in magneto.

Engine operating instruments are located in the center of the instrument panel. Colored arcs on instrument faces mark operating ranges. Proper interpretation of engine instrument readings is essential for selecting optimum control settings and for maintaining maximum cruise fuel economy. (Refer to SECTION II for Limitations).

ENGINE OPERATION AND CARE

Life of an engine is determined by the care it receives. Maximum efficiency and engine service life can be expected when a good maintenance program is followed. Poor maintenance results in faulty engine performance and reduced service life. Efficient engine operation demands careful attention to cleanliness of air, fuel, oil and maintaining operating temperatures within required limits. Servicing of the engine should be accomplished only by qualified personnel. The minimum grade of fuel for this engine is 100 LL or 100 octane aviation gasoline. If the grade required is not available, use a higher rated fuel; never use a lower rated fuel. Operational procedures for adverse environmental conditions can be found in engine maintenance and operator's manual.

OIL SYSTEM

The engine has a full-pressure, wet sump oil system with an 8 quart (7.57 liters) capacity. A conventional dip stick is provided for determining oil quantity. The oil system is depicted in Figure 7-6. The propeller governor boosts engine oil pressure for operation of the propeller. It controls oil pressure going to the propeller hub to maintain or change propeller blade angles. This oil flows through propeller shaft to reach the propeller.

LUBRICATION SYSTEM

Oil Filter - Full flow oil filter is a throw away filter element with a bypass valve incorporated.

BREATHER FOR CRANKCASE

The crankcase is vented overboard to a near static location.

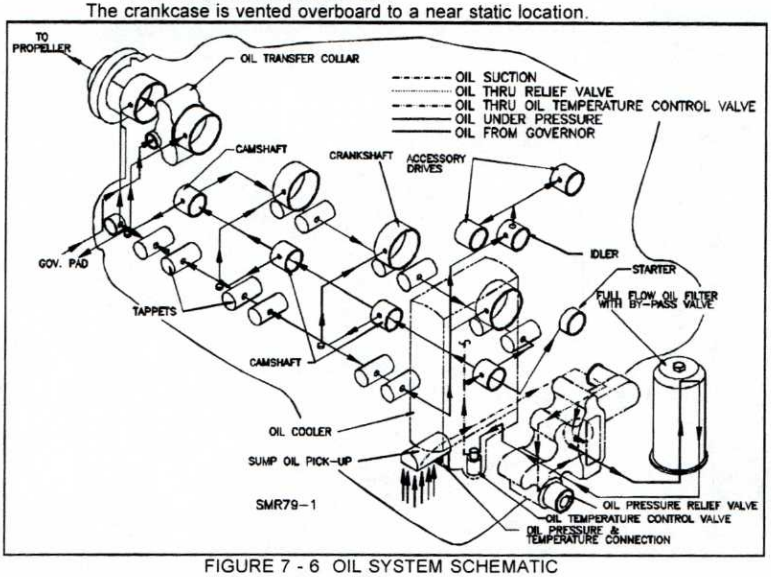

FIGURE 7 - 6 OIL SYSTEM SCHEMATIC

IGNITION SYSTEM

Power from the engine crankshaft is transmitted through camshaft gear to the magneto drive gears, which in turn drives the magneto drive couplings. The left magneto incorporates an impulse coupling. As the rubber bushings in the drive gear turns the coupling drive lugs, counter weighted latch pawls inside the coupling cover, engage pins on the magneto case and hold back the latch plate until forced inward by the coupling cover. When the latch plate is released, the coupling spring spins the magneto shaft through its neutral position and the breaker opens to produce a high voltage surge in the secondary coil. The spring action permits the latch plate, magnet and breaker to be delayed through a lag angle of 30 degrees of drive gear rotation dur-

ing the engine cranking period. Two lobes on the breaker cam produce two sparks per revolution of the drive shaft. After engine is running, counter-weights hold the latch pawls away from the stop pins and the magneto shaft is driven at full advance.

The engine firing order is 1-6-3-2-5-4. Ignition harnesses are connected to the magnetos so right magneto fires the upper plugs on the right side and lower plugs on the left. The left magneto fires the upper plugs on the left and lower plugs on the right. The magneto cases, spark plugs, harnesses and connections are shielded to prevent radio interference.

AIR INDUCTION SYSTEM

The engine air induction system consists of a NACA, flush-type air inlet duct located on front of lower cowling. The air inlet duct incorporates the air filter housing. This housing contains a throw-away, paper canister type air filter element.

A secondary or alternate air source for combustion air is provided. This air inlet has a spring loaded door which normally remains closed. If the air filter or induction air inlet should become restricted, the alternate air door will automatically open. Warmer air will then be drawn from the engine compartment. There will be a reduction of engine power when the alternate air door is open due to lower inlet air pressure and higher air temperature. Whenever the alternate air door is open, a switch will activate the "ALT AIR" annunciator light on the panel to alert the pilot.

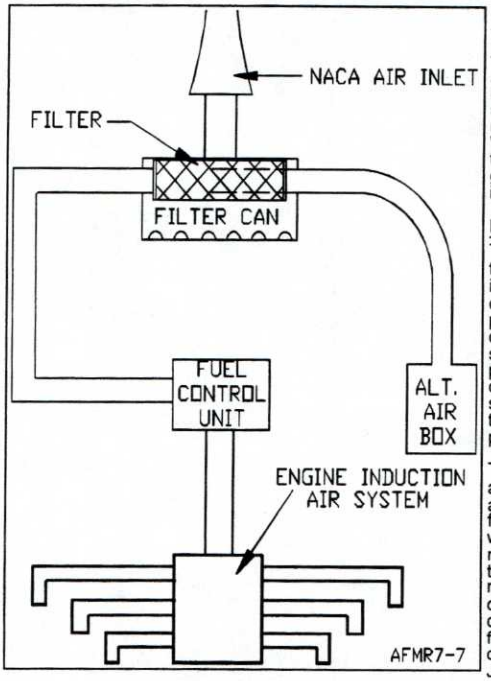

FIGURE 7 - 7 AIR INDUCTION SYSTEM SCHEMATIC

ICING PROTECTION

Continued operation of the induction system in the event of intake air being obstructed is provided by activation of the alternate air system. The alternate air is automatically or manually controlled. When the door is opened, unfiltered, relatively warm air, from engine compartment, is admitted into the induction system.

EXHAUST SYSTEM

The exhaust system consists of tubes from each cylinder mating into a muffler under the engine crankcase. The right collector pipe crosses through muffler and out an exhaust pipe on the left side of aircraft. The left collector pipe crosses through muffler and out an exhaust pipe on the right side of aircraft. A short tailpipe attaches to the end of each exhaust pipe.

The muffler has a heat shroud around it which serves as a cabin air heater. Outside ambient air is forced into the cabin heater by forward velocity. Air flows around the muffler, picking up heat and is then carried to a cabin heat J-box mounted on the firewall. When cabin heat is not required, the air continues to flow around the muffler for cooling and is dumped overboard through the cabin heat J-box outlet duct.

FUEL INJECTION

The fuel injection system is of the multi-nozzle, continuous flow type which controls fuel flow to match engine requirements. Any change in air throttle position, engine speed or a combination of these causes changes in fuel pressure in direct relation to engine requirements. A manual mixture control is provided for precise leaning at any altitude and power setting. A fuel flow system is installed for digital readout of fuel flow in gallons per hour. However, fuel flow is NOT to be used as reference for manual leaning. Use the EGT gauge for this purpose.

The continuous-flow system permits the use of a typical rotary vane pump with integral relief valve. With this system there is no need for an intricate mechanism for timing fuel injection to the engine. The fuel injector pump is equipped with a separator where vapor is separated by a swirling augmenter system from the liquid fuel and returned to the tank selected. The fuel injector pump forces liquid fuel into the metering unit assembly.

The fuel metering unit/air throttle controls the amount of intake air admitted into the intake manifold and meters the proportionate amount of fuel to the fuel manifold valve. The assembly has three control units, one for air, in the air throttle assembly, and two for the fuel control unit.

The manifold valve receives fuel from the metering unit. When fuel pressure reaches approximately 3.5 PSI, a check valve opens and admits fuel to six ports in the manifold valve (one port for each fuel nozzle line). The manifold valve also serves to provide a clean cutoff of fuel to the cylinder when engine is shut down.

The injector nozzle lines connect the manifold valve to the six fuel injector nozzles.

The injector nozzles (one per cylinder) are "air bleed" type fuel nozzles which spray fuel directly into the intake port of the cylinder. When engine is running, flow through the nozzle is continuous and will enter the cylinder combustion chamber when the intake valve opens.

Since the size of the fuel nozzles are fixed, the amount of fuel flowing through them is determined by the pressure applied. For this reason, fuel flow may be accurately determined by measuring fuel pressure at the manifold valve.

ENGINE COOLING AIR

Ram air is drawn into the forward part of upper cowl and flows down, around the cylinders using several baffles to control air direction. Hot air, off the cylinders, exits cowl thru lower cowl openings, located on either side of engine lower cowl, immediately forward of the firewall.

ENGINE STARTING SYSTEM

Engine starting is provided by a 24 volt starter. A starter engaged warning light (START POWER) is incorporated as standard equipment in annunciator panel. Ignition is provided by an impulse coupled magneto.

The engine firing order is 1-6-3-2-5-4. The ignition harnesses are connected to the magnetos so the right magneto fires the upper plugs on the right side and lower plugs on the left. The left magneto fires the upper plugs on the left and the lower plugs on the right.

ACCESSORIES

ALTERNATOR

Standard electrical power is supplied by a gear driven, 28 Volt, 100 ampere alternator.

An optional l gear driven, 24 Volt, 20 ampere stand-by alternator is available.

VACUUM PUMP

A full time, engine driven vacuum pump supplies suction for the vacuum-operated gyroscopic flight instruments. Air entering vacuum-powered instruments is filtered: hence, sluggish or erratic operation of vacuum driven instruments may indicate that a clogged vacuum filter is preventing adequate air intake. A vacuum annunciator light is provided to monitor system operation. Refer to Airborne Service Letter No. 31, located in Section X.
One Stand-by Vacuum pump is also driven from the engine accessory case, but is coupled through an electrically actuated clutch. Another Stand-by Vacuum pump system (electric) is installed in the tailcone. The pilot must PUSH a panel mounted rocker switch ON for either Stand-by Vacuum system to be operable.

EXHAUST GAS TEMPERATURE PROBE

The exhaust gas temperature (EGT) probe measures exhaust gas temperature as it exits the exhaust valves into the exhaust manifold. The EGT probe varies electrical current (milliamps), based on exhaust gas temperature, and supplies this to an EGT gauge located on instrument panel. The EGT gauge is used as the primary source to lean fuel mixture.

PROPELLER

The propeller is a two blade, metal, constant speed unit. Propeller rotational speed (RPM) is maintained by a balance of air load, oil pressure and engine rotational forces. The propeller governor regulates a flow of high pressure engine oil to a piston in the propeller dome. The pis-

ton is linked by a sliding rod and fork arrangement to propeller blades. Governor oil pressure, acting on a piston and spring, increase propeller blade pitch, thus decreasing propeller and engine RPM. As oil pressure is reduced, centrifugal twisting moments on the propeller blades decrease pro pel ler blade pitch and in crease RPM.

In cruise, always use the power setting charts provided in SECTION V.

FUEL SYSTEM

Fuel is carried in two integrally sealed sections of the forward, inboard area of wing. Total usable fuel capacity is 89 U.S. gallons (337 liters). There are sump drains at the lowest point in each tank for taking fuel samples to check for sediment contamination or condensed water accumulation.

The recessed three position fuel selector valve, aft of console, on the floor, allows pilot to set selector valve to LEFT tank, RIGHT tank or OFF position.

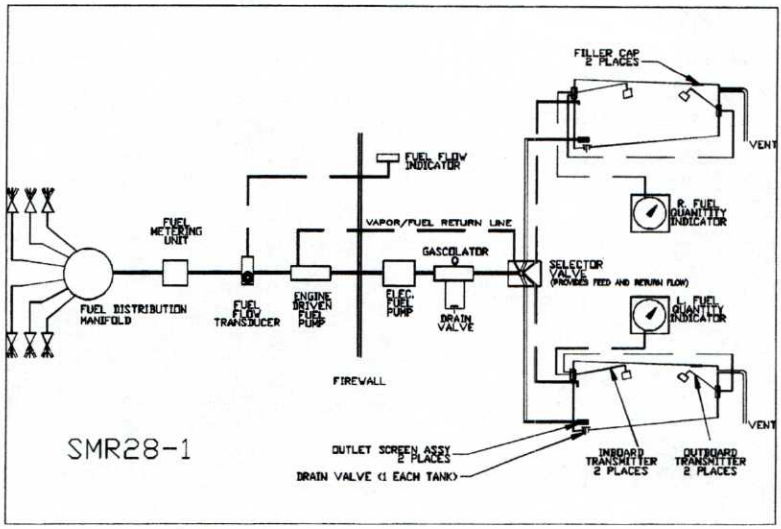

FIGURE 7 - 8 FUEL SYSTEM SCHEMATIC

The gascolator, located at right of selector valve, in the floorboard, is for draining condensed water and sediment from lowest point in fuel system before first flight of the day and after each refueling. The gascolator sump can be used to drain the selected fuel tank.

Fuel is de liv ered, by the en gine driven pump, to a throt tle body fuel in jec tor where pres sure is regulated and the correct volume of fuel is metered to each cylinder of the engine.
Fuel not needed by the engine is returned to the tank from which it is drawn.

An electric Fuel Boost Pump is provided which has the capability of operating engine at partial power in case of engine driven fuel pump failure. The pump is controlled by two switches. The "BOOST PUMP" switch is to be used for priming engine during normal starting procedures (See SECTION IV) or purging fuel vapor from sys tem when en vi ron mental con di tions or a heat soaked engine may require it. (See SECTION III). The BOOST PUMP switch connects the pump through a voltage regulator for correct pump output. A guard on the "HIGH BOOST" switch prevents inadvertent operation and must be lifted for switch operation. (See SECTION III). "HIGH BOOST" is to be used when en gine driven fuel pump has mal func tioned and will provide suf fi cient fuel for par tial power op era tion un til a pre cau tion ary land ing can be made to correct malfunction.

Two electric fuel-level transmitters, working in series, in each wing tank operate the appropriate, left or right, fuel quantity gauges. The master switch actuates the fuel quantity indicator system to depict an indication of fuel remaining in each tank. Vents in each fuel tank allow for overflow and pressure equalization.
The optional, visual fuel quantity indicators, in the top of each wing, are to be use for PARTIAL FUEL LOADING only and NOT for preflight inspection purpose.

Fuel Flow indicating system (if installed) indicates the volume of fuel being used, total fuel used or fuel remaining or time remaining. Optional fuel flow systems are available and each do not indicate the same type data. The fuel flow memory switch can be shut off if aircraft is to be stored for long periods of time.

ELECTRICAL SYSTEM

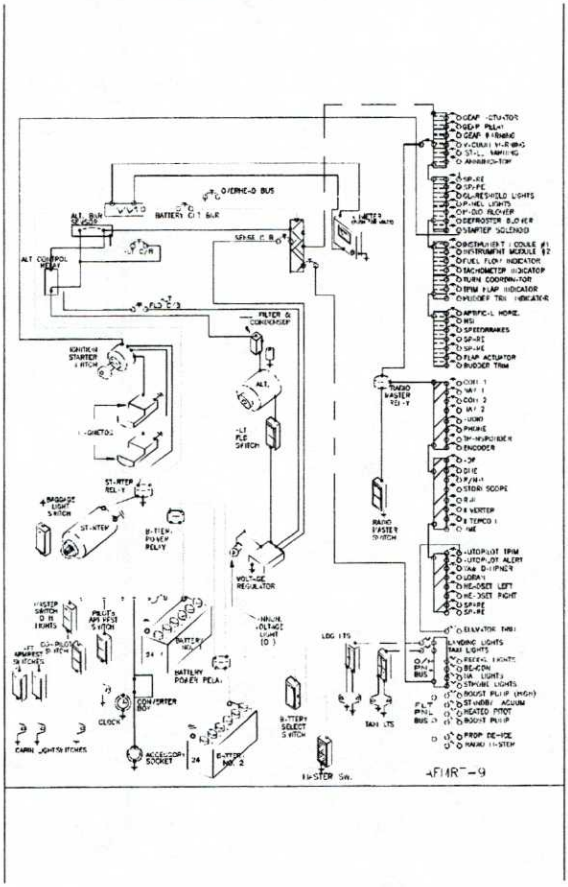

FIGURE 7-9 ELECTRICAL SCHEMATIC

ALTERNATOR & BATTERY

Two 24-volt, 10-ampere-hour storage batteries (in the tailcone) and one 100 ampere self-rectifying alternator (produces 99 amps) supplies electrical power for equipment operation. The No. 1 battery, left side of tailcone, is normally used as the primary to sustain the electrical system and to start the aircraft. The No. 2 battery, right side of tailcone, is normally considered as backup and is kept in a fully charged condition by trickle charge, through a diode system.

Should the No. 1 battery be depleted to the point of being unable to supply adequate power for system needs, it may be de-selected from the system and No. 2 battery selected on line by pushing the rocker switch marked BAT-1/BAT-2, on the circuit breaker panel, from the BAT-1 to BAT-2 position. The MASTER switch still controls battery power to the buss from either position. With the BAT-1/BAT-2 switch in the No. 2 position the No. 1 battery will be recharged (trickle charged) through the diode system. Alternate between #1 & #2 batteries, as desired, to keep both active.

A standard Ammeter which has a "PUSH for Volts" button depicts battery charge or discharge.

SCHEMATIC (See FIGURE 7-9)

The voltage regulator adjusts alternator output to current load while maintaining a constant voltage level. A voltage warning light illuminates steadily when voltage limits are exceeded (IE. voltage spikes) and flashes when the voltage is low.

CIRCUIT BREAKER PANEL (See FIGURES 7-10/7-10A)
(Illustration depicts typical C/B panel; may vary from your aircraft)

Push-pull or rocker switch-circuit breakers automatically break the electricalcurrent flow if the system or unit receives an overload to prevent damage to electrical wiring.
The main circuit breaker panel is in the extreme right panel. Figure 7-10 illustrates a typical main circuit breaker panel with its push-pull circuit breakers. Rocker switch-circuit breakers are at the bottom and left of the pilot's flight panel.

The alternator's push-pull circuit breaker, on the main breaker panel, furnish an emergency overload break between the alternators and the power buss. Since the alternator is incapable of output in excess of circuit breaker capacity, a tripped breaker normally indicates a fault within the alternator.

The alternator field has a push-pull circuit breaker to furnish an emergency break in the alternator field excitation circuit in the event of alternator or voltage regulator malfunction. If regulator output voltage exceeds limits, the warning light illuminates steadily and the alternator field circuit breaker trips.

Resetting the alternator field circuit breaker should reset alternator. If the circuit breaker will not reset, continue flight with minimum electrical load. The flight will be continued using only battery power, caution is advised to not drain both batteries if electrical power will be required before you are able to land. Land when practicalto correct the malfunction.

|NOTE|
The circuit breakers installed in the panel may vary depending on installed equipment.

ANNUNCIATOR PANEL

The landing gear, low fuel, speed brakes, alternate air, propeller de-ice and pitot heat lights are grouped in the upper annunciator panel. The vacuum malfunction, alternator fail, start power, stand-by vacuum, remote RNAV are grouped in the lower annunciator panel.

A test and dim switch are also found in the panel; each of the lights and switches are discussed elsewhere in this Section.

ELT PANEL

The ELT Panel houses the remote ELT Switch and provides room for other switches as required for optional avionics installations. (See SECTION IX for Avionics Systems installed in this aircraft).

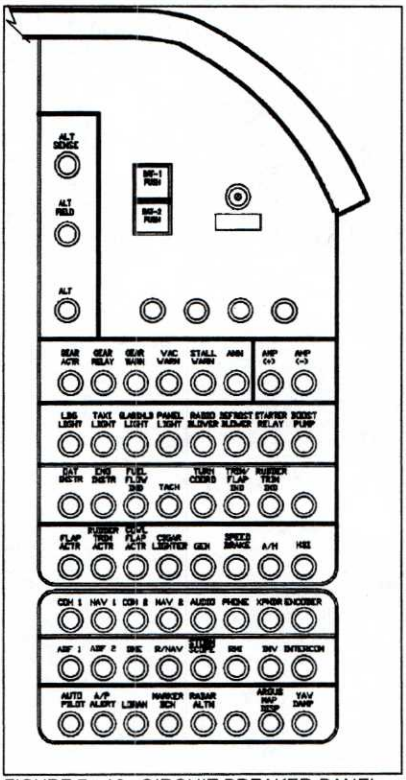

FIGURE 7 - 10 CIRCUIT BREAKER PANEL (TYPICAL)
(S/N 29-0183, 29-0200--29-0296, 0298, 0299)

LIGHTING SYSTEM

INSTRUMENT & PLACARD LIGHTS

All placards are floodlighted by lights from the glareshield. There are two rheostat knobs on the right hand radio panel. The left control regulates intensity of the placard lighting. The right control provides avionics and instrument lighting. Rotating the knobs clockwise turns ON and increases light intensity.

MAP LIGHT

The map light switch is located on the center of the pilot's and co-pilot's control wheel.

CABIN LIGHTING

Two sets of overhead lights illuminate the cabin.

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~ CAUTION ~

The Cabin Light rocker switches are connected directly to battery.

All passenger overhead lights are controlled by a Master Light switch located on the pilot's arm rest. With Master Light Switch ON, individual overhead cabin lights are controlled by rocker switches located on each passenger's arm rest (excluding front seat passenger). Front seat passenger's light switch is located forward of cabin door hinge on side panel.

EXTERIOR LIGHTING

Conventional navigation and high intensity strobe lights are installed on the wing tips and on the rudder trailing edge (strobe light only). Landing and Taxi lights are installed in the right and left wing leading edge. Split switches are used to control either the left or right taxi or landing lights. All exterior light switches are located on overhead panel just behind top of windshield.

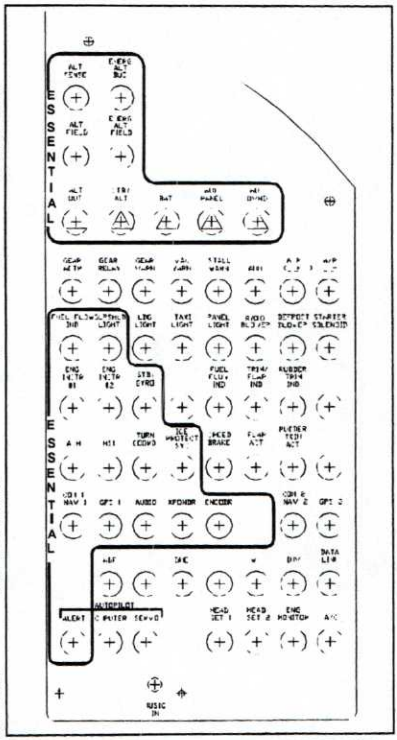

FIGURE 7-10A CIRCUIT BREAKER PANEL (TYPICAL) (S/N 29-0297, 29-0300 THRU 29-TBA))

The high intensity wing tip and tail strobe lights are required for night operation but should be turned OFF when taxiing near other aircraft or flying in fog or clouds. The conventional position lights must be used for all night operations.

CABIN ENVIRONMENT

HEATING & VENTILATION SYSTEMS

Four ventilating systems provide cabin environmental conditions which can be controlled to pilot and passenger individual preferences:

FRESH AIR - One source of outside air enters cabin through air ducts on both sides of fuselage. This outside air is always available through adjustable outlets (Wemacs) near pilot's and co-pilot's knees.

CABIN VENT - When the CABIN VENT control is pulled, fresh air from air duct on fuselage right side is supplied to the cabin (through mixer box and lower console duct) and/or to the defrost system.

CABIN HEAT - Fresh air, heated by engine exhaust muff, and cool air from air duct on co-pilot side can be individually controlled and mixed to desired temperature by use of the Cabin Vent
~~~~~~

and Cabin Heat controls. Pulling cabin heat control supplies heat to cabin and defroster system. Hot and cold air may be mixed by adjusting both heat and vent controls. These controls may be adjusted anywhere between full open and full closed.

OVERHEAD VENTILATION - Cabin overhead ventilating system works independently of cabin heating and ventilating system. Fresh air enters a NACA duct on dorsal fin and is controlled by individual outlets above and between each seat. A master air vent control regulates flow of air through the individual overhead outlets. This control is located between the pilots & co-pilots seat on the overhead panel.

WINDSHIELD DEFROSTING SYSTEM

The windshield defrost system takes air from the cabin air distribution system and distributes this over the windshield interior surface any time the heat and/or fresh air valves are opened. Pulling the defrost control Full AFT decreases flow to the cabin, turns defroster blower ON and forces maximum air to flow through the defrost ducts.

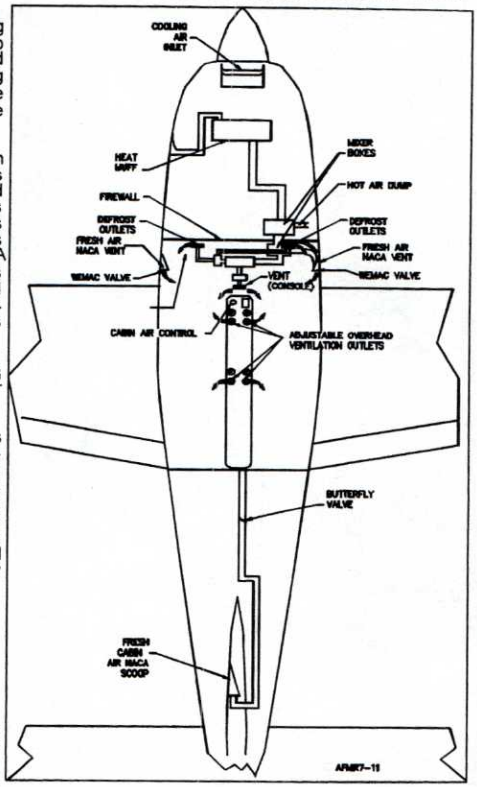

FIGURE 7 - 11 CABIN AIR FLOW

PITOT PRESSURE & STATIC SYSTEM

A pitot tube, mounted on lower surface of the left wing, picks up ram air for airspeed indicator. A pitot heater prevents pitot tube icing when flying in moisture-laden air. A pitot system drain valve is located on the forward bottom skin of the left wing to fuselage fillet. Static ports on each side of the tailcone supply static air pressure for the altimeter, the airspeed indicator, and vertical speed indicator. A static system drain valve is located on fuselage bottom skin below the left side, tailcone ac cess door and is used to drain mois ture that might col lect in static sys tem lines. An alternate static pressure source valve handle is installed in the instrument panel below the pi lot's con trol wheel shaft. Al ter nate static air is taken from within the cock pit and will affect flight instrument readings. Performance variation charts in SECTION V depict the difference between primary and alternate static indications.

STALL WARNING SYSTEM

The electrical stall warning system uses a vane-actuated switch, installed in left wing leading edge, to en er gize stall warn ing horn lo cated in the cabin. The stall warn ing switch is ad justed to provide aural warning at 5 to 10 KIAS before actual stall is reached and will remain on until aircraft flight attitude is changed toward a non-stalled condition.

| NOTE |

Do not attempt to adjust prestall warning speed by bending the vane. This part has been heat treated and cannot be bent without damaging or breaking the vane.

OXYGEN SYSTEM

An optional four-place oxygen system provides supplementary oxygen necessary for continuous flight at high altitude. An oxygen cylinder is located in the equipment bay, accessible through a removable panel on the aft wall of the baggage compartment, or through the standard external, right side, panel in the tailcone. A combined pressure regulator/shutoff valve, attached to the cylinder, automatically reduces cylinder pressure to the delivery pressure required for operating altitude. The oxygen cylinder filler valve is located under a spring loaded door aft of the baggage door.
A pilot's oxygen panel contains a cylinder pressure gauge, on the pilot's arm rest, effectively a quantity gauge, and a control knob, below arm rest, which is mechanically connected to the shutoff valve at the cylinder. The supply of oxygen can thus be shut off from the cockpit when not required. When the control is in the "ON" position, sufficient oxygen flow is available at the maximum airplane operating altitude (see Section II Limitations) while at lower altitudes the reducing valve automatically economizes the flow to conserve oxygen for longer duration or for future availability, without requiring any action by the pilot. (See Fig. 7-13)

Four oxygen outlets are provided in the overhead panel between the pilot's and co-pilot's seat for the convenience of all occupants. Oxygen flows from the outlets only when a mask hose is connected. Four partial re-breathing type masks are provided, each with vinyl plastic hoses and flow indicators. The three passenger masks are of the disposable type. The pilot's mask is a permanent type with a built-in microphone for ease of radio communication while using oxygen. To use the mask-microphone, connect its lead to the microphone jack located left of the instrument panel, in place of the aircraft or headset microphone lead, and key the switch on the control yoke.

The oxygen cylinder, (composite) when fully charged, contains either a 77.1 $ft.^3$ or 115.7 $ft.^3$ of aviator's breathing oxygen (Spec No. MIL-0-27210) under a pressure of 1850 PSI at 21° C (70° F).
Filling pressures will vary, however, due to ambient temperature in filling area, and the rise of temperature resulting from compression of the oxygen. Because of this, merely filling to 1850 PSI will not necessarily result in a properly filled cylinder. Fill to pressures indicated on Fig. 7-12 for ambient temperatures.

////////////////
// WARNING //
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Oil, grease or other lubricants in contact with oxygen create a serious fire hazard, and such contact must be avoided when handling oxygen equipment.

Ambient Temperature ° F	Filling Pressure PSIG	Ambient Temperature ° F	Filling Pressure PSIG
0	1650	50	1875
10	1700	60	1925
20	1725	70	1975
30	1775	80	2000
40	1825	90	2050

FIGURE 7-12 OXYGEN FILLING PRESSURES

| NOTE |

The oxygen cylinder should not be run down to less than 100 PSI. Below this pressure, atmospheric contamination of the cylinder may occur, requiring valve removal and cylinder cleaning and inspection at an FAA approved repair station.

For FAA requirements concerning supplemental oxygen, refer to FAR 91.32. Supplemental oxygen should be used by all occupants when cruising above 12,500 feet. It is often advisable to use oxygen at altitudes lower than 12,500 feet under conditions of night flying, fatigue, or periods of physiological or emotional disturbances. Also the habitual and excessive use of tobacco or alcohol will usually necessitate the use of oxygen at less than 10,000 feet.

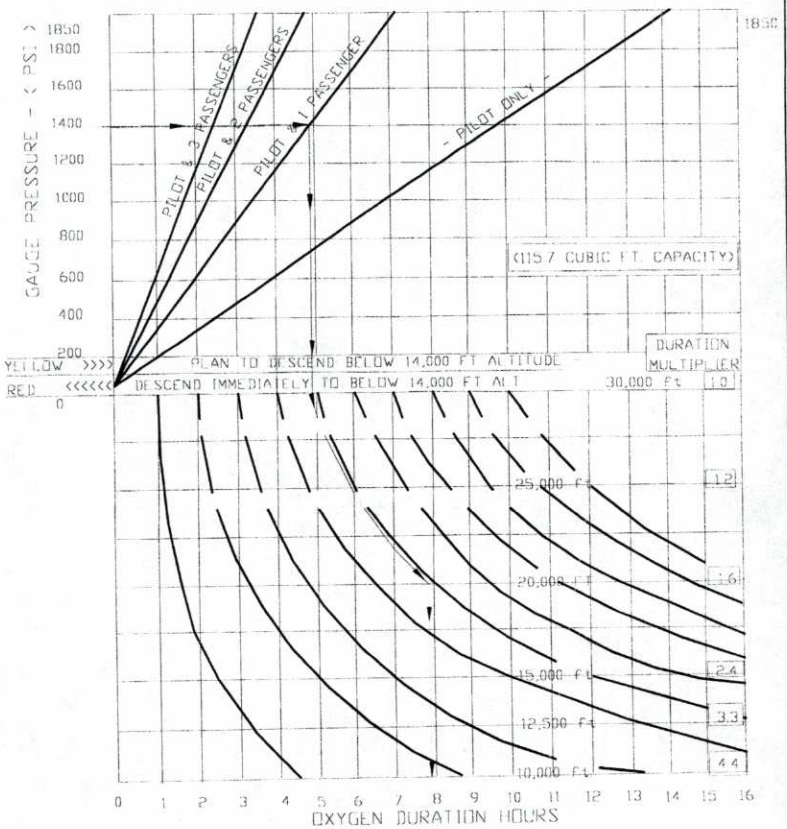

FIGURE 7 - 13 OXYGEN DURATION CHART (115.7 Cu.Ft)

The oxygen duration chart (Fig. 7-13 or Fig. 7-13A) should be used in determining the usable duration (in hours) of the oxygen supply in the airplane for the chosen cruising altitude. The following procedure outlines the method of finding the duration from the chart:

1. Note the available oxygen pressure shown on the pressure gage.

2. Locate this pressure on the scale on the left side of the chart. Then go across the chart horizontally to the right until intersecting the diagonal line which represents the number of persons on board. From that intersection drop vertically down to the heavy line, marked 30,000 ft..

3. From this point on the heavy line, follow the trend of the curved lines, down to the horizontal line representing cruise altitude. Then drop vertically down to the bottom of the chart and

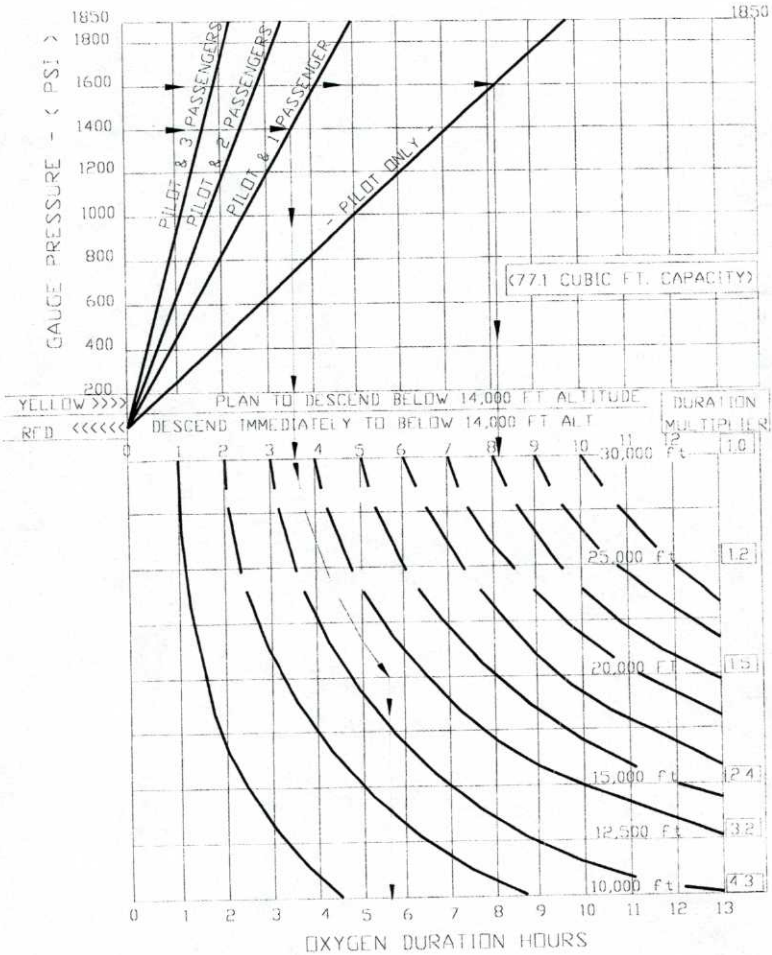

FIGURE 7-13A OXYGEN DURATION CHART 77.1 ft^3 CYLINDER

read the duration in hours given on the scale.

4. As an example of the above procedure, 1400 PSI of pressure will safely sustain the pilot and one passenger for 4 hours and 55 minutes (Fig. 7-13) at 28,000 ft.; however, cruising at 20,000 ft. would permit an oxygen duration of 7 hours and 55 minutes (Fig. 7-13).

Light crew loads and relatively low altitudes will permit oxygen durations off the chart. Such durations can be calculated by determining the duration at 30,000 feet (by steps 1 and 2 above) and multiplying by the "duration multiplier" shown on the right of the appropriate cruising altitude. Example, Pilot only, at 1600 PSI has 11.25 hours duration at 30,000 ft. Duration Multiplier of 2.4 for 20,000 ft., gives 26 hours and 54 minutes duration. Oxygen durations off the chart obviously exceed the airplanes duration. However, judicious choices of altitude for the number of persons on board can permit flight planning for several fuel stops, without need for recharging oxygen system at each stop.

CAUTION

Facial hair, beards & mustaches may prevent a proper seal between face and mask, causing 16 - 67% leakage. Duration chart may be invalid.

VACUUM SYSTEM

The standard vacuum system on the M20R consist of a main vacuum pump, regulator, filters and a clutch activated, engine driven, stand-by vacuum pump. The main vacuum pump operates when engine is running. The standard stand-by vacuum pump is coupled to the engine accessory drive but the electrically activated clutch must be turned ON, by pushing the STBY VAC switch, before the pump is on line. An optional Stand-by Vacuum Pump System is located in the tailcone when the optional, No. 2 alternator is installed.

A vacuum system malfunction is shown to the pilot by a RED, HI/LO VAC, annunciator light. A FLASHING annunciator light indicates LOW VACUUM and a STEADY light indicates HIGH VACUUM. In either case, vacuum operated instruments are to be considered UNRELIABLE and use of stand-by vacuum pump is recommended. The STBY VAC legend on the annunciator will be illuminated when the STBY VAC switch is ON.

EMERGENCY LOCATOR TRANSMITTER

The Emergency Locator Transmitter (ELT) is located in the tailcone and is accessible from the battery access door on the right side of the tailcone. The emergency locator transmitter meets the requirements of FAR 91.52 and is automatically activated by a longitudinal force of 5 to 7 g's. The ELT transmits a distress signal on both 121.5 MHz and 243.0 MHz for a period of from 48 hours in low temperature areas and up to 100 hours in high temperature areas. The unit operates on a self-contained battery. The battery should be checked at each annual inspection. The battery has a useful life of four years. However, to comply with FAA regulations it must be replaced after two years of shelf life. The battery should also be replaced if the transmitter has been used in an emergency situation or if accumulated test time exceeds one hour. The battery replacement date is marked on the transmitter label.

On the unit itself is a three position selector switch placarded "ARM", "OFF", "ON". The "ARM" position is provided to set the unit to the automatic position so that it will transmit only after impact and will continue to transmit until battery is drained to depletion or until the switch is manually moved to "OFF". "ARM" position is selected when the transmitter is installed at the factory and switch should remain in that position whenever unit is installed in the airplane.

The "ON" position is provided so unit can be used as a portable transmitter or in the event the automatic feature was not triggered by impact or to periodically test the function of the transmitter.

Select the "OFF" position when changing battery, when rearming the unit if it has been activated for any reason, or to discontinue transmission.

| NOTE |

If the switch has been placed in the "ON" position for any reason, the "OFF" position has to be selected before selecting "ARM". If "ARM" is selected directly from the "ON" position the unit will continue to transmit in the "ARM" position.

ELT REMOTE SWITCH OPERATION

A pilot's remote ELT switch, located at the top of right hand radio panel, is provided to allow transmitter to be controlled from inside cabin. The pilot's remote switch is placarded "ON", & "ARM". The unit will start transmitting with switch in "ON" position and will stop when remote switch is returned to "ARM" position during cockpit checkout.

| NOTE |

If for any reason a test transmission is necessary, the operator must first obtain permission from a local FAA or FCC representative (or other applicable Authority) or in accordance with current regulations. Test transmission should be kept to a minimal duration. Testing of ELT should be conducted only during the first five (5) minutes after any hour and no longer than three (3) audible sweeps.

The ELT should be checked during the ground check to make certain the unit has not been accidentally activated. Check by tuning a radio receiver to 121.5 MHz. If there is an oscillating/warbling sound, the locator may have been activated and should be turned off immediately. Reset to "ARM" position and check again to insure against outside interference.

TABLE OF CONTENTS

INTRODUCTION

This section contains factory recommended procedures for proper ground handling, routine care and servicing of your Mooney.

It is recommended that all aircraft undergo a complete inspection (ANNUAL) each twelve calendar months. In addition to the recommended ANNUAL inspection aircraft operated commercially (for hire) should have a complete inspection every 100 hours of operation. All inspections must be performed by a designated representative of the FAA or the Aviation Authority of the country in which the aircraft is licensed.

The FAA may require other inspections by the issuance of airworthiness directives applicable to the airplane, engine, propeller and other components. It is the responsibility of the owner/operator to ensure compliance with all applicable Airworthiness Directives and recommended "MANDATORY" Mooney Aircraft Service Bulletins/Instructions. When inspections are repetitive the owner/operator should take appropriate steps to prevent inadvertent non-compliance.

Scheduling of ALL maintenance is the responsibility of the aircraft operator. A general knowledge of the aircraft is necessary to perform day-to-day service procedures and to determine when non-routine or unusual service or shop maintenance is needed.

Service information in this section of the manual is limited to service procedures which the operator will normally perform or supervise. Reference should be made to FAR Part 43 for information regarding preventive maintenance which may be performed by a U.S. licensed pilot.

It is wise to follow a planned schedule of lubrication and preventive maintenance based on climatic and flying conditions encountered in your locality.

Keep in touch with your Mooney Service Center and take advantage of his knowledge and experience. He knows your airplane and how to maintain it. Should an extraordinary or difficult problem arise concerning the repair or upkeep of your Mooney, consult the Product Support Department, Mooney Aircraft Corporation, Louis Schreiner Field, Kerrville, TX. 78028. Telephone: Area Code (830)-896-6000 (ext. 2092) or (830) 792-2092.

All correspondence regarding your airplane should include the aircraft MODEL and SERIAL NUMBER. These numbers can be found on an identification plate located on the lower aft portion of the left side of the tailcone. The aircraft Model and Serial Number must also be used when consulting either the Service & Maintenance Manual or Illustrated Parts Catalog.

Service & Maintenance, Illustrated Parts and Service Bulletin/Service Instruction Manuals for your airframe and systems (excluding Avionics & Navigation) may be obtained from your Mooney Service Center.

Avionics and Navigation Systems information should be obtained from the applicable manufacturers.

Engine information should be obtained from Teledyne Continental Motors, P.O. Box 90, Mobile, AL 36601, USA, Telephone, (205) 438-3411.

GROUND HANDLING

TOWING

For maneuvering the aircraft in close quarters, in the hangar, or on the ramp, use the manual tow bar furnished with the aircraft loose equipment. The tow bar attaches to the nose gear crossbar. One man can move the aircraft providing the ground surface is relatively smooth and the tires are properly inflated.
When no tow bar is available, or when assistance in moving the aircraft is required, push by hand:

(1) on wing leading edges
and
(2) on inboard portion of propeller blades adjacent to propeller hub.

Towing by tractor or other powered equipment is NOT RECOMMENDED.

~ CAUTION ~

Exercise care not to turn the nose wheel past its normal swivel angle of 11° Left or 13° Right of center. Exceeding the turn limits shown on the turn indicator may cause structural damage.

TIEDOWN

As a precaution against wind damage, always tie down the aircraft when parked outside. Removable wing tie down eye-bolts, supplied with the loose equipment, screw into wing receptacles marked HOIST POINT just outboard of each main gear.
Replace these eyebolts with jack point fixtures when it is necessary to lift the aircraft with jacks. The tail tie down point is part of the tail skid.

TO TIE DOWN AIRCRAFT:

a. Park the airplane facing the wind.
b. Fasten the co-pilot seat belt through the flight control wheel. Pull seat belt snug so flight controls are immobilized.
c. Fasten strong ground-anchored chain or rope to the installed wing tie down eyebolts, and place wheel chocks fore and aft of each wheel.
d. Fasten a strong ground-anchored chain or rope through the tail skid.

JACKING

When it is necessary to raise the aircraft off the ground:

a. Install jack points in tie down mounting holes outboard of each main gear.
b. Use standard aircraft jacks at both wing hoist points (wing tie down eyebolt receptacles) outboard of the main gears. While holding jack point in place, raise jack to firmly contact jack point.
c. Place a jack under front jack point (Sta. – 5.51) to lift nose wheel.
d. Raise aircraft, keeping wings as nearly level as possible.
e. Secure safety locks on each jack.

~ CAUTION ~

Do not raise the aircraft on jacks out of doors when wind velocity is over 8 KTS. When lowering aircraft on jacks, bleed off pressure on all jacks simultaneously and evenly to keep aircraft level as it is lowered.

| NOTE |

Individual wheels may be raised without raising entire aircraft. Wheels not being raised should be chocked fore and aft.

SERVICING

REFUELING

Integrally sealed tanks, in forward, inboard sections of wing (LH & RH), carry the standard fuel quantity. With aircraft positioned on level ground, service each fuel tank after flight with 100 octane or 100LL aviation grade gasoline. The fuel tank is considered full when fuel completely covers bottom of standpipe.

The optional, visual fuel quantity indicators on top of each wing tank should be used as a reference for partial refueling only. These gauges will not indicate the tank's total capacity above 30 gallons of fuel.

Before filling fuel tanks, when planning a maximum weight flight configuration, consult the Weight & Balance Record (SECTION VI) for loading data.

~~~~~~
~ CAUTION~
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Never use aviation fuel of a lower grade than 100 octane or 100 LL avgas.

Fuel samples from the sump drain of each tank should always be taken before the first flight of the day to check for water, sediment or other contamination. It is recommended that fuel samples be taken prior to each flight. Fuel samples taken immediately after refueling may not show water or sediment due to mixing action of refueling process.

////////////////
// WARNING //
////////////////

Allow five minutes after refueling for water and sediment to settle in tank and fuel drain valve before taking fuel samples or draining gascolator.

Tank sump drains are near each wing root, forward of the wheel wells. A small plastic [illegible] is supplied as loose equipment for obtaining fuel samples. To collect a fuel sample, insert [illegible] actuator prong into sump drain receptacle; push upward to open valve momentarily and d[illegible]el into cup. If water is in fuel, a distinct line separating water from gasoline will be seen through transparent cup wall. Water, being heavier, will settle to bottom of cup, while colored fuel will remain on top. Continue taking fuel samples until all water is purged from tank. Aircraft should be in a level position to prevent the possibility of any contamination not being at sump drain area.

The fuel system gascolator is on the cabin floor, forward of co-pilot's seat. To flush system and lines leading from wing tanks to selector valve, turn selector handle to the left tank position and pull fuel drain valve for about five seconds. Repeat procedure for right tank. Be sure fuel drain valve is returned to closed position and drain valve is not leaking.

| NOTE |

Use recommended engine break-in procedures as published by engine manufacturer.

ENGINE LUBRICATION

Operate and service new engine within limitations given in SECTION II and per TCM Maintenance and Operators Manual.
Before every flight, check engine oil level and replenish as necessary.
The oil filler cap access door is located in top cowling. Any lubricating oil must conform with TCM Specification MHS24 or MHS25 to be acceptable for use in engine. See TCM Maintenance and Operators Manual for specifically approved products.
New or newly overhauled engines should be operated on aviation grade mineral oil during the first 25 HOURS of operation or until oil consumption has stabilized. The aircraft is delivered from Mooney with multi-viscosity mineral oil. Single viscosity mineral oil may be added to multi-viscosity mineral oil if necessary.

The engine is equipped with an external, full flow, oil filter. Engine oil change intervals are recommended at each 50-HOUR INTERVALS if small capacity oil filter is installed. If large capacity oil filter is installed, the oil change interval may be increased to 100-HOUR INTERVALS provided the oil filter is replaced every 50 hours. The external oil filter element is recommended to be replaced at 50-HOUR INTERVALS in all cases.

~~~~~~~
~ CAUTION ~
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If an engine has been operating on mineral oil for several hundred hours, a change to additive oil should be undertaken with caution.

If the engine is in an extremely dirty condition, the switch to additive oil should be deferred until after engine has been overhauled. When changing from mineral oil to additive or compounded oil, after several hundred hours of operation on mineral oil, take the following precautionary steps:

a. DO NOT MIX additive oil and mineral oil. Drain mineral oil from engine, change filter and fill with additive oil.

b. DO NOT operate engine longer than FIVE HOURS before again changing oil.

c. Check oil filter for evidence of sludge or plugging. CHANGE oil and REPLACE oil filter element every 10 HOURS if sludge is evident. Resume normal oil drain periods after sludge conditions improve.

Your Mooney Service Center will change engine oil in addition to performing all other service and inspection procedures needed when you bring your airplane in for its 50-hour; 100-hour, or annual inspections.

~~~~~~~
~ CAUTION ~
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Excessive oil sludge buildup indicates that the oil system needs servicing at less than 50-hour intervals.

When changing or adding oil, the following grades of oil are recommended:
Multi-Viscosity. . . . . 15W-50 or 20W-50 *

* Refer to the latest edition of TCM Maintenance and Operators Manual for approved brands of oil.

Mooney Service Center's stock approved brands of lubricating oil and all consumable materials necessary to service your airplane.

INDUCTION AIR FILTER

The importance of keeping the induction air filter clean cannot be over-emphasized. A clean filter promotes fuel economy and longer engine life. The dry-type filter can usually be washed six to eight times before replacement is necessary. Replace the paper induction air filter every **500 HOURS** or at **ONE YEAR** intervals, whichever occurs first.

1. To clean the dry-type induction air filter:

   a. Remove engine cowling.
   b. Remove filter element.
   c. Direct a jet of air from inside of filter out (opposite normal airflow). Cover entire filter area with air jet.

~~~~~~~
~ CAUTION ~
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Do not use a compressor unit with a nozzle pressure greater than 100 PSI.

   d. After cleaning, inspect filter for damage. Discard if filter or gasket is damaged.

| NOTE |

If filter shows an accumulation of carbon, soot, or oil, continue with cleaning steps e through h.

e. Soak filter in nonsudsing detergent for 15 minutes; then agitate filter back and forth for two to five minutes to free filter element of deposits.

| NOTE |

A Donaldson D-1400 Filter Cleaner is also recommended. Do not use solvents.

f. Rinse filter element with a stream of clear water until rinse water is clear.

g. Dry filter thoroughly. Do not use a light bulb or air heated above 180° F. for filter drying.

h. Inspect for damage and ruptures by holding light bulb inside filter. If damage is evident, replace filter with a new one.

GEAR & TIRES

The aircraft is equipped with 6-ply, Type III, standard-brand tires and tubes. Keep main gear tires inflated at 42 PSI and the nose tire at 49 PSI for maximum service life. Proper inflation will minimize tire wear and impact damage. Visually inspect tires during preflight for cracks, ruptures and worn spots. Avoid taxi speeds that require heavy braking or fast turns. Keep the gear and exposed gear retraction system components free of mud and ice to prevent retraction interference and binding. It is recommended that retraction/extension cycles (5 minimum) be done any time any tire is replaced to assure that no interference exists during the cycle.

~ CAUTION ~

After any landing, other than a smooth touchdown and rollout, when aircraft is above 3200 Lbs (1,452 Kg), the aircraft should undergo the Gear System Operational Inspection as outlined in M20R Service and Maintenance Manual, No. 160, Chapter 32-30-01.

The gear warning horn may be checked in flight by retarding throttle with the gear up. The gear horn should sound with an intermittent note when throttle is positioned 1/4 to 3/8 inch from idle (while gear is up).

BATTERIES

The two 24-volt, 10 ampere-hour electrical storage batteries are located in the tailcone, aft of baggage compartment bulkhead, accessible through left and right side tailcone access panels. Check battery fluid level every 25 FLIGHT HOURS or each 30 DAYS whichever comes first.

To service batteries, remove tailcone access cover(s) to gain access to battery(ies). Check terminals and connectors for corrosion. Add distilled water to each battery cell as necessary. Keep the fluid at one-quarter inch over the separator tops.
Check fluid specific gravity for a reading of 1.265 to 1.275. A recharge is necessary when the specific gravity is 1.240 or lower. Start charging at four amperes and finish at two amperes; do not allow battery temperature to rise above 120° F. during recharging. Keep battery at full charge to prevent freezing in cold weather and to prolong service life.

~ CAUTION ~

Alternator and voltage regulator operate only as a one-polarity system. Be sure the polarity is correct when connecting a charger or booster battery.

If corrosion is present, flush battery, shelf and mounting area with a solution of baking soda and water. Do not allow soda to enter battery cells. Keep cable connections clean and tightly fastened and keep overflow line free of obstruction.

HYDRAULIC BRAKE RESERVOIR SYSTEM

The brake system hydraulic reservoir is located on the tailcone bulkhead, forward of the avionics components. To service, remove the left side tailcone access panel and check fluid level every 50 HOURS of operation. Fluid level should be no higher than two (2) inches (5 cm) below filler cap. Use only hydraulic fluid (Red) conforming to specification MIL-H-5606. DO NOT FILL reservoir while parking brake is set.

MAINTENANCE

ENGINE PERFORMANCE CHECKS

When the aircraft leaves the factory the IO-550-G(6) engine has been properly tuned and will perform at optimum efficiency. To insure that the engine is continuing to perform properly certain maintenance action should be performed during the 100 HOUR or ANNUAL inspection or whenever it is suspected that engine performance is not correct.

Refer to M20R SERVICE AND MAINTENANCE MANUAL or TCM maintenance manuals for specific maintenance actions to adjust engine, if necessary.

PROPELLER CARE

The high stresses to which propeller blades are subjected makes their careful inspection and maintenance vitally important. Check blades for nicks, cracks or indications of other damage before each flight. Nicks tend to cause high stress concentrations in the blades which, if ignored, may result in cracks. It is very important that all nicks and scratches be repaired prior to flight. It is not unusual for propeller blades to have some end play or fore and aft movement as a result of manufacturing tolerances in the parts. This has no adverse effect on propeller performance or operation. With the first turn, centrifugal force firmly seats the blades, rigidly and positively against the retention bearing in the propeller hub.

Preflight inspection of the propeller blades should include, in addition to the foregoing, an occasional wiping with an cloth soaked in kerosene. NEVER USE AN ALKALINE CLEANER ON THE BLADES.

Your Mooney Service Center will answer any questions you may have concerning blade repair and inspection.

EXTERIOR CARE

As with any paint applied to a metal surface, an initial curing period is necessary for developing the desired qualities of durability and appearance. Therefore, DO NOT APPLY WAX TO THE NEW AIRCRAFT EXTERIOR UNTIL TWO OR THREE MONTHS AFTER DELIVERY. Wax substances will seal paint from the air and prevent curing. Wash the exterior to prevent dirt from working into the curing paint. Hold buffing to a minimum until curing is complete and there is no danger of disturbing the undercoat.

~~~~~~~
~CAUTION ~
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Before washing the exterior, be certain the brake discs are covered, a pitot cover is in place, and all static-air buttons are masked off.

Remove grease or oil from the exterior by wiping with a cotton cloth saturated in kerosene. Flush away loose dirt and mud deposits before washing the exterior with an aircraft-type washing compound mixed in warm water. Use soft cleaning cloths or a chamois, and USE ONLY MILD LIQUID TYPE DETERGENTS, avoid harsh or abrasive detergents that might scratch or corrode the surface. It is essential that ALL CLEANING COMPOUNDS AND APPLICATION CLOTHS BE FREE OF ABRASIVES, GRIT, OR OTHER FOREIGN MATTER. Use a prewax cleaner to remove a heavy oxidation film. For nonoxidized or precleaned surfaces, apply a good exterior finish wax recommended for protection of urethane enamel finishes. Carefully follow the manufacturer's instructions. A heavier coating of wax on the leading edge of the wings, empennage, and nose section will help reduce drag and abrasion in these areas.

If fuel, hydraulic fluid or any other dye-containing substance is found on the exterior paint, wash the area at once to prevent staining. Immediately flush away spilled battery acid and treat the area with a baking soda-and-water solution, followed by a thorough washing with a mild aircraft detergent and warm water.

Before wiping windows or windshield, flush exterior with clear water to remove particles of dirt. Household window cleaning compounds should NOT be used; some contain abrasives or solvents which could harm plexiglas. Any commercial anti-static plexiglass cleaner is recommended for cleaning and polishing the windshield and windows.

INTERIOR CARE

Normal household cleaning practices are recommended for routine interior care. Frequently vacuum clean seats, carpets, fabric, side panels and headliner to remove as much surface dust and dirt as possible. For cleaning Izit Leather side panels and wool upper cabin panels, use Woolite, mixed 1 part Woolite to 3 parts water. Other type cleaners are not recommended at this time.

~ CAUTION ~

Never use benzene, carbon tetrachloride, acetone, or gasoline for cleaning plexiglas or interior panels. Carefully follow the manufacturer's instructions when using commercial cleaning and finishing compounds.

Foam type shampoos may be used for routine cleaning of carpets. To minimize carpet wetting, keep foam type cleaners as dry as possible and gently rub in circles. Use vacuum cleaner to remove foam and dry the materials. Grease spots, on carpet, should be removed with jelly-type spot lifter. Do not saturate carpet with a solution which could damage backing materials.

Use a damp cloth to clean metal surfaces.

AIRPLANE FILE

Certain miscellaneous data, information and licenses are a part of the airplane file. The following is a checklist of documents that must either be carried in the airplane or available on request of the proper authority.

1. To be displayed in the airplane at all times:
   a. Aircraft Airworthiness Certificate (FAA Form 8100-2).
   b. Aircraft Registration Certificate (FAA Form 8050-3).
   c. Aircraft Radio Station License, if transmitter installed (FCC Form 556).

2. To be carried in the airplane during all flight operations:
   a. Pilot's Operating Handbook (including FAA Approved Flight Manual).
   b. Weight and Balance, and associated papers (latest copy of the Repair and Alteration Form, FAA Form 337, if applicable).
   c. Equipment List.

| NOTE |

The original weight and balance data and Equipment List are contained in SECTION VI of this manual. This manual is supplied with each new airplane purchased from Mooney Aircraft Corporation. It is recommended that copies of SECTION VI be made and stored in a safe place.

3. To be made available upon request:
   a. Airplane Log Book.
   b. Engine Log Book.

Since the Regulations of other nations may require other documents and data, owners of airplanes not registered in the United States should check with their own aviation officials to determine their individual requirements.

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THE SUPPLEMENTS INSERTED INTO THIS SECTION ARE FAA APPROVED

SUPPLEMENT INSERTED	DATE
KFC225 Auto Flight Control	11/99
WX-500 Stormscope	12/99
Dual Garmin GNS 430	11/99
Speedbrake 2000 System	12/99
Stand-By Vacuum Pump Sys	2/99

SUPPLEMENT INSERTED . . . . DATE

INTRODUCTION

FAA approved data pertaining to Limitations, Normal Procedures, Emergency Procedures, and effects on performance for certain optional equipment installed in the airplane are contained in this section. Commonly installed items of optional equipment whose function and operation do not require detailed instructions are described by SECTION VII.

The Supplements are Approved by the FAA prior to incorporation into the Airplane Flight Manual.

BLANK

J.P.INSTRUMENTS
PO BOX 7033
HUNTINGTON BEACH CA 92646

FAA APPROVED
AIRPLANE/ROTORCRAFT FLIGHT MANUAL SUPPLEMENT OR
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL (INCLUDING POH AND FAA AFM)
(FOR THOSE AIRCRAFT WITHOUT A BASIC AIRPLANE FLIGHT MANUAL)

EGT-701 TEMPERATURE INDICATOR
FOR

Single and Twin Reciprocating Engine Powered Aircraft as listed on Master Eligibility List of

STC SA2586NM.

REG. NO. N2210Y
SER. NO. 29-0212

This Supplement must be attached to the FAA Approved Airplane/Rotorcraft Flight Manual when the J.P. Instruments EGT-701 is installed in accordance with Supplemental Type Certificate SA 2586NM. For those airplanes without a basic Airplane Flight Manual, the Supplemental AFM must be in the aircraft when the EGT-701 is installed.

The information contained in this Airplane/Rotorcraft Flight Manual Supplement/ Supplemental Aircraft Flight Manual supplements or supersedes the basic manual/ placards only in those areas listed. For limitations, procedures and performance information not contained in this supplement, consult the basic Airplane Flight manual, Markings and Placards.

FAA APPROVED:

Donald Armstrong

Manager, Flight Test Branch, ANM-160L
Federal Aviation Administration
Los Angeles Aircraft Certification Office
Transport Airplane Certification Directorate

Date: Nov. 12, 1992

***GENERAL** (cont.)*

An alarm causes the digital function to flash as soon as the particular limit is exceeded. Factory set alarm limits for CHT (450°F) and OIL (230°F) are lower than the actual aircraft limits and can not be set by the pilot. The values may be adjusted to suit individual preference by a qualified technician. Other factory set alarm limits are: "BAT" Voltage 15.5/11.0 or 31.0/22.0 Hi/Lo as appropriate; "DIF" (differential Hi/Lo EGT) 500°F, "TIT" 1650°F Hi; "OIL" Lo 90°F; "CLD" (Rate of change of cylinder head temperature in degrees per minute) -60 degrees/minute. The pilot should be aware of the setting of each alarm for his particular aircraft. An alarm is "Canceled" by holding the step button in for 5 seconds and seeing the word "OFF". Then, only that particular alarm is canceled. Canceled alarms will not appear again until the power has been removed and reapplied to the EGT-701. The entire display dims automatically depending on the ambient lighting.

The Cylinder Head with the Gasket probe and oil temperature will indicate generally higher temperatures than instruments provided by the aircraft manufacturer because the EGT-701 sensing thermocouples are not collocated with the primary instrument sensing probes. Therefore, airplane flight manual limitations based on primary instrument indication take precedence over those of the EGT-701

II OPERATING LIMITATIONS

A. The EGT-701 may not replace any existing instrument or indicator required by the aircraft type design or operating limits.

B. The EGT-701 display may not be used in lieu of, or to supersede, engine operating limitations established by the airframe or engine manufacturer during certification.

III. EMERGENCY PROCEDURES

No change

IV. NORMAL PROCEDURES

CAUTION

Comply with manufacturer's Airplane
Flight Manual leaning procedure.
Do not exceed applicable engine
or aircraft limitations.

After establishing desired cruise power depress the LF button to activate the Lean Find Mode. As the mixture is leaned, one column on the EGT-701 display will begin blinking, indicating the exhaust gas temperature for that cylinder has peaked showing its digital value along with the fuel flow (option) at that time. Continue with the leaning procedure as recommended by the aircraft manufacturer while monitoring the primary engine instruments and the EGT-701 display. Once the leaning procedure has been completed, depress the Step button briefly to exit the Lean Find Mode and enter the Monitor Mode.

FAA APPROVED 6/17/99

MOONEY AIRCRAFT CORPORATION
LOUIS SCHREINER FIELD
KERRVILLE, TEXAS 78028

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR
M20M, M20R, M20S

WITH

BENDIX/KING KFC 225 AUTOMATIC
FLIGHT CONTROL SYSTEM

Model M20R

Reg. No. N2210Y

Serial No. 29-0212

This supplement must be attached to the FAA Approved Airplane Flight Manual when the Bendix/King KFC 225 Automatic Flight Control System is installed in accordance with Mooney Aircraft Corporation Drawing No. 830139. The information contained herein supplements or supersedes the basic manual only in those areas listed herein. For limitations, procedures, and performance information not contained in this supplement; consult the basic Airplane Flight Manual.

FAA APPROVED: Michele M Owsley
Nov. 2, 1999

Michele M. Owsley - Manager
Aircraft Certification Office
DOT/FAA ASW-150
2601 Meacham Boulevard
Fort Worth, Texas 76137-0150

Date of Approval:

MOONEY AIRCRAFT CORPORATION

LOUIS SCHREINER FIELD
KERRVILLE, TEXAS 78028

LOG OF REVISIONS

Rev. No.	Revised Pages	Description of Revision	FAA Approved	Date

The revised portions of affected pages are indicated by vertical black lines in the margin.

TABLE OF CONTENTS

SECTION I — GENERAL

This manual is provided to acquaint the pilot with the limitations as well as normal and emergency operating procedures of the Bendix/King KFC 225 Automatic Flight Control System. The limitations presented are pertinent to the operation of the KFC 225 system as installed in the Mooney M20M, M20R, and M20S airplane; the Autopilot must be operated within the limitations herein specified.

The KFC 225 Automatic Flight Control System is certified in this airplane with 3-axis Autopilot control: pitch, roll and yaw.

The KFC 225 system provides the pilot with the following features:
pitch attitude hold (PIT), vertical speed hold (VS), altitude hold preselect (ALT ARM), altitude capture (ALT CAP), altitude hold (ALT), altitude alerting, and go around (GA) in pitch; roll attitude hold (ROL), heading hold (HDG), navigation course capture (NAV ARM), navigation course tracking (NAV), approach course capture (APR ARM), and back course approach tracking (REV) in the roll axis. Control wheel steering (CWS) allows synching of the pitch axis modes (except glideslope) and maneuvering the aircraft by hand if desired.

The KFC 225 system has an electric pitch trim system that provides auto-trim during autopilot operation and manual electric trim (MET) for the pilot when the autopilot is not engaged. Trim faults are monitored and annunciated both visually and aurally.

An automatic preflight self-test begins with initial power application to the autopilot. A lockout device prevents autopilot engagement and MET operation until the system has successfully passed preflight self-tests.

The following circuit breakers are used to protect the following elements of the KFC 225 Automatic Flight Control System:

The following conditions will cause the Autopilot to automatically disengage:

A. Electrical Power failure.
B. Internal Automatic Flight Control System failure.
C. Roll rates in excess of 14° per second except when the CWS button is depressed.
D. Pitch rates in excess of 6° per second except when the CWS button is depressed.
E. Pitch accelerations in excess of +1.6 g or less than +0.4g will cause only the autopilot servo clutch to disengage, (Sustained accelerations will cause auto pilot disengagement except when the CWS button is depressed.)

The Radio Master switch supplies power to the avionics bus bar for the radio and autopilot circuit breakers.
The airplane MASTER switch function is unchanged and can be used in conjunction with the alternator switches in an emergency to shut off electrical power to all automatic flight control systems while the problem is being isolated.

LABEL	FUNCTION
COMPUTER	Supplies power to the KFC 225 Computer.
SERVO	Supplies power to the autopilot pitch, roll and pitch trim servos.
ALERT	Supplies sonalert power for autopilot disconnect tone and separate TRIM/FAIL annunciator when installed.
HSI	Supplies power to the KCS 55A Compass System.
ENCDR	Supplies power to the Altitude Encoder.
ANN	Supplies power to the TRIM FAIL annunciation when the original equipment annunciator panel is installed.
AUDIO	Supplies power to the autopilot speaker alerting and autopilot headphone alerting.

The following voice messages will be annunciated as conditions warrant:

1. "TRIM IN MOTION, TRIM IN MOTION..." - Elevator trim running for more than 5 seconds.
2. "CHECK PITCH TRIM" - An out of trim condition has existed for 16 seconds.
   a. Airplane control Wheel - GRASP FIRMLY, press CWS and check for an out of pitch trim condition. Manually retrim as required.
   b. CWS button - RELEASE.
   c. AUTOPILOT OPERATION - CONTINUE if satisfied that the out of trim condition was temporary. DISCONTINUE if evidence indicates a failure of the auto trim function.

The following optional voice messages will be annunciated if the system is configured for voice messaging:

1 "ALTITUDE" - 1000 feet before approaching selected altitude.
2 "LEAVING ALTITUDE" - 200 feet away, departing selected altitude.
3 "AUTOPILOT" - Autopilot has disengaged, either through pilot action or automatically.

SECTION II — LIMITATIONS

A. The entire preflight test procedure outlined under Section 4, paragraph A of this supplement, including steps 1 through 7, must be successfully completed prior to each flight. Use of the autopilot or manual electric trim system is prohibited prior to completion of these tests.\

B. During autopilot operation, a pilot with seat belt fastened must be seated at the left pilot position.

C. The autopilot must be OFF during Takeoff and Landing.\

E. Autopilot maximum airspeed limitations:—— 180 KIAS.
Autopilot minimum airspeed limitation:—— 80 KIAS.

F. Altitude Select captures below 800 feet AGL are prohibited.

G. The autopilot must be disengaged below 200 feet AGL during approach operations and below 800 feet AGL for all other phases of flight.

H. Overriding the autopilot to change pitch or roll attitude is prohibited. (Disengage the autopilot or press CWS while maneuvering).

I. The SERVOS circuit breaker must be pulled following any in-flight illumination of the red TRIM/FAIL warning light,but only after first completing the Emergency Procedures (Section IIIA) paragraph A. The manual electric trim and autopilot autotrim systems will be disabled with the circuit breaker pulled. (The red TRIM/FAIL warning will illuminate normally during preflight self-test If the TRIM FAIL light remains illuminate after preflight self-test, the SERVOS circuit breaker must be PULLED. Do not operate autopilot with flaps extended beyond the Take-Off position.)

J. Required Placards:
1. Above Radio Stack

AUTOPILOT AND ELECTRIC TRIM PREFLIGHT TESTS MUST BE CONDUCTED PRIOR TO EACH FLIGHT.

SECTION IIIA — EMERGENCY PROCEDURES

The four-step procedure listed under paragraph A should be among the basic airplane emergency procedures that are committed to memory. It is important that the pilot be proficient in accomplishing all four steps without reference to this manual.

A. In case of Autopilot, Autopilot Trim, or Manual Electric Trim malfunction (accomplish Item 1 & 2 simultaneously):

1. Airplane Control Wheel ..... **GRASP FIRMLY,** regain aircraft control.
2. **A/P DISC/TRIM INTER** Switch ..... **PRESS** and **HOLD** throughout recovery until Step 4 has been accomplished.
3. AIRCRAFT ..... **RETRIM** manually as needed.
4. **SERVOS** circuit breaker ..... **PULL**

NOTE:

The RADIO MASTER switch may be used as an alternate means of removing all power from the autopilot and electric trim systems. If necessary, perform Steps 1 through 3 above, then turn the AVIONICS MASTER switch OFF before locating the SERVOS circuit breaker. Turn the RADIO MASTER switch back ON as soon as possible to restore power to all other avionics equipment. Primary attitude, airspeed and altitude instrument will remain operational at all times.

If the malfunction has been identified as a TRIM FAIL event, the CMPTR circuit breakers may be reset allowing use of the flight director only.

WARNING:

Do not attempt to re-engage the autopilot following an autopilot, autotrim, or manual electric trim malfunction until the cause for the malfunction has been corrected.

Maximum Altitude losses due to autopilot malfunction:

Configuration	Altitude Loss
Cruise, Climb, Descent	340 ft.
Maneuvering	100 ft.
APPR	90 ft.

B. Airplane Stall (Autopilot coupled)

1. **AUTOPILOT**.....**DISENGAGE,** perform stall recovery.

C. Amplified Emergency Procedures

The following paragraphs are presented to supply additional information for the purpose of providing the pilot with a more complete understanding of the recommended course of action for an emergency situation.

1. An autopilot or autopilot trim malfunction may be recognized as an uncommanded deviation in the airplane flight path or when there is abnormal control wheel or trim wheel motion. In some cases, and especially for autopilot trim, there may be little to no airplane motion, yet the red TRIM FAIL annunciator may illuminate and an alert tome will sound.

   The primary concern in reacting to an autopilot or autopilot trim malfunction, or to an automatic disconnect of the autopilot, is in maintaining control of the airplane. immediately grasp the control wheel firmly and press and hold down the A/P DISC/TRIM INTER switch throughout the recovery. Manipulate the controls as required to safely ;maintain operation of the airplane within all of its operating limitations. Elevator trim should be used manually as needed to relieve control forces. Finally, pull the SERVOS circuit breaker to completely disable these systems.

2. A manual electric trim malfunction may be recognized by the illumination of a red TRIM FAIL annunciator accompanied by an alert tone or by unusual trim wheel motions with the autopilot disengaged without pilot actuation of the manual electric trim switch. As with an autopilot malfunction, the first concern following a manual electric trim malfunction is regaining control of the airplane

following a manual electric trim malfunction is regaining control of the airplane Grasp the control wheel firmly and press and hold down the A/P DISC/TRIM INTER switch. Pull the SERVOS circuit breaker.

3. Note that the emergency procedure for any malfunction is essentially the same: — immediately grasp the control wheel firmly to regain airplane control while pressing and holding the A/P DISC/TRIM INTER switch down, and manually retrim the airplane as needed. After these steps have been accomplished, disable the autopilot or electric trim system by pulling the SERVOS circuit breaker. As with any other airplane emergency procedure, it is important that the 4 steps of the Autopilot/Electric Trim Emergency Procedures located on Page 6 of this supplement are committed to memory.

4. The AVIONICS MASTER switch may be used as required to remove all power from the Autopilot and Electric Pitch Trim systems in lieu of pulling the SERVOS circuit breaker. Return the AVIONICS MASTER switch to the ON position as soon as possible. With the AVIONICS MASTER switch OFF, all flight instruments will remain operational; however, communications, navigation and identification equipment will be inoperable.

5. The KFC 225 autopilot incorporates pitch, roll and yaw monitors that detect abnormal airplane movement; therefore, if the airplane, for any reason, is moved rapidly in pitch, roll or yaw, the monitors may disconnect the autopilot automatically.

6. It is important that all portions of the autopilot and electric trim system are preflight tested prior to each flight in accordance with the procedures published herein in order to assure their integrity and continued safe operation during flight.

WARNING:

Do not attempt to re-engage the autopilot or to use the manual electric trim system following an autopilot, autotrim or manual electric trim malfunction until the cause for the malfunction has been corrected.

SECTION IIIB — ABNORMAL PROCEDURES

A. A flashing **PT** auto trim annunciation with an UP or DOWN arrowhead in the display of the autopilot computer suggests a failure of the auto trim function to relieve pitch servo loading in a timely manner.

1. FLASHING **PT** ANNUNCIATION ..... **OBSERVE** aircraft pitch behavior. If pitch behavior is satisfactory, wait 5-10 seconds for the annunciation to stop.
2. If annunciation continues, Airplane Control Wheel ..... **GRASP FIRMLY** press **CWS** and check for an out of pitch trim condition. Manually retrim as required.
3. **CWS** Button ..... **RELEASE**
4. **AUTOPILOT OPERATION** ..... **CONTINUE** if satisfied that the out of trim indication was temporary.
   ..... **DISCONTINUE** if evidence indicates a failure of the auto trim function.

B. A red **P** or **R** annunciation on the face of the autopilot computer.

1. A red **P** annunciation is an indication that the pitch axis of the autopilot has been disabled and the autopilot cannot be engaged.

NOTE:

If the red **P** lamp was the result of some abnormal accelerations on the airplane, the annunciation should extinguish within approximately one minute and normal use of the autopilot will be re-established. This annunciation may be present during power up.

2. A red **R** annunciation is an indication that the roll axis of the autopilot has been disabled and the autopilot cannot be engaged.

C. A flashing mode annunciation on the display of the autopilot computer or on the remote mode annunciator is normally indication of mode loss.

1. Flashing **HDG** - Indication of a failed heading input. ..... PRESS **HDG** button to terminate flashing.

2. Flashing **NAV, APR**, or **REV** - Usually an indication of a flagged navigation source..... PRESS **NAV, APR** or **REV** button to terminate flashing. Select a valid navigation source.

NOTE:

A flashing NAV, APR, or REV annunciation can also be caused by a failed heading or course datum input.

3. Flashing GS - Indication of a flagged glideslope (or a fault in the KFC 225 pressure sensor). GS will re-arm automatically if a valid GS signal is received.

NOTE:

To continue tracking localizer, observe the appropriate minimums for a non-precision approach. (Press VS to terminate the flashing GS and allow the vertical speed control of the pitch axis.)

At the onset of mode annunciator flashing, the autopilot has already reverted to a default mode of operation, i.e., ROL and/or PIT mode. An immediate attempt to re-engage the lost mode may be made if the navigation, glideslope or compass flag has cleared.

D. Erratic altitude encoder operation:

1. Inaccurate or erratic altitude encoder output noted on the transponder or GPS altitude display.

or

2. Erroneous altitude alert operation.

If items 1 and/or 2 are noted — altitude arm and capture should not be used and the altitude alerts should be ignored.

F. Effects of other instrument losses upon autopilot operation:

1. Loss of the artificial horizon — will severely impact autopilot operation. **DO NOT ENGAGE** autopilot into this situation.

2. Loss of turn coordinator — no effect on the autopilot.

3. Loss of the HSI — Heading, navigation and approach modes inoperative.
4. Loss of altitude encoding — preselect altitude captures and altitude alerting inoperative. Note a dashed altitude display will appear on the autopilot computer.

SECTION IV — NORMAL PROCEDURES

A. PREFLIGHT (Perform prior to each flight)

1. **RADIO MASTER** switch ..... **ON**.
2. **POWER APPLICATION AND SELF TEST** ..... **OBSERVE**.

An approximate one minute self test is performed upon power application to the computer. This test is a sequence of internal checks that validate proper system operation prior to allowing normal operation. The sequence is indicated by "PFT" with an increasing number for the sequence steps. Successful completion of self-test is identified by all display segments being illuminated (Display Test), a momentary appearance of the flight director command bars and the disconnect tone sounding.

NOTE

Following the preflight self test, the red **P** annunciation warning on the face of the autopilot may illuminate indicating that the pitch axis cannot be engaged. this condition should be temporary,lasting less than 30 seconds. The **P** will extinguish and normal operation will be available.

WARNING

When power is first applied to the autopilot computer, the servo clutches will engage momentarily during self-test requiring additional effort to control the airplane through the engaged clutches if taxiing or flying.

WARNING

If the TRIM/FAIL warning light stays ON, the autotrim did not pass preflight test. The SERVOS circuit breaker must be pulled. The autopilot and manual electric trim can not be used.

3. **MANUAL ELECTRIC TRIM** ..... **TEST** as follows:

Command NOSE UP trim using the manual electric trim switches and verify the ability to interrupt trim motion by pressing the **A/P DISC/TRIM INTER** switch. Repeat NOSE DOWN.

4. **AUTOPILOT** ..... **ENGAGE** by pressing AP button
5. **FLIGHT CONTROLS** ..... **MOVE** fore, aft, left & right to verify that the autopilot clutches can be overpowered.

Verify that the yaw damper (if installed) can be overpowered through movement of the rudder pedals.

6. **A/P DISC/TRIM INTER** switch ..... **PRESS**

Verify that the pitch, roll and yaw clutches disengage and that the autopilot disconnects. Note the aural disconnect tone.

7. **TRIM** ..... **SET** to Take-Off position manually.

B. FLIGHT DIRECTOR OPERATION

The flight director modes of operation are the same as those used for autopilot operations except that the autopilot is not engaged and the pilot must maneuver the aircraft to satisfy the flight director commands. Note that the flight director will always be in view when the autopilot is engaged.

C. AUTOPILOT OPERATION

WARNING

The pilot in command must continuously monitor the autopilot when it is engaged, and be prepared to disconnect the autopilot and take immediate corrective action - including manual control of the airplane and/or performance of emergency procedures - if autopilot operation is not as expected or if airplane control is not maintained.

During all autopilot coupled operations , the pilot in command must use proper autopilot commands and use the appropriate combination of engine power, wing flaps, and landing gear to ensure that the airplane is maintained between 80 and 180 KIAS, and does not exceed other basic airplane operating limitations.

1. Before Take-Off:
   a. **A/P DISC/TRIM INTER** Switch ..... **PRESS**
   b. Flight Director ..... ENGAGE as desired.
   (HDG & GA modes are common choices.)
   c. Altitude Alert/Altitude preselect ..... **SET** **ARM** as desired

NOTE

An aural and visual alert is annunciated 1000 ft. prior to arrival at the selected altitude. After arriving at the selected altitude, another alert is annunciated if the aircraft deviates from the selected altitude by ±200 ft. The aural alert is a series of 5 short tones followed by the voice message -"ALTITUDE" or "LEAVING ALTITUDE".

2. Inflight Autopilot Engagement
   a. Elevator Trim ..... **VERIFY** or **SET** to place the airplane in a trimmed condition prior to autopilot engagement.
   b. **AP** button ..... **PRESS**

If no other modes have been selected on the flight director, the autopilot will operate in the **ROL** and **PIT** modes. If other flight director modes have been selected, the autopilot will engage into the existing flight director modes.

NOTE

Satisfy existing flight director commands manually prior to autopilot engagement to avoid undesirable pitch and roll transients.

WARNING

Do not help the autopilot or hand-fly the airplane with the autopilot engaged as the autopilot will run the pitch trim to oppose control wheel movement. A mistrim of the airplane, with accompanying large elevator control forces, will result if the pilot manipulates the control wheel manually while the autopilot is engaged.

3. Climb or Descent

a. Choose pitch attitude hold (**PIT**) or vertical speed hold (**VS**) mode.

WARNING

When operating at or near the best rate of climb airspeed and using vertical speed hold, it is easy to decelerate to an airspeed on the back side of the power curve where a decrease in airspeed results in a reduced rate of climb. Continued operation on the back side of the power curve in vertical speed mode will result in a stall. When operating at or near the maximum autopilot speed, it may be necessary to reduce power in order to maintain the desired rate of descent and not exceed the maximum autopilot speed.

b. Using **CWS**

1) **CWS** Button ..... **PRESS** and **MOVE** aircraft nose to the desired pitch attitude or vertical speed.

2) **CWS** Button **RELEASE**

Autopilot will command the present attitude within the limits of ± 15° or the present vertical speed within the limits of ± 2000 ft/min.

c. Using Vertical Trim

1) **VERTICAL TRIM** Control **PRESS** either the **UP** or **DN** button to modify aircraft attitude within the the limits of ± 15°, or modify vertical speed within the limits of ± 2000 ft/min.

2) **VERTICAL TRIM** Control **RELEASE** when the desired attitude is achieved or the desired vertical speed command is displayed.

4. Altitude (**ALT**) Hold

a. **ALT** Mode Selector Button **PRESS**

Note **ALT** mode annunciator **ON**. Autopilot will maintain the barometric pressure corrected altitude present at the time of engagement.

NOTE

In accordance with FAA recommendation (AC00-24B), use of basic "pitch attitude hold" mode is recommended during operation in severe turbulence.

b. Pre-selected altitude captures with flight director engaged.

1) **ALTITUDE SELECT** knob **ROTATE** until the desired altitude is displayed.

Note **ARM** annunciation occurs automatically upon altitude selection when the flight director is engaged.

2) Airplane..... **ESTABLISH** climb or descent necessary to intercept the selected altitude.

Note **ALT CAP** annunciated during level off at the pre-selected altitude.

3) ALTITUDE SELECT MODE (**ARM**) button..... **PUSH** to automatically disarm or arm altitude capture.

NOTE

Pre-selected altitude captures are not recommended on non-precision approaches to capture the **MDA**. A pre-selected altitude capture cannot be armed during glideslope operation.

c. Altitude changes

1) Using **CWS** (recommended for altitude changes greater than 100 ft.

a) **CWS** button ..... **PRESS** and maneuver aircraft to desired altitude.

b) **CWS** button ..... **RELEASE** when desired altitude is reached.

The autopilot will maintain the altitude present at the time of button release.

2) Using Vertical Trim (Recommended for altitude changes less than 100 ft).

a) **VERTICAL TRIM** control ..... **PRESS** and **HOLD** either UP or DN button

Vertical Trim will command an altitude rate of change of about 500 fpm

b) **VERTICAL TRIM** control ..... **RELEASE** when the desired altitude is reached.

The autopilot will maintain the altitude present at the time of button release.

NOTE

As an alternative, press either the UP or DN button with a succession of quick momentary presses programming either an increase or decrease in the altitude reference at the rate of 20 feet per button press.

5. Heading Changes

a. Manual heading changes in **ROL** mode.

1) **CWS** button..... **PRESS** and **MANEUVER** aircraft to the desired heading.

2) **CWS** button..... **RELEASE** w/bank angle less than 6°.

Autopilot will attempt to maintain the aircraft at wings level in the ROL mode.

3) **CWS** button..... **RELEASE** w/bank angle greater than 6°.

Autopilot will maintain the bank angle present at the time of button release (up to the maximum bank angle commanded by the autopilot).

NOTE

Aircraft heading may change in **ROL** mode due to turbulence or attitude gyro precession.

b. Heading Hold

1) Heading Selector Knob.....**SET BUG** to desired heading

2) **HDG** Mode Selector Button .....**PRESS**

Note HDG mode annunciator **ON**. Autopilot will automatically turn the aircraft to the selected heading.

c. Command Turns (Heading Hold mode **ON**)

1) Heading Selector Knob..... **MOVE BUG** to the desired heading.

Autopilot will automatically turn the aircraft to the new selected heading.

6. **NAV** Coupling

a. Course Bearing Pointer.....**SET** to desired course.

b. Heading Selector Knob .....**SET BUG** to provide desired intercept angle and engage HDG mode.

c. **NAV** Mode Selector Button.....**PRESS**

1) If the Course Deviation Bar is greater than 2 to 3 dots from center:

The aircraft will continue in HDG mode (or ROL if HDG is not selected) with **NAV ARM** annunciated; when the computed capture point is reached, HDG will disengage, the **ARM** annunciator will go out and the selected course will be automatically captured and tracked.

2) If the D-Bar is less than 2 to 3 dots from center:

The HDG mode will disengage upon selecting NAV mode; the **NAV** annunciator will illuminate and the capture/track sequence will automatically begin.

NOTE

When operating in the NAV or APR mode with VOR as the selected navigation sensor, changes in the selected course which result in a D-Bar deviation of greater than 50% may result in the autopilot not tracking the signal. It is recommended that the new course be manually captured using the heading bug and the NAV ARM or APR ARM modes.

7. Approach (**APR**) Coupling (to enable glideslope coupling on an ILS, and more precise course tracking on instrument approaches).

a. Course Bearing Pointer.....**SET** to desired course

b. Heading Selector Knob .....**SET BUG** to provide the desired intercept angle

c. APR Mode Selector Button.....**PRESS**

1) If the Course Deviation Bar is greater than 2 to 3 dots from center:

The aircraft will continue in HDG mode (or ROL if HDG is not selected) with the **APR ARM** annunciated; when the computed capture point is reached, HDG mode will disengage, the **ARM** annunciator will go out and the selected course will be automatically captured and tracked.

NOTE

When operating in the NAV or APR mode with VOR as the selected navigation sensor, changes in the selected course which result in a D-Bar deviation of greater than 50% may result in the autopilot not tracking the signal. It is recommended that the new course be manually captured using the heading bug and the NAV ARM or APR ARM modes.

8. BC Approach Coupling (**REV**) (i.e., reverse localizer)
   a. Course Bearing Pointer ..... **SET**
   to the **ILS** front course inbound heading
   b. Heading Selector Knob ..... **SET BUG**
   to provide desired intercept angle and engage HDG mode.
   c. **REV** Mode Selector Button ..... **PRESS**

1) If the Course ;Deviation ;Bar is greater than 2 to 3 dots from center:
The aircraft will continue in HDG mode (or ROL if HDG is not selected) with the **REV ARM** annunciated; when the computed capture point is reached, HDG mode will disengage, the **ARM** annunciator will go out and the selected course will be automatically captured and tracked.

2a) If the D-Bar is less than 2 to 3 dots from center:
The HDG mode will disengage upon selecting NAV mode; the **NAV** annunciator will illuminate and the capture/track sequence will automatically begin.

2b) If the D-Bar is less than 2 to 3 dots from center:
The HDG mode will disengage upon selecting REV mode; the **REV** annunciator will illuminate and the capture/track sequence will automatically begin.

9. Glideslope Coupling

NOTE

Glideslope coupling is inhibited when operating in NAV or REV modes. Glideslope arm and coupling occurs automatically in the APR mode when tracking localizer.

   a. **APR** Mode ..... **ENGAGED**
   Note **GS ARM** annunciated

NOTE

Autopilot can capture glideslope from above or below the beam. Establish a glideslope intercept in **ALT, PIT** or **VS**.

   b. At Glideslope centering ..... Note **ARM** annunciator **OFF**
   and GS becomes the active pitch mode.

10. Missed Approach
   a. **GA** Button ..... **PRESS**
   to disengage the autopilot and obtain a flyup and wings level flight director command
   b. MISSED APPROACH ..... EXECUTE
   Utilize flight director modes as desired.

NOTE

If tracking the ILS course outbound as part of the missed approach procedure is desired, use the **NAV** mode to prevent inadvertent GS coupling.

c. **AUTOPILOT**-after aircraft is in trim.....**ENGAGE** as desired

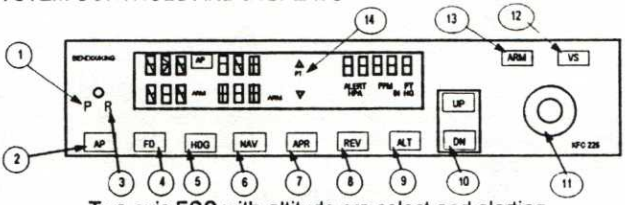
11. Before Landing

a. **A/P DIS/TRIM INTER** Switch .....**PRESS** to disengage autopilot.

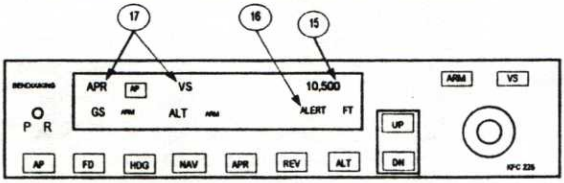
NOTE

Selective flight controls disengagement may be practiced by initially disconnecting the autopilot only at approach minimums via a momentary press of the manual electric trim switch.

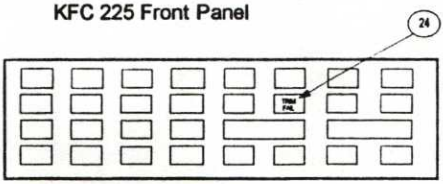
D. SYSTEM CONTROLS AND DISPLAYS



Two-axis FCC with altitude pre-select and alerting.



KFC 225 Front Panel



Original Equipment System Annunciator Panel

NOTE

Default PIT and ROL modes are not displayed on the remote KA 285A annunciator

1. PITCH AXIS, (**P**) ANNUNCIATOR — When illuminated, indicates failure of the pitch axis and will lead to disengagement of the autopilot. (Will also illuminate during short term vertical accelerations in excess of +1.6g or less than +0.4g which may not cause autopilot disengagement.)

2. AUTOPILOT ENGAGE/DISENGAGE (**AP**) BUTTON — When pressed, engages the flight director, autopilot and optional yaw damper if all logic conditions are met. If the flight director is not already engaged, the system will engage into the basic wings level (ROL) and pitch (PIT) altitude hold modes. The pitch attitude maintained will be the pitch attitude present at the moment of AP button press. When pressed again, will disengage the autopilot.

3. ROLL AXIS (**R**) ANNUNCIATOR — When illuminated, indicates failure of the roll axis and will disengage the autopilot.

4. FLIGHT DIRECTOR (**FD**) MODE SELECTOR BUTTON — When pressed will engage the flight director into the basic roll (ROL) mode which functions as a wing leveler, and into the pitch attitude (PIT) hold mode. The pitch attitude maintained will be the pitch present at the moment of FD button press. When pressed again (and the autopilot is not engaged) will disengage the flight director.

5. HEADING (**HDG**) MODE SELECTOR BUTTON — When pressed, will engage the Heading mode, which commands the airplane to turn to an d maintain the heading selected by the heading bug on the HSI. A new heading may be selected at any time and will result in the airplane turning to the new heading. The button can also be used to toggle between HDG and ROL modes. This button will engage the flight director.

7. APPROACH (**APR**) MODE SELECTOR BUTTON — When pressed, will arm the Approach mode. This mode provides automatic beam capture and tracking of VOR, GPS, LOC, and Glideslope (GS) on an ILS, as selected for presentation on the HSI. APR ARM will annunciate. If pressed when APR mode is either armed or coupled, will disengage the mode. This button will engage the flight director.

8. BACK COURSE APPROACH (**REV**) MODE SELECTOR BUTTON — When pressed, will select the back course approach mode. This mode functions similarly to the approach mode except that the autopilot response to LOC signals is reversed and glideslope is inhibited. This button will engage the flight director.

9. ALTITUDE HOLD (**ALT**) MODE SELECT BUTTON — When pressed, will engage the Altitude Hold mode. The altitude maintained is the altitude at the moment the ALT button is pressed. If the ALT button is pressed with an established VS rate present, there will be approximately a 10% (of VS rate) overshoot, with the airplane returned positively to the selected altitude. If pressed when ALT hold mode is engaged, will disengage the mode, defaulting to PIT mode. This button will engage the flight director.

10. VERTICAL TRIM (**UP/DN**) BUTTONS — The response of these buttons is dependent upon the vertical mode present when pressed. If PIT mode is active, successive button presses will move the pitch attitude hold reference either up or

down by 0.5° per press, or at the rate of 0.8° per second if held continuously. If **VS** mode is active, the initial button press will bring up the commanded vertical speed in the display. Subsequent immediate button presses will increment the vertical speed command either up or down at the rate of 100 ft/min per button press, or at the rate of approximately 300 ft/min per second if held continuously. If **ALT** mode is active, successive button presses will move the altitude hold reference altitude either up or down by 20 feet per press, or if held continuously, will command the airplane up or down at the rate of 500 ft/min, synchronizing the altitude hold reference to the actual airplane altitude upon button release. (Note that neither the pitch attitude nor the altitude hold reference is displayed. The display will continue to show the altitude alerter reference.)

11. ROTARY KNOBS — Used to set the altitude alerter/altitude pre-select reference altitude. When the flight director is engaged, will automatically arm a pre-select altitude hold capture.

12. VERTICAL SPEED (**VS**) MODE SELECTOR BUTTON — When pressed, will engage the vertical speed hold mode. The vertical speed maintained is the vertical speed present at the moment the VS button is pressed. The vertical speed command reference will initially be displayed in place of the altitude alert annunciation, defaulting back in 3 seconds to the altitude alerter value. Pressing either the up or DN button will again cause the vertical speed command reference to be displayed while causing it to increase or decrease. Vertical speed can be commanded to a maximum of a 2000-ft/min climb down to a maximum of a 2000-ft/min descent. When the VS button is pressed again, it will disengage the vertical speed mode. This button will engage the flight director.

13. ALTITUDE ARM (**ARM**) BUTTON — When pressed, will toggle altitude arming ON or OFF. When ALT ARM is annunciated, the automatic flight control system will capture the altitude displayed in the Altitude Alerter/Vertical Speed d Display (provided the aircraft is climbing or descending to the displayed altitude). ALT ARM mode is engaged automatically whenever the selected altitude is changed via the rotary knobs. Note that the alerter functions are independent of the arming process thus providing full time alerting, even when the flight director is disengaged. This button will engage the flight director.

14. PITCH TRIM (**PT**) ANNUNCIATION — A flashing **PT** with an accompanying arrow head is an indication that the request for auto trim has lasted longer than 10 seconds. A solid **PT** without an arrowhead is an indication of pitch trim fault. A trim runaway will generate the solid **PT** annunciation, a remote **TRIM/FAIL** (see item 24) annunciation and a continuous alert tone. Refer to the EMERGENCY PROCEDURES for proper response to a pitch trim fault.

15. ALTITUDE ALERTER/VERTICAL SPEED DISPLAY — Normally displays the altitude alerter selected altitude. The display indicates the reference vertical speed in FPM for 3 seconds after the CWS button or the UP or DN button is pressed and the VS mode is engaged.

16. ALTITUDE ALERT (**ALERT**) ANNUNCIATION — Illuminates as a solid alert in the region of from 1000 to 200 feet from the selected altitude if the airplane was previously outside of this region. Flashes (1) for two seconds the first time the airplane crosses the selected altitude and (2) flashes continuously in the 200 to 1000 feet region if the airplane was previously inside of this region (i.e., at the selected altitude). Associated with the visual alerting is an aural alert (5 short tones) which occurs 1000 feet from the selected altitude upon approaching the altitude and 200 feet from the selected altitude on leaving the altitude.

17. PITCH AND ROLL MODE, AND AUTOPILOT ANNUNCIATIONS — Displays the active flight director pitch modes (PIT, VS, ALT ARM, ALT CAP, ALT, GS ARM, GS. GA, and roll modes (ROL, HDG, NAV ARM, NAV, APR ARM, APR, REV ARM, REV). Displays when the autopilot (AP) is engaged. Also displayed will be a flashing AP annunciation (5 seconds) at each autopilot disconnect accompanied by an aural tone (for 2 seconds).

18. AUTOPILOT DISCONNECT (**AP DISC/TRIM INTER**) SWITCH (not shown) — When pressed, will disengage the autopilot and yaw damper (if installed), and interrupt electric trim power. (Located on the left horn of the pilot's control wheel. The switch is RED in color). (May also disengage the flight director depending on how the system is configured.)

19. MANUAL ELECTRIC TRIM SWITCHES (not shown) — When both switches are pressed in the same direction, will activate pitch trim in the selected direction. If only one switch is moved, the trim system will not operate. If one switch fails or is moved and held for 3 seconds, the trim monitoring system will detect a switch failure resulting in a **PT** annunciation on the autopilot display and the disabling of the electric trim system. Use of manual electric trim during autopilot operation will disengage the autopilot. (Located on the pilot's control wheel).

20. CONTROL WHEEL STEERING (**CWS**) MODE BUTTON (not shown) — When pressed and held, disengages the pitch, roll, and pitch trim clutches allowing the pilot to maneuver the airplane by hand. Pressing the CWS button will also sync the automatic flight control system PIT, ROL, ALT or VS commands to the actual attitude, altitude or vertical speed present at the time the button is released. ROL will maintain wings level if CWS is released at less than 6° bank angle. (Located on the left horn of the pilot's control wheel.)

21. GO AROUND (**GA**) MODE BUTTON (not shown) — When pressed, will engage the flight director in a pitch up attitude of 6° and wings level (ROL mode). GA will disengage the autopilot, and cancel all armed modes including an armed altitude preselect. Lateral modes such as HDG or NAV ARM may subsequently be added. The autopilot may subsequently be engaged. Modification to the commanded pitch attitude such as through the UP/DN button or CWS, etc. will cancel GA and revert to pitch altitude hold. (Located on the instrument panel above throttle).

22. OMNI BEARING SELECT KNOB  Selects the desired course to be tracked by the autopilot. (Located on the HSI.)

23. HEADING SELECT KNOB  Positions the heading bug on the compass card. (Located on the HSI).

24. **TRIM/FAIL** ANNUNCIATOR — Illuminates whenever the automated pre-flight self-test detects a pitch trim fault or a continuous monitoring system detects a pitch trim fault in flight. (Located in either the system annunciator panel or the pilot's instrument panel. The annunciator is RED in color). Refer to the EMERGENCY PROCEDURES for proper response to a pitch trim fault.

SECTION V THROUGH X

NO CHANGES TO THESE SECTIONS

MOONEY AIRCRAFT CORPORATION
LOUIS SCHREINER FIELD
KERRVILLE, TEXAS 78028

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR

MOONEY M20M, M20R, M20S

WITH

WX-500 STORMSCOPE SENSOR SYSTEM
INSTALLED IN CONJUNCTION WITH
THE GARMIN GNS-430 SYSTEM

Model M20R

Reg. No. N2210Y

S/N 29-0212

This Supplement must be attached to the FAA Approved Airplane Flight Manual when the Stormscope WX-500 Series II, Weather Mapping Sensor System is installed with the GARMIN GNS 430 VHF Communication Transceiver / VOR/ILS Receiver / Global Positioning System in accordance with Mooney Aircraft Corporation Drawing No. 810447. The information contained herein supplements the information of the basic Airplane Flight Manual. For Limitations, Procedures and Performance information not contained in this Supplement, consult the basic Airplane Flight Manual.

FAA APPROVED Michele M Owsley
Dec. 8, 1999

Michele M. Owsley
Manager, Aircraft Certification Office
Federal Aviation Administration
DOT/FAA ASW-150
2601 Meacham Boulevard
Fort Worth, Texas 78137-0150

DATE: December, 1999

MOONEY AIRCRAFT CORPORATION

LOUIS SCHREINER FIELD
KERRVILLE, TEXAS 78028

LOG OF REVISIONS

Rev. No.	Revised Pages	Description of Revision	FAA Approved	Date

The revised portions of affected pages are indicated by vertical black lines in the margin.

TABLE OF CONTENTS

SECTION I - GENERAL

1. The GNS 430 System is a fully integrated, panel mounted instrument, which contains a VHF Communications Transceiver, a VOR/ILS receiver, and a Global Positioning System (GPS) Navigation computer. The system consists of a GPS antenna, GPS Receiver, VHF VOR/LOC/GS antenna, VOR/ILS receiver, VHF COMM antenna and a VHF Communications Transceiver. The primary function of the VHF Communication portion of the equipment is to facilitate communication with Air Traffic Control. The primary function of the VOR/ILS Receiver portion of the equipment is to receive and demodulate VOR, Localizer, and Glide Slope signals. The primary function of the GPS portion of the system is to acquire signals from the GPS system satellites, recover orbital data, make range and Doppler measurements, and process this information in real-time to obtain the user's position, velocity, and time.

   Electrical power for the GNS-430 system is supplied through two circuit breakers (C/B's) for each installed GNS-430. A 5 amp C/B labeled **GPS1** (**GPS2** for #2 system), located on the C/B panel. RH Copilot's side of cabin, supplies power to the GPS and display system. Another 5 amp C/B labeled **COM1/NAV1** (**COM2/NAV2** for #2 system) also located on the C/B panel, RH Copilot's side of the cabin, supplies power to the communications and navigation portion of the system. These C/B's protect the GNS-430 wiring. In the event of a failure of a system or subsystem which causes either C/B to trip, remaining system capabilities, redundant systems and standardized procedures (i.e. Lost Comm procedures, etc.) should be used and flight planning should be re-evaluated.

   WX-500 power for the Processor Unit is provided through one C/B labled WX, located on the C/B panel. Its purpose is to protect the WX-500 wiring. In the event of a failure of the WX-500 system which causes the WX C/B to trip, the functionality of the GNS-430 will be unaffected except for the loss of Stormscope information.

NOTE

On M20M and M20R models, the GNS-430 will have dual systems installed (#1 & #2). On the M20S the standard installation will be a single GNS-430 system with dual systems an option if the customer desires.

When dual GNS-430 systems are installed, the WX-500 is set up from the #2 system, but may be displayed on either #1 or #2 displays. When a single GNS-430 system is installed, the WX-500 System is set up and displayed on the #1 GNS-430 system.

2. Provided the GARMIN GNS 430's GPS receiver is receiving adequate usable signals, it has been demonstrated capable of and has been shown to meet the accuracy specifications for:

   VFR/IFR enroute, terminal, and non-precision instrument approach (GPS, Loran-C, VOR, VOR-DME, TACAN, NDB, NDB-DME, RNAV) operation within the U.S. National Airspace System in accordance with AC 20-138.

   One of the approved sensors, for a single or dual GNS 430 installation, for North Atlantic Minimum Navigation Performance Specification (MNPS) Airspace in accordance with AC 91-49 and AC 120-33.

- The system meets RNP5 airspace (BRNAV) requirements of AC 90-96 and in accordance with AC 20-138, and JAA AMJ 20X2 Leaflet 2 Revision 1, provided it is receiving usable navigation information from the GPS receiver.

Navigation is accomplished using the WGS-84 (NAD-83) coordinate reference datum. Navigation data is based upon use of only the Global Positioning System (GPS) operated by the United States of America.

SECTION II - LIMITATIONS

1. The GARMIN GNS 400 Pilot's Guide Addendum, P/N 190-00140-10, Rev. A, dated October, 1999, or later appropriate revision, must be immediately available to the flight crew whenever navigation is predicated on the use of the system.

   The GARMIN 400 Series Pilot's Guide Addendum,[P/N 190-00140-10 Rev. A or later approved version] Display Interface for Traffic and Weather Data, must be immediately available to the flight crew if the BFGoodrich WX-500 Stormscope is installed.

2. The GNS 430 must utilize the following or later FAA approved software versions:

SUB-SYSTEM	SOFTWARE VERSION
MAIN	2.12
GPS	2.00
COMM	1.22
VOR/LOC	1.25
G/S	2.00

   The Main software version is displayed on the GNS 430 self test page immediately after turn-on for 5 seconds. The remaining system software versions can be verified on the AUX group sub-page 2, "SOFTWARE/DATABASE VER".

3. IFR enroute and terminal navigation predicated upon the GNS 430's GPS Receiver is prohibited unless the pilot verifies the currency of the data base or verifies each selected waypoint for accuracy by reference to current approved data.

4. Instrument approach navigation predicated upon the GNS 430's GPS Receiver must be accomplished in accordance with approved instrument approach procedures that are retrieved from the GPS equipment data base. The GPS equipment database must incorporate the current update cycle.

   (a) Instrument approaches utilizing the GPS receiver must be conducted in the approach mode and Receiver Autonomous Integrity Monitoring (RAIM) must be available at the Final Approach Fix.

   (b) Accomplishment of ILS, LOC, LOC-BC, LDA, SDF, MLS or any other type of approach not approved for GPS overlay with the GNS 430's GPS receiver is not authorized.

   (c) Use of the GNS 430 VOR/ILS receiver to fly approaches not approved for GPS require VOR/ILS navigation data to be present on the external indicator.

   (d) When an alternate airport is required by the applicable operating rules, it must be served by an approach based on other than GPS or Loran-C navigation, the aircraft must have the operational equipment capable of using that navigation aid, and the required navigation aid must be operational.

   (e) VNAV information may be utilized for advisory information only. Use of VNAV information for Instrument Approach Procedures does not guarantee Step-Down Fix altitude protection, or arrival at approach minimums in normal position to land.

5. If not previously defined, the following default settings must be made in the "SETUP 1" menu of the GNS 430 prior to operation (refer to Pilot's Guide for procedure if necessary):

(a) **dis, spd** ..... kt (sets navigation units to "nautical miles" and "knots")

(b) **alt, vs** ..... ft fpm (sets altitude units to "feet" and "feet per minute")

(c) **map datum** WGS 84 (sets map datum to WGS-84, see note below)

(d) **posn** ..... deg-min (sets navigation grid units to decimal minutes)

NOTE: In some areas outside the United States, datums other than WGS-84 or NAD-83 may be used. If the GNS 430 is authorized for use by the appropriate Airworthiness authority, the required geodetic datum must be set in the GNS 430 prior to its use for navigation.

6. PLACARD REQUIRED:

LIGHTNING DETECTION
EQUIPMENT NOT TO BE
USED FOR THUNDERSTORM
AREA PENETRATION

or (alternate versions)

SECTION III - EMERGENCY PROCEDURES

ABNORMAL PROCEDURES

1. If GARMIN GNS 430 navigation information is not available or invalid, utilize remaining operational navigation equipment as required.
2. If "RAIM POSITION WARNING" message is displayed the system will flag and no longer provide GPS based navigational guidance. The crew should revert to the GNS 430 VOR/ILS receiver or an alternate means of navigation other than the GNS 430's GPS Receiver.
3. If "RAIM IS NOT AVAILABLE" message is displayed in the enroute, terminal, or initial approach phase of flight, continue to navigate using the GPS equipment or revert to an alternate means of navigation other than the GNS 430's GPS receiver appropriate to the route and phase of flight. When continuing to use GPS navigation, position must be verified every 15 minutes using the GNS 430's VOR/ILS receiver or another IFR-approved navigation system.
4. If "RAIM IS NOT AVAILABLE" message is displayed while on the final approach segment, GPS based navigation will continue for up to 5 minutes with approach CDI sensitivity (0.3 nautical mile). After 5 minutes the system will flag and no longer provide course guidance with approach sensitivity. Missed approach course guidance may still be available with 1 nautical mile CDI sensitivity by executing the missed approach.
5. In an in-flight emergency, depressing and holding the Comm transfer button for 2 seconds will select the emergency frequency of 121.500 MHz into the "Active" frequency window.

SECTION IV - NORMAL PROCEDURES

1. DETAILED OPERATING PROCEDURES

Normal operating procedures are described in the GARMIN GNS 400 Pilot's Guide Addendum, P/N 190-00140-10, Rev. A, dated October, 1999, or later appropriate revision.

2. PILOT'S DISPLAY

The number one GNS 430 System data will appear on the Pilot's HSI. The source of data for the HSI is either GPS or VLOC as annunciated on the display above the CDI key on the number one GNS 430. The number two GNS 430 System [if installed] data will appear on the secondary indicator [I.E. CDI]. The source of data for the secondary indicator is either GPS or VLOC as annunciated on the display above the CDI key on the number two GNS 430 System.

3. AUTOPILOT / FLIGHT DIRECTOR OPERATION

Coupling of the number one GNS 430 System steering information to the autopilot can be accomplished by engaging the autopilot in the NAV or APR mode. The number two GNS 430 System [if installed] is not connected to the autopilot system and cannot be autopilot coupled.

When the autopilot system is using course information supplied by the number one GNS 430 System, the course pointer on the HSI must be manually set to the desired track (DTK) indicated by the number one GNS 430 System. For detailed autopilot operational instructions, refer to the FAA Approved Flight Manual Supplement for the autopilot.

4. CROSSFILL BETWEEN NUMBER ONE AND TWO [if installed] GNS 430 SYSTEMS

Manual crossfill capabilities exist between the number one and number two GNS 430 Systems. Refer to the GARMIN GNS 430 Pilot's Guide for detailed crossfill operating instructions.

5. REMOTE DME CHANNELING

The capability exists to channel the DME system installed in the aircraft with either the number one or two [if installed] GNS 430 Systems. The source selector switch for remote DME channeling is located on the top section of the panel in front of the copilot. The source selector switch has two positions - the up position is for the number one GNS 430 System and the down position is for the number two GNS 430 System [if installed]. When operating the DME in remote channeling mode, the tuned DME channel is determined by the source selector switch and the VOR/LOC frequency in the active window of the selected GNS 430 source.

6. AUTOMATIC LOCALIZER COURSE CAPTURE

By default, the GNS 430 automatic localizer course capture feature is enabled. This feature provides a method for system navigation data present on the external indicators to be switched automatically from GPS guidance to localizer / glide slope guidance at the point of course intercept on a localizer at which GPS derived course deviation equals localizer derived course deviation. If an offset from the final approach course is being flown, it is possible that the automatic switch from GPS course guidance to localizer / glide slope course guidance will not occur. It is the pilot's responsibility to ensure correct system navigation data is present on the external indicator before continuing a localizer based approach beyond the final approach fix.

7. DISPLAY OF LIGHTNING STRIKE DATA

For installations that interface the BFGoodrich WX-500 Stormscope and the GNS-430, lightning strike data detected by the WX-500 will appear on the GNS-430 display [on #1 if a single GNS-430 is installed or on either #1 or #2 if dual GNS-430 systems are installed].

A momentary switch is mounted on the Pilot's control wheel, labeled **WX CLR**. When depressed, this allows the pilot to unclutter the Stormscope presentation on the GNS-430. When the button is released, the WX-500 system will resume collecting and displaying Stormscope data

For detailed operating instructions regarding the interface of the GNS-430, refer to the BFGoodrich WX-500 User's Guide (P/N 009-11501-001 [Rev. A, 9/10/97] or later approved version) and the GNS-430 Pilot's Guide Addendum [P/N 190-00140-10, Rev. A, Dated October, 1999 or later approved version] for the WX-500 Stormscope interface.

SECTION V - PERFORMANCE

No change.

SECTION VI - WEIGHT AND BALANCE

See current weight and balance data.

SECTION VII - AIRPLANE & SYSTEM DESCRIPTIONS

See GNS 430 Pilot's Guide for a complete description of the GNS 430 system.

SECTION VIII THRU SECTION X

No change to these sections.

MOONEY AIRCRAFT CORPORATION
LOUIS SCHREINER FIELD
KERRVILLE, TEXAS 78028

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR

MOONEY M20J, M20K, M20M, M20R, M20S

WITH

DUAL GARMIN GNS 430 VHF COMMUNICATION
TRANSCEIVER / VOR/ILS RECEIVER / GPS RECEIVER

Model M20R

Reg. No. N2210Y

S/N 29-0212

This Supplement must be attached to the FAA Approved Airplane Flight Manual when the GARMIN GNS 430 VHF Communication Transceiver / VOR/ILS Receiver / Global Positioning System is installed in accordance with Mooney Aircraft Corporation Drawing No. 810445. The information contained herein supplements the information of the basic Airplane Flight Manual. For Limitations, Procedures and Performance information not contained in this Supplement, consult the basic Airplane Flight Manual.

FAA APPROVED Michele M Owsley
Nov. 4, 1999

Michele M. Owsley
Manager, Aircraft Certification Office
Federal Aviation Administration
Fort Worth, Texas 78137-0150

DATE: 31 October, 1999

MOONEY AIRCRAFT CORPORATION

LOUIS SCHREINER FIELD
KERRVILLE, TEXAS 78028

LOG OF REVISIONS

Rev. No.	Revised Pages	Description of Revision	FAA Approved	Date

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TABLE OF CONTENTS

SECTION I - GENERAL

1. The GNS 430 System is a fully integrated, panel mounted instrument, which contains a VHF Communications Transceiver, a VOR/ILS receiver, and a Global Positioning System (GPS) Navigation computer. The system consists of a GPS antenna, GPS Receiver, VHF VOR/LOC/GS antenna, VOR/ILS receiver, VHF COMM antenna and a VHF Communications Transceiver. The primary function of the VHF Communication portion of the equipment is to facilitate communication with Air Traffic Control. The primary function of the VOR/ILS Receiver portion of the equipment is to receive and demodulate VOR, Localizer, and Glide Slope signals. The primary function of the GPS portion of the system is to acquire signals from the GPS system satellites, recover orbital data, make range and Doppler measurements, and process this information in real-time to obtain the user's position, velocity, and time.

   Electrical power for the GNS-430 system is supplied through two circuit breakers (C/B's) for each installed GNS-430. A 5 amp C/B labeled **GPS1** (**GPS2** for #2 system), located on the C/B panel. RH Copilot's side of cabin, supplies power to the GPS and display system. Another 5 amp C/B labeled **COM1/NAV1** (**COM2/NAV2** for #2 system) also located on the C/B panel, RH Copilot's side of the cabin, supplies power to the communications and navigation portion of the system. These C/B's protect the GNS-430 wiring. In the event of a failure of a system or subsystem which causes either C/B to trip, remaining system capabilities, redundant systems and standardized procedures (i.e. Lost Comm procedures, etc.) should be used and flight planning should be reevaluated.

2. Provided the GARMIN GNS 430's GPS receiver is receiving adequate usable signals, it has been demonstrated capable of and has been shown to meet the accuracy specifications for:

   - VFR/IFR enroute, terminal, and non-precision instrument approach (GPS, Loran-C, VOR, VOR-DME, TACAN, NDB, NDB-DME, RNAV) operation within the U.S. National Airspace System in accordance with AC 20-138.
   - One of the approved sensors, for a single or dual GNS 430 installation, for North Atlantic Minimum Navigation Performance Specification (MNPS) Airspace in accordance with AC 91-49 and AC 120-33.
   - The system meets RNP5 airspace (BRNAV) requirements of AC 90-96 and in accordance with AC 20-138, and JAA AMJ 20X2 Leaflet 2 Revision 1, provided it is receiving usable navigation information from the GPS receiver.

   Navigation is accomplished using the WGS-84 (NAD-83) coordinate reference datum. Navigation data is based upon use of only the Global Positioning System (GPS) operated by the United States of America.

SECTION II - LIMITATIONS

1. The GARMIN GNS 430 Pilot's Guide, P/N 190-00140-00, Rev. A, dated October, 1998, or later appropriate revision, must be immediately available to the flight crew whenever navigation is predicated on the use of the system.

2. The GNS 430 must utilize the following or later FAA approved software versions:

SUB-SYSTEM	SOFTWARE VERSION
MAIN	2.00
GPS	2.00
COMM	1.22
VOR/LOC	1.25
G/S	2.00

The Main software version is displayed on the GNS 430 self test page immediately after turn-on for 5 seconds. The remaining system software versions can be verified on the AUX group sub-page 2, "SOFTWARE/DATABASE VER".

3. IFR enroute and terminal navigation predicated upon the GNS 430's GPS Receiver is prohibited unless the pilot verifies the currency of the data base or verifies each selected waypoint for accuracy by reference to current approved data.

4. Instrument approach navigation predicated upon the GNS 430's GPS Receiver must be accomplished in accordance with approved instrument approach procedures that are retrieved from the GPS equipment data base. The GPS equipment database must incorporate the current update cycle.

   (a) Instrument approaches utilizing the GPS receiver must be conducted in the approach mode and Receiver Autonomous Integrity Monitoring (RAIM) must be available at the Final Approach Fix.

   (b) Accomplishment of ILS, LOC, LOC-BC, LDA, SDF, MLS or any other type of approach not approved for GPS overlay with the GNS 430's GPS receiver is not authorized.

   (c) Use of the GNS 430 VOR/ILS receiver to fly approaches not approved for GPS require VOR/ILS navigation data to be present on the external indicator.

   (d) When an alternate airport is required by the applicable operating rules, it must be served by an approach based on other than GPS or Loran-C navigation, the aircraft must have the operational equipment capable of using that navigation aid, and the required navigation aid must be operational.

   (e) VNAV information may be utilized for advisory information only. Use of VNAV information for Instrument Approach Procedures does not guarantee Step-Down Fix altitude protection, or arrival at approach minimums in normal position to land.

5. If not previously defined, the following default settings must be made in the "SETUP 1" menu of the GNS 430 prior to operation (refer to Pilot's Guide for procedure if necessary):

   (a) **dis, spd** ..... kt (sets navigation units to "nautical miles" and "knots")

   (b) **alt, vs** ..... ft fpm (sets altitude units to "feet" and "feet per minute")

   (c) **map datum** WGS 84 (sets map datum to WGS-84, see note below)

   (d) **posn** ..... deg-min (sets navigation grid units to decimal minutes)

   NOTE: In some areas outside the United States, datums other than WGS-84 or NAD-83 may be used. If the GNS 430 is authorized for use by the appropriate Airworthiness authority, the required geodetic datum must be set in the GNS 430 prior to its use for navigation.

SECTION III - EMERGENCY PROCEDURES

ABNORMAL PROCEDURES

1. If GARMIN GNS 430 navigation information is not available or invalid, utilize remaining operational navigation equipment as required.

2. If "RAIM POSITION WARNING" message is displayed the system will flag and no longer provide GPS based navigational guidance. The crew should revert to the GNS 430

VOR/ILS receiver or an alternate means of navigation other than the GNS 430's GPS Receiver.

3. If "RAIM IS NOT AVAILABLE" message is displayed in the enroute, terminal, or initial approach phase of flight, continue to navigate using the GPS equipment or revert to an alternate means of navigation other than the GNS 430's GPS receiver appropriate to the route and phase of flight. When continuing to use GPS navigation, position must be verified every 15 minutes using the GNS 430's VOR/ILS receiver or another IFR-approved navigation system.

4. If "RAIM IS NOT AVAILABLE" message is displayed while on the final approach segment, GPS based navigation will continue for up to 5 minutes with approach CDI sensitivity (0.3 nautical mile). After 5 minutes the system will flag and no longer provide course guidance with approach sensitivity. Missed approach course guidance may still be available with 1 nautical mile CDI sensitivity by executing the missed approach.

5. In an in-flight emergency, depressing and holding the Comm transfer button for 2 seconds will select the emergency frequency of 121.500 Mhz into the "Active" frequency window.

SECTION IV - NORMAL PROCEDURES

1. DETAILED OPERATING PROCEDURES

Normal operating procedures are described in the GARMIN GNS 430 Pilot's Guide, P/N 190-00140-00, Rev. A, dated October, 1998, or later appropriate revision.

2. PILOT'S DISPLAY

The number one GNS 430 System data will appear on the Pilot's HSI. The source of data for the HSI is either GPS or VLOC as annunciated on the display above the CDI key on the number one GNS 430. The number two GNS 430 System data will appear on the secondary indicator. The source of data for the secondary indicator is either GPS or VLOC as annunciated on the display above the CDI key on the number two GNS 430 System.

3. AUTOPILOT / FLIGHT DIRECTOR OPERATION

Coupling of the number one GNS 430 System steering information to the autopilot can be accomplished by engaging the autopilot in the NAV or APR mode. The number two GNS 430 System is not connected to the autopilot system and cannot be autopilot coupled.

When the autopilot system is using course information supplied by the number one GNS 430 System, the course pointer on the HSI must be manually set to the desired track (DTK) indicated by the number one GNS 430 System. For detailed autopilot operational instructions, refer to the FAA Approved Flight Manual Supplement for the autopilot.

4. CROSSFILL BETWEEN NUMBER ONE AND TWO GNS 430 SYSTEMS

Manual crossfill capabilities exist between the number one and number two GNS 430 Systems. Refer to the GARMIN GNS 430 Pilot's Guide for detailed crossfill operating instructions.

5. REMOTE DME CHANNELING

The capability exists to channel the DME system installed in the aircraft with either the number one or two GNS 430 Systems. The source selector switch for remote DME channeling is located on the top section of the panel in front of the copilot. The source selector switch has two positions - the up position is for the number one GNS 430 System and the down position is for the number two GNS 430 System. When operating the DME in remote channeling mode, the tuned DME channel is determined by the source selector switch and the VOR/LOC frequency in the active window of the selected GNS 430 source.

6. AUTOMATIC LOCALIZER COURSE CAPTURE

By default, the GNS 430 automatic localizer course capture feature is enabled. This feature provides a method for system navigation data present on the external indicators to be switched automatically from GPS guidance to localizer / glide slope guidance at the

point of course intercept on a localizer at which GPS derived course deviation equals localizer derived course deviation. If an offset from the final approach course is being flown, it is possible that the automatic switch from GPS course guidance to localizer / glide slope course guidance will not occur. It is the pilot's responsibility to ensure correct system navigation data is present on the external indicator before continuing a localizer based approach beyond the final approach fix.

SECTION V - PERFORMANCE

No change.

SECTION VI - WEIGHT AND BALANCE

See current weight and balance data.

SECTION VII - AIRPLANE & SYSTEM DESCRIPTIONS

See GNS 430 Pilot's Guide for a complete description of the GNS 430 system.

SECTION VII THRU SECTION X

No change to these sections.

MOONEY AIRCRAFT CORPORATION
LOUIS SCHREINER FIELD
KERRVILLE, TEXAS 78028

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR
MOONEY M20J, M20K, M20M, M20R, M20S

WITH

PRECISE FLIGHT, INC.

SPEEDBRAKE 2000 SYSTEM
(WITH CONTROL WHEEL SWITCH OPERATION)

Model M20R

Registration No. N2210Y

Serial No. 29-0212

This supplement must be attached to the Pilots Operating Handbook and FAA Approved Airplane Flight Manual when the Precise Flight SpeedBrake 2000 System is installed in accordance with Mooney Aircraft Corporation Drawing 950286.

The information contained herein supplements or supersedes the information in the basic Pilots Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations,
procedures and performance information not contained in this supplement, consult the basic Pilots Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED: Efrain F. Esparza 12-6-99

for Michele M. Owsley -Manager,
Aircraft Certification Office
DOT/FAA ASW-150
2601 Meacham Boulevard
Fort Worth TX 76137-0150

DATE OF APPROVAL: 6 December, 1999

MOONEY AIRCRAFT CORPORATION

LOUIS SCHREINER FIELD
KERRVILLE, TEXAS 78028

LOG OF REVISIONS

Revision Number	Revised Pages	Description of Revision	FAA Approved	Date

The revised portions of affected pages are indicated by vertical black lines in the margin.

SECTION I - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Precise Flight SpeedBrake 2000 System is installed in accordance with MAC Approved data.
Refer to SECTION VII of this supplement for detailed description of the Speedbrake 2000 System

SECTION II - OPERATING LIMITATIONS

AIRSPEED LIMITATIONS.....Same as the basic airplane
ICING CONDITIONS...Aircraft is restricted from flight into known or forecast icing conditions.
PLACARDS REQUIRED:

SPEEDBRAKE

Located on the circuit breaker panel (included on the aircraft C/B panel placard when Speedbrake system is installed)

ELECTRICALLY ACTUATED DO NOT MANUALLY OPERATE

On each wing, at each SpeedBrake location, in full view.

SECTION III - EMERGENCY PROCEDURES

FORCED LANDING AFTER ENGINE FAILURE .....SpeedBrakes OFF
or as required to modulate glidepath with use of speedbrakes.
SPIN RECOVERY.....SpeedBrakes OFF
DITCHING .....SpeedBrakes OFF
DISABLED ELEVATOR SYSTEM.....SpeedBrakes OFF
ELECTRICAL FAILURE .....SpeedBrakes OFF
PULL Speedbrake Circuit Breaker

SPEEDBRAKE SWITCH FAILURE.....PULL SpeedBrake Circuit Breaker

NOTE

If use of the circuit breaker is required for SpeedBrake retraction, leave the circuit breaker in the PULLED position, and have maintenance personnel inspect system per Precise Flight SpeedBrake 2000 Maintenance procedures.

SECTION IV - NORMAL PROCEDURES

The SpeedBrake system should be functionally checked for proper operation prior to flight. The independent electrical clutches need to be synchronized by SpeedBrake activation before flight and/or after SpeedBrake Circuit Breaker has been Pulled.

BEFORE TAKE-OFF
SPEEDBRAKE SWITCH.....Depress SpeedBrake Switch ONCE (ON) to extend SpeedBrakes
Verify Annunciator AMBER light - ILLUMINATED, both SpeedBrakes extended.
SPEEDBRAKE SWITCH.....Depress SpeedBrake Switch AGAIN (OFF) to retract SpeedBrakes prior to take-off.
Verify Annunciator AMBER light - OFF, both SpeedBrakes retracted.

DURING TAKE-OFF
SPEEDBREAKS .....RETRACTED during TakeOff roll

WARNING

If SpeedBrakes do not fully extend or do not operate simultaneously (extend or retract), place SpeedBrake circuit breaker in the PULLED position, and have maintenance personnel inspect system per Precise Flight SpeedBrake 2000 Maintenance procedures.

EMERGENCY DESCENTS

Select 2200 RPM and approximately 22 inches Manifold Pressure.

SpeedBrake switch ON to extend SpeedBrakes.

With Landing Gear Extended:

- Maintain 165 KIAS (M20J [S/N 24-3000 thru 24-3078], M20K, M20M, M20R, M20S);
- Maintain 132 KIAS (M20J [all other S/Ns]).

SpeedBrake switch OFF to retract SpeedBrakes (as needed dunng descent).

FINAL APPROACH

Fly a high base leg and final approach. Extend wing flaps as desired. Depress SpeedBrake switch - ON - to extend the SpeedBrakes.

NOTE

The SpeedBrakes may be operated intermittently - as required - to modulate glide path. Maintain an 85 KIAS approach speed by establishing a moderately steep, nose-down attitude.

NOTE

Increase the aircraft nose down attitude in anticipation of increased drag as the SpeedBrakes are extended.

LANDING

Initiate landing flare at a slightly higher altitude above runway.
Rotate aircraft more rapidly than usual to perform a tail-low touchdown.

CAUTION

If the landing rate of sink is excessive, place the SpeedBrake System switch OFF to retract the SpeedBrakes; add power as required to reduce the rate of descent.

BALKED LANDING (Go Around)

Advance throttle; SpeedBrakes - Retracted; Wing flaps - Retracted;
Landing Gear - Retracted.

SECTION V - PERFORMANCE

Inadvertent takeoff with SpeedBrakes extended.....expect an extended takeoff roll and reduction in rate of climb until SpeedBrakes are retracted

Cruise flight with SpeedBrakes extended.....expect cruise speed and range to be reduced approximately the same amount as flight with landing gear extended.

In the unlikely event of one SpeedBrake Cartridge extending while the other remains retracted, a maximum of 10% of corrective aileron travel and 5 lbs. of rudder pressure are required for coordinated flight from stall through V_{NE}. Indication of this condition will be noted by the lack of a cockpit annunciator light display with the SpeedBrake Switch in the ON mode.

SECTION VI - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data of the Pilots Operating Handbook

SECTION VII - DESCRIPTION AND OPERATION OF THE PRECISE FLIGHT SPEEDBRAKE 2000 SYSTEM

The Precise Flight SpeedBrake 2000 System is installed to provide expedited descents at low cruise power, glide path control on final approach, airspeed reduction and an aid to the prevention of excessive engine cooling in descent. The SpeedBrakes can be extended at aircraft speeds up to VNE.

WARNING

If icing is encountered with the SpeedBrakes extended, retract the SpeedBrakes immediately.

The Series 2000 SpeedBrake System (Optional) consists of a wing mounted, electrically actuated, SpeedBrake Cartridge, left & right side of wing. Each SpeedBrake Cartridge is interconnected electronically by a central logic-switching unit and the yoke mounted SpeedBrake actuator switch. The SpeedBrake Cartridges receive electrical power from the aircraft electrical buss through a disconnect type circuit breaker.

The SpeedBrake push button switch is located on the Pilots control wheel yoke - outside left hand arm. The switch is depressed once to fully extemd and is depressed again to fully retract the SpeedBrakes. The system features an annunciation legend (on Annunciator panel) to indicate the status of the SpeedBrake system. Annunicator ON - both units extended. Annunciator OFF - both units retracted or a possible malfunction exists.

NOTE

The failure of either cartridge drive unit to fully extend, will prevent the annunciator legend from illuminating.

SPEEDBRAKE ANNUNCIATOR

	GEAR DOWN	GEAR UNSAFE	LEFT FUEL	RIGHT FUEL	SPEED BRAKE	——	PROP DEICE	PITOT HEAT	
TEST	HI/LO VAC	ALT VOLTS	——	START POWER	STBY VAC	REMOTE RNAV	——	B OOST PUMP	DIM

-- ANNUNCIATOR LEGENDS WILL VARY WITH AIRCRAFT MODELS SLIGHTLY --

FIGURE 1 -1

The Mooney Annunciator Panel is located in the upper, center, right instrument panel. The Annunciator will illuminate after the SpeedBrake switch is depressed ON and both units are in the fully extended position. If the annunciator fails to illuminate and both speedbrakes do not extend after the switch is depressed ON, it indicates a failure of one of the SpeedBrake cartridges. The SpeedBrake switch should be depressed OFF. The system may be checked a second time for proper operation, but after the second attempt the SpeedBrake switch should be left
OFF. When the SpeedBrake Switch is depressed to the OFF position, the annunciator will extinguish when both speedbrakes are fully retracted in the wing.

The central - logic unit will disconnect the SpeedBrake clutch power to both SpeedBrake cartridges if one cartridge does not reach full extension. However, the drive motors will continue to operate until the SpeedBrake Switch is depressed OFF. The central - logic unit also disconnects clutch power if speedbrakes retract to within 10 degrees of the fully stowed position.

NOTE

A SpeedBrake cartridge that operates but does not fully retract flush with the wing surface is an indication of a failed cartridge clutch. Place the Speedbrake circuit breaker in the pulled position and have maintenance personnel inspect the system per Precise Flight SpeedBrake 2000 Maintenance procedures before any subsequent Speedbrake System operation.

MOONEY AIRCRAFT CORPORATION
Louis Schreiner Field
KERRVILLE, TEXAS 78028

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR

MOONEY AIRCRAFT MODELS

M20J, M20K, M20M, M20R, M20S
WITH
STAND-BY VACUUM PUMP SYSTEM
(ELECTRIC MOTOR DRIVEN VACUUM PUMP)

MODEL NO. M20R

REG. NO. N2210Y

SERIAL NO. 29-0212

This Supplement must be attached to the applicable FAA Approved Pilot"s Operating Handbook and Airplane Flight Manual (POH/AFM) when the Stand-by Vacuum Pump System is installed in accordance with Mooney Drawing number 860060 (M20J/M20K), 860063 (M20M, M20R/M20S). The information contained herein supplements or supersedes the basic manual only in those areas listed. For limitation, procedures and performance information not contained in this supplement, consult the basic Airplane Flight Manual.

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MOONEY AIRCRAFT CORPORATION

LOUIS SCHREINER FIELD
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LOG OF REVISIONS

Revision Number	Revision Pages	Description of Revisions	FAA Approved	Date
F	Title Page, Page 1 thru Page 6	Added M20S Model application to all pages.	[illegible]	2/7/99

The revised portions of affected pages are indicated by vertical black lines in the margin.

TABLE OF CONTENTS

SECTION I - GENERAL

The standby dry air vacuum pump installation is designed to provide an alternate vacuum source for the attitude gyro and directional gyro instruments in the event of a malfunction in the primary engine driven vacuum pump system. The standby vacuum pump is driven by a DC electric motor, and the combination pump/motor assembly is mounted o;n the radio racks behind the aft cabin bulkhead in the tailcone. The standby pump can be operated at any time by activating a circuit breaker/rocker switch labeled "STBY VAC ON" mounted on the lower instrument subpanel in front of the pilot.* A separate panel mounted amber annunciator labeled "STBY VAC ON" and a vacuum gauge are provided for monitoring proper operation of the standby system. The vacuum gauge will indicate vacuum, in inches of mercury, for both the engine driven pump when operating normally and for the standby vacuum pump system.

* M20J- S/N 24-0001 thru 24-3153 only
M20K- S/N 25-0001 thru 25-1224 only
(excludes S/N 25-1196)

SECTION II - LIMITATIONS

This supplement advises that use of the standby vacuum pump system may impose a limit on the installed equipment in operation.

NOTE
Weather radar will be inoperative with only the standby vacuum pump system in operation.

1. The maximum allowable continuous current drain for all optional electrical equipment in alternator equipped aircraft is 39.0 amperes, day flight, and 32.0 amperes, night flight (14V); 46.0 amps day and 36.0 amps night (28V).

CAUTION
If operation of optional electrical equipment exceeds these ratings, this equipment must be selected OFF to prevent exceeding the maximum allowed alternator load.

2. The standby vacuum motor will require 15 amps at Sea Level and 11 amps at 15,000 ft. (14V); 8 amps - S/L and 6 amps - 15,000 ft. (28V). This amperage reduction is basically linear as altitude increases.

**** CAUTION**
When standby vacuum pump system is activated, the ammeter should be monitored for a current discharge indication. If a discharge is observed turn off any non-essential electrical equipment until a discharge indication no longer exists on the ammeter.

** S/N's M20J - 24-0001 thru 24-2999, 24-3154 thru 24-TBA
S/N's M20K - 25-0001 thru 25-0999, 25-1225 thru 25-TBA
(includes S/N 25-1196)

3. PLACARDS REQUIRED

CAUTION - When "STBY VAC" is ON - LOW VAC light inop.

Located adjacent to annunciator panel.

SECTION III - EMERGENCY PROCEDURES

Any time that the RED "LOW VAC" annunciator flashes, indicating the engine driven vacuum pump is providing insufficient vacuum for the gyro instruments, the standby vacuum pump system should be operated in the following manner:

1. "STBY VAC" switch - ON.

2. Flashing "LOW VAC" annunciator - Verify EXTINGUISHED.

SECTION III - EMERGENCY PROCEDURES (con't.)

3. "STBY VAC ON" annunciator - ILLUMINATED.

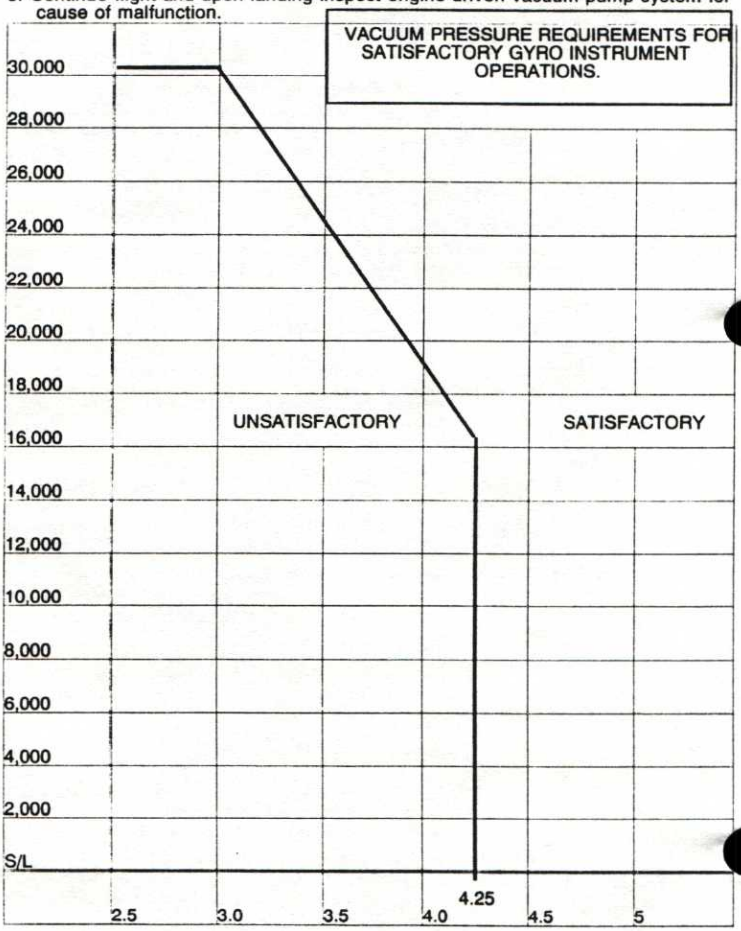
4. All non-essential electrical equipment - OFF.

5. Vacuum Gauge - Monitor for proper standby vacuum pump operation.

NOTE

Minimum vacuum required for satisfactory gyro instrument operation is a function of aircraft pressure altitude. Use the graph below (page 4) to verify adequate standby vacuum pump output for the particular operating altitude.

6. Continue flight and upon landing inspect engine driven vacuum pump system for cause of malfunction.



SECTION IV - NORMAL PROCEDURES

Before Starting Check

The following pre-engine start check should be performed on the standby vacuum system before each flight where use of standby system may be desired.

1. Master Switch - ON.
2. "LOW VAC" Annunciator light - FLASHING.
3. "STBY VAC" Switch - ON.
4. Flashing "LOW VAC" Annunciator light - EXTINGUISHED.
5. "STBY VAC ON" Annunciator light - ILLUMINATED.
6. Vacuum Gauge - Monitor for proper standby vacuum pump operation.
7. "STBY VAC" Switch - OFF.
8. Continue with remainder fo "Before Starting Checklist."

SECTION V

No Change.

SECTION VI - WEIGHT AND BALANCE

Refer to revised empty weight and center of gravity data for effect on loading instructions.

SECTION VII - SYSTEMS DESCRIPTION

Standby Vacuum Pump System

The standby vacuum system consist of an electric motor driven dry air vacuum pump mounted in the radio racks behind the aft cabin bulkhead. System plumbing for this pump is routed along the left-hand side of the aircraft to a manifold /check valve/regulator assembly mounted on the cabin side of the firewall. The manifold/check valve/regulator assembly provides both isolation and interconnect functions between the main engine driven and the standby electrically driven vacuum pumps. A circuit breaker/rocker switch labeled "STBY VAC" is provided for activation of the standby pump. When activated, operation of the standby vacuum pump is verified by the illumination of annunciator light labeled "STBY VAC ON". Standby pump output is monitored by a panel mounted vacuum gauge.

Operationally, a malfunction in the normal engine driven vacuum pump system is noted by the flashing RED "LOW VAC" annunciator light located in the center annunciator panel. This annunciator light will flash whenever engine driven vacuum drops below 4.25 +/-.2 inches of mercury. Activating the circuit breaker/rocker switch labeled "STBY VAC" to the

ON position will supply electrical power to the electric motor driving the Standby Vacuum Pump and electrically extinguish the RED flashing "LOW VAC" annunciator light.

Verification of proper standby vacuum system operation is determined by the illumination of the AMBER "STBY VAC ON" annunciator and monitoring the panel mounted vacuum gauge for adequate standby vacuum pump output.

The standby vacuum pump system can be used whenever a malfunction is suspected in the primary engine driven vacuum pump system. Should a short occur in the standby electrical system, the combination switch/circuit breaker will automatically trip to the OFF position.

SECTIONS VIII thru X

No Change.

TABLE OF CONTENTS

INTRODUCTION

The best of engineering know-how and manufacturing craftsmanship have gone into the design and building of your Mooney aircraft. Like any high performance airplane, it operates most efficiently and safely in the hands of a skilled pilot.

We urge you to be thoroughly familiar with the contents of your operating manuals, placards, and check list to insure maximum utilization of your airplane. When the airplane has changed ownership, some of these may have been misplaced. If any are missing, replacements should be obtained from any Mooney Service Center as soon as possible.

For your added protection and safety, we have added this special section to the Pilot's Operating Handbook to refresh your knowledge of a number of safety subjects. You should review these subjects periodically.

Topics in this section are mostly excerpts from FAA Documents and other articles pertaining to the subject of safe flying. They are not limited to any particular make or model airplane and do not replace instructions for particular types of airplanes.

Your Mooney aircraft was designed and built to provide you with many years of safe and efficient transportation. By maintaining it properly and flying it prudently, you should realize its full potential.

GENERAL

Flying is one of the safest modes of travel. Remarkable safety records are being established each year. As a pilot you are responsible to yourself, your relatives, to those who travel with you, to other pilots and to ground personnel to fly wisely and safely.

The following materials in this Safety section covers several subjects in limited detail. Here are some condensed DO's and DON'Ts.

DO'S

1. Be thoroughly familiar with your airplane and be current in it, or get a check ride.
2. Pre-plan all aspects of your flight-including weather.
   —— FLY YOUR PLAN ——.
3. Use services available-FSS, Weather Bureau, etc.
4. Pre-flight you airplane thoroughly.
5. Use your check lists.
6. Have more than enough fuel for takeoff, the planned trip, and adequate reserve.
7. Be sure your weight loading and C.G. are within limits.
8. Be sure articles and baggage are secured.
9. Check freedom of all controls.
10. Maintain appropriate airspeed in takeoff, climb, descent and landing.
11. Avoid other aircraft wake turbulence.
12. Switch fuel tanks before engine starvation occurs.
13. Practice engine out, emergency landing gear extension and other emergency procedures at safe altitude; preferably with a check pilot.
14. Use caution in mountainous terrain.
15. Keep your airplane in good mechanical condition.
16. Stay informed and alert, fly in a sensible manner.

DON'TS

1. Don't take off with frost, ice or snow on the aircraft surfaces.
2. Don't take off with less than minimum recommended fuel, plus reserves.
3. Don't fly in a reckless, show off, careless manner.
4. Don't fly in thunderstorms or severe weather.
5. Don't fly in possible icing conditions. If you encounter icing conditions, alter altitude or course to minimize exposure.
6. Don't apply controls abruptly or with high forces that could exceed design loads of the airplane.
7. Don't fly when physically or mentally exhausted.
8. **DON'T TRUST TO LUCK.**

GENERAL SOURCES OF INFORMATION

There is a wealth of information available to the pilot created for the sole purpose of making your flying easier, faster, and safer. Take advantage of this knowledge and be prepared for an emergency in the remote event that one should occur. You as a pilot also have certain responsibilities under government regulations. These are designed for your own protection. Compliance is not only beneficial but mandatory.

RULES AND REGULATIONS

Federal Aviation regulations, Part 91, General Operating and Flight Rules, is a document of law governing operation of aircraft and the owner's and pilot's responsibilities.

This document covers such subjects as:

Responsibilities and authority of the pilot in command
Certificates required
Liquor and drugs
Flight plans
Pre-flight action
Fuel requirements
Flight rules
Maintenance, preventative maintenance, alterations, inspections and maintenance records

These are only some of the topics covered. It is the owner's and pilot's responsibility to be thoroughly familiar with all items in FAR Part 91 and to follow them.

FEDERAL AVIATION REGULATIONS, PART 39 -AIRWORTHINESS DIRECTIVES

This document specifies that no person may operate a product to which an airworthiness directive issued by the FAA applies, except in accordance with the requirements of that airworthiness directive.

AIRMAN INFORMATION, ADVISORIES, AND NOTICES, FAA AIRMAN'S INFORMATION MANUAL

This document contains a wealth of pilot information for nearly all realms of flight, navigation, ground procedures and medical information. Among the subjects are:

Controlled Air Space
Services Available to Pilots
Radio Phraseology and Technique
Airport Operations
Clearances and Separations
Pre-flight
Departures - IFR
Enroute - IFR
Arrival - IFR
Emergency Procedures
Weather
Wake Turbulence
Medical Facts for Pilots
Bird Hazards
Good Operating Practices
Airport Location Directory

We urge all pilots to be thoroughly familiar with and use the information in this manual.

ADVISORY INFORMATION

Airmen can subscribe to services to obtain FAA NOTAMS and Airman Advisories, and these are also available at FAA Flight Service Stations. NOTAMS are documents that have information of a time-critical nature that would affect a pilot's decision to make a flight; for example, an airport closed, terminal radar out of service, enroute navigational aids out of service, etc.

GENERAL INFORMATION ON SPECIFIC TOPICS

FLIGHT PLANNING

FAR Part 91 requires that each pilot in command, before beginning a flight, familiarize himself with all available information concerning that flight.

All pilots are urged to obtain a complete preflight briefing. This would consist of weather; local, enroute and destination, plus alternates, enroute navaid information. Also airport runways active, length of runways, take off and landing distances for the airplane for conditions expected should be known.

The prudent pilot will review his planned enroute track and stations and make a list for quick reference. It is strongly recommended a flight plan be filed with Flight Service Stations even though the flight may be VFR. Also, advise Flight Service Stations of changes or delays of one hour or more and remember to close the flight plan at destination.

The pilot must be completely familiar with the performance of the airplane and performance data in the airplane manuals and placards. The resultant effect of temperature and pressure altitude must be taken into account in determining performance if not accounted for on the charts. Applicable FAA manuals must be aboard the airplane at all times including the weight and balance forms and equipment lists.

The airplane must be loaded so as not to exceed the weight and the weight and balance loading center of gravity (c.g.) limitations. Also, that at least minimum fuel for takeoff is aboard and sufficient for the trip, plus reserves. Oil in the engines should be checked and filled as required.

INSPECTIONS - MAINTENANCE

In addition to maintenance inspections and preflight information required by FAR Part 91, a complete pre-flight inspection is imperative. It is the responsibility of the owner and operator to assure that the airplane is maintained in an airworthy condition and proper maintenance records are kept.

While the following items cannot substitute for the pre-flight specified for each type of airplane, they will serve as reminders of general items that should be checked.

SPECIAL CONDITIONS CAUTIONARY NOTICE

Airplanes operated for Air Taxi or other than normal operation and airplanes operated in humid tropics or cold and damp climates, etc., may need more frequent inspections for wear, corrosion and or lack of lubrication. In these areas periodic inspections should be performed until the operator can set his own inspection periods based on experience.

| NOTE |

The required periods do not constitute a guarantee that the item will reach the period without malfunction, as the aforementioned factors cannot be controlled by the manufacturer.

Corrosion, and its effects, must be treated at the earliest possible opportunity. A clean dry surface is virtually immune to corrosion. Make sure that all drain holes remain unobstructed. Protective films and sealants help to keep corrosive agents from contacting metallic surfaces. Corrosion inspections should be made most frequently under high-corrosion-risk operating conditions, such as in regions of heavy airborne salt concentrations (e.g., near the sea) and high-humidity areas (e.g., tropical regions).

WALK AROUND INSPECTIONS

All airplane surfaces free of ice, frost or snow.
Tires properly inflated.
All external locks, covers and tie downs removed.
Fuel sumps drained.
Fuel quantity, adequate for trip, plus reserve, (visually checked) and access doors secured.
Oil quantity checked and access doors secured.
Check general condition of airplane, engine, propeller, exhaust stacks, etc.
All external doors secured.

COCKPIT CHECKS

Flashlight available.
Required documents on board.
Use the check list.
All internal control locks removed (If installed).
Check freedom of controls.
Cabin and baggage door properly closed.
Seat belts and shoulder harnesses fastened.
Passengers briefed.
Engine and propeller operating satisfactorily.
All engine gauges checked for proper readings.
Fuel selector in proper position.
Fuel quantity checked by gauges.
Altimeter setting checked.

FLIGHT OPERATIONS

GENERAL

The pilot should be thoroughly familiar with all information published by the manufacturer concerning the airplane. The pilot is required by FAA to operate in accordance with the FAR's and the FAA Approved Airplane Flight Manual and/or placards installed.

TURBULENT WEATHER

A complete weather briefing prior to beginning a flight is the start of assurance of a safe trip. Updating of weather information enroute is another assurance. However, the wise pilot also knows weather conditions change quickly at times and treats weather forcasting as professional advice rather than as absolute fact. He obtains all the advice he can, but still stays alert through knowledge of weather changes, observations, and conditions.

Plan the flight to avoid areas of severe turbulence and thunderstorms. It is not always possible to detect individual storm areas or find the in between clear areas.

Thunderstorms, squall lines and violent turbulence should be regarded as extremely dangerous and MUST be avoided. Hail and tornadic wind velocities can be encountered in thunderstorms that can destroy any airplane, just as tornados destroy nearly everything in their path on the ground.

A roll cloud ahead of a squall line or thunderstorm is visible evidence of violent turbulence, however, the absence of a roll cloud should not be interpreted as denoting the lack of turbulence.

FLIGHT IN TURBULENT AIR

Even though flight in severe turbulence is to be avoided, flight in turbulent air may be encountered under certain conditions. Flying through turbulent air presents two basic problems, to both of which the answer is PROPER AIRSPEED. On the one hand, if you maintain an excessive airspeed, you run the risk of structural damage or failure; on the other hand, if your airspeed is too low, you may stall. If turbulence encountered in cruise or descent becomes uncomfortable to the pilot or passengers, the best procedure is to reduce speed to the maneuvering speed, which is listed in the Limitations Section of the FAA Approved Airplane Flight Manual and Pilots Operating Handbook. This speed gives the best assurance of avoiding ex-

cessive stress loads, and at the same time providing margin against inadvertent stalls due to gusts.

Beware of overcontrolling in attempting to correct for changes in altitude; applying control pressure abruptly will build up G-forces rapidly and could cause damaging structural stress loads. You should watch particularly your angle of bank, making turns as wide and shallow as possible, and be equally cautious in applying forward or back pressure to keep the nose level. Maintain straight and level attitude in either up or down drafts. Use trim sparingly to avoid being grossly mistrimmed as the vertical air columns change velocity and direction.

MOUNTAIN FLYING

Avoid flight at low altitudes over mountainous terrain, particularly near the lee slopes. -OBSERVE PUBLISHED MINIMUM ENROUTE ALTITUDES (MEA)-. If the wind velocity near the level of the ridge is in excess of 25 knots and approximately perpendicular to the ridge, mountain wave conditions are likely over and near the lee slopes. If the wind velocity at the level of the ridge exceeds 50 knots, a strong mountain wave is probable with strong up and down drafts and severe or extreme turbulence. The worst turbulence will be encountered in and below the rotor zone which is usually 8 to 10 miles downwind from the ridge. This zone is characterized by the presence of "roll clouds" if sufficient moisture is present; alto cumulus standing lenticular clouds are also visible signs that a mountain wave exists, but their presence is likewise dependent on moisture. Mountain wave turbulence can, of course, occur in dry air and the absence of such clouds should not be taken as any assurance that mountain wave turbulence will not be encountered. A mountain wave downdraft may exceed the climb capability of your airplane.

—— AVOID MOUNTAIN WAVE DOWNDRAFTS ——

VFR - LOW CEILINGS

If you are not instrument rated, avoid "VFR On Top" and "Special VFR". Being caught above an undercast when an emergency descent is required (or at destination) is an extremely hazardous position for the VFR pilot.

Accepting a clearance out of certain airport control zones with no minimum ceiling and one-mile visibility as permitted with **" Special VFR " is not a recommended practice for VFR pilots.**

Avoid areas of low ceilings and restricted visibility unless you are instrument proficient and have an instrument equipped airplane. Then proceed with caution and have planned alternates.

VFR - AT NIGHT

When flying VFR at night, in addition to the altitude appropriate for the direction of flight, pilots should maintain a safe minimum altitude as dictated by terrain, obstacles such as TV towers, or communities in the area flown. This is especially true in mountainous terrain, where there is usually very little ground reference and absolute minimum clearance is 2,000 feet. Don't depend on your being able to see obstacles in time to miss them. Flight on dark nights over sparsely populated country can be almost the same as IFR and should be avoided by untrained pilots.

VERTIGO -DISORIENTATION

Disorientation can occur in a variety of ways. During flight, inner ear balancing mechanisms are subjected to varied forces not normally experienced on the ground. This combined with loss of outside visual reference can cause vertigo. False interpretations (illusions) result and may confuse the pilot's conception of the attitude and position of his airplane.

Under VFR conditions the visual sense, using the horizon as a reference, can override the illusions. Under low visibility conditions (night, fog, clouds, haze, etc.) the illusions predominate. Only through awareness of these illusions, and proficiency in instrument flight procedures, can an airplane be operated safely in a low visibility environment.

Flying in fog, dense haze or dust, cloud banks, or very low visibility, with strobe lights, and particularly rotating beacons turned on frequently causes vertigo. They should be turned off in these conditions, particularly at night.

All pilots should check the weather and use good judgment in planning flights. The VFR pilot should use extra caution in avoiding low visibility conditions.

Motion sickness often precedes or accompanies disorientation and may further jeopardize the flight.

STALLS, SPINS AND SLOW FLIGHT

Stalls, and slow flight should be practiced at safe altitudes to allow for recovery. Any of these maneuvers should be performed at an altitude in excess of 6,000 feet above ground level. Spins may be dangerous and should be avoided. In fact, most airplanes are placarded against intentional spins. Spins are preceded by stalls. A prompt and decisive stall recovery protects against inadvertent spins. All airplanes are required to have flight characteristics that give adequate advance warning of an impending stall or they must be equipped with an artificial stall warning device. Keep the artificial system in good working order. Do not operate the airplane with the device made inoperative by the use of circuit breakers or other means.

Stalls should be practiced at safe altitudes for ample recovery. Should a spin be encountered inadvertently, spin recovery should be initiated immediately.

As stall attitude is approached, be alert. Take prompt corrective action to avoid the stall or if you are practicing stalls, react the moment the stall occurs. The following is suggested:

1. Do not carry passengers. Be certain that the airplane's center of gravity is as far forward as possible. Forward CG aids spin recovery.
2. Be certain that both student pilot and instructor pilot have a full set of operable controls.
3. Conduct such practice at altitudes in excess of 6,000 ft. above ground level.

Remember that an airplane at or near traffic pattern altitude probably will not recover from a spin before impact with the ground. When descending to traffic pattern altitude and during operation in the traffic pattern and approach, maintain a safe margin above stall speed. During takeoff or go- around, be especially careful to avoid departure stalls associated with turns at low speed. Maintain speeds recommended in this handbook(Section II & V).

STANDARD PROCEDURE FOR SPIN RECOVERY

In the event of an inadvertent spin, the following recovery procedure should be used:

Throttle	RETARD to IDLE
Ailerons	**NEUTRAL**
Rudder	Apply **FULL RUDDER opposite** the direction of spin.
Control Wheel	**FORWARD** of neutral in a brisk motion to break stall. Additional **FORWARD** elevator control may be required if rotation does not stop.
Flaps (If extended)	**RETRACT** as soon as possible
Rudder	**NEUTRALIZE** when spin stops.
Control Wheel	Smoothly **MOVE AFT** to bring the nose up to a level flight attitude **after spin has stopped.**

VORTICES - WAKE TURBULENCE

Every airplane generates wakes of turbulence while in flight. Part of this is from the propeller or jet engine and part from the wing tip vortices. The larger and heavier the airplane the more pronounced wake turbulence will be. Wing tip vortices from large heavy airplanes are very severe at close range, degenerating with time, wind and space. These are rolling in nature from each wing tip. In test, vortex velocities of 133 knots have been recorded.
Exhaust velocities from large airplanes at takeoff have been measured at 25 mph, 2100 feet behind medium, large airplanes.

Encountering the rolling effect of wing tip vortices within two minutes or less after passage of large airplanes is hazardous to light airplanes. This roll effect can exceed the maximum counter roll obtainable in an airplane.

The turbulent areas may remain for as long as three minutes or more, depending on wind conditions, and may extend several miles behind the airplane. Plan to fly slightly above or to the upwind side of the other airplane's flight path.

Because of the wide variety of conditions that can be encountered, there is no set rule to follow to avoid wake turbulence in all situations. However, the Airman's Information Manual goes into considerable detail for a number of wake turbulence avoidance procedures. Use prudent judgment and allow ample clearance time and space following or crossing the wake turbulence of other airplanes in all takeoff, climb out, approach and landing operations. Be observant of wake turbulence from all aircraft, regardless of size.

The Airman's Information Manual contains a section on wake turbulence. FAA Advisory Circular AC 90-230 is also recommended reading.

TAKE - OFF AND LANDING CONDITIONS

When taking off on runways covered with water or freezing slush, the landing gear should remain extended for approximately ten seconds longer than normal, allowing the wheels to spin and dissipate the freezing moisture. The landing gear should then be cycled up, then down, wait approximately five seconds and then retract again. Caution must be exercised to insure that the entire operation is performed below Maximum Landing Gear Operating Airspeed.

Use caution when landing on runways that are covered by water or slush which cause hydroplaning (aquaplaning), a phenomenon that renders braking and steering ineffective because of the lack of sufficient surface friction. Snow and ice covered runways are also hazardous. The pilot should be alert to the possibility of the brakes freezing.

Use caution when taking off or landing in gusty winds. Be aware of special wind conditions caused by buildings or other obstructions located near runway in a crosswind pattern.

MEDICAL FACTS FOR PILOTS

GENERAL

Modern industry's record in providing reliable equipment is very good. When the pilot enters the airplane, he becomes an integral part of the man-machine system. He is just as essential to a successful flight as the control surfaces. To ignore the pilot in pre-flight planning would be as senseless as failing to inspect the integrity of the control surfaces or any other vital part of the machine. The pilot himself has the responsibility for determining his reliability prior to entering the airplane for flight.

While piloting an airplane, an individual should be free of conditions which are harmful to alertness, ability to make correct decisions, and rapid reaction time.

FATIGUE

Fatigue generally slows reaction times and causes foolish errors due to inattention. In addition to the most common cause of fatigue, insufficient rest and loss of sleep, the pressure of business, financial worries and family problems, can be contributing factors. If your fatigue is a factor prior to a given flight, don't fly. To prevent fatigue effects during long flights, keep mentally active by making ground checks and radio-navigation position plots.

HYPOXIA

Hypoxia in simple terms is a lack of sufficient oxygen to keep the brain and other body tissues functioning properly. There is wide individual variation in susceptibility to hypoxia. In addition to progressively insufficient oxygen at higher altitudes, anything interfering with the blood's ability to carry oxygen can contribute to hypoxia (anemias, carbon monoxide, and certain drugs). Also, alcohol and various drugs decrease the brain's tolerance to hypoxia.

Your body has no built in alarm system to let you know when you are not getting enough oxygen. It is impossible to predict when or where hypoxia will occur during a flight, or how it will manifest itself. A major early symptom of hypoxia is an increased sense of well-being (referred to as euphoria). This progresses to slow reactions, impaired thinking ability, unusual fatigue, and dull headache feeling.

Symptoms are slow but progressive, insidious in onset, and are most marked at altitudes starting above 10,000 feet. Night vision, however, can be impaired starting at altitudes lower than 10,000 feet. Heavy smokers may experience early symptoms of hypoxia at altitudes lower than non-smokers. Use oxygen on flights above 10,000 feet and at any time when symptoms appear.

HYPERVENTILATION

Hyperventilation or over-breathing, is a disturbance of respiration that may occur in individuals as a result of emotional tension or anxiety. Under conditions of emotional stress, fright, or pain, breathing rate may increase, causing increased lung ventilation, although the carbon dioxide output of the body cells does not increase. As a result, carbon dioxide is "washed out" of the blood. The most common symptoms of hyperventilation are: dizziness; hot and cold sensations; tingling of the hands, legs and feet; tetany; nausea; sleepiness; and finally unconsciousness.

Should symptoms occur that cannot definitely be identified as either hypoxia or hyperventilation try three or four deep breaths of oxygen. The symptoms should improve markedly if the condition was hypoxia (recovery from hypoxia is rapid). If the symptoms persist, discontinue use of oxygen; consciously slow your breathing rate until symptoms clear; then resume normal breathing rate. Normal breathing can be aided by talking aloud.

ALCOHOL

Common sense and scientific evidence dictate that you not fly as a crew member while under the influence of alcohol. Even small amounts of alcohol in the human system can adversely affect judgment and decision making abilities. FAR 91.11 states "(a) No person may act as a crew member-(1) within 8 hours after the consumption of any alcoholic beverage."

Tests indicate that as a general rule, 2 ounces(.06 liters) of alcohol at 15,000 feet produce the same adverse effects as 6 ounces(.18 liters) at sea level. In other words, the higher you get, "the higher you get".

DRUGS

Self-medication or taking medicine in any form when you are flying can be extremely hazardous. Even simple home or over-the-counter remedies drugs such as aspirin, antihistamines, cold tablets, cough mixtures, laxatives, tranquilizers, and appetite suppressors, may seriously impair the judgment and coordination needed while flying. The safest rule is to TAKE NO MEDICINE before or while flying, except on the advice of your Aviation Medical Examiner.

SCUBA DIVING

Flying shortly after any prolonged scuba diving could be dangerous. Under the increased pressure of the water, excess nitrogen is absorbed into your system. If sufficient time has not elapsed prior to takeoff for your system to rid itself of this excess gas, you may experience the bends at altitudes even under 10,000 feet, where most light planes fly.

ADDITIONAL INFORMATION

In addition to the coverage of subjects in this section, the National Transportation Safety Board and the F.A.A. periodically issue general aviation pamphlets concerning aviation safety, and in greater detail. These can be obtained at FAA Offices, Weather Stations, Flight Service Stations, or Airport Facilities. These are very good sources of information and are highly recommended for study. Some of these are titled:

Airman's Information Manual
12 Golden Rules for Pilots
Weather or Not
Disorientation
Plane Sense
Weather Info Guide for Pilots
Wake Turbulence
Don't Trust to Luck, Trust to Safety
Thunderstorm - TRW
IFR-VFR , Either Way **Disorientation Can be Fatal**

MANUFACTURER'S INFORMATION

See following applicable pages of information that may have been inserted.